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Earth Science interpretations where GOCE improved the gravity field most: North Africa

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Our work is focused on the Solid Earth Science exploitation of the satellite mission GOCE. In Northern Africa the differences between the GOCE observations and the gravity field models that include terrestrial data, as EGM08, are one of the greatest worldwide. The differences are due to errors in, or lack of terrestrial data, and subsequent data infilling based on statistical assumptions. Therefore the analysis of the field in North Africa is particularly important, as the GOCE-observations and the derived third-generation products bring a safe improvement of the field. The usefulness of the gravity field is expressed in the improvement of the density inhomogeneities that are derived from it and by the newness of the conclusions regarding the tectonic or geodynamic interpretation. Beyond the first step of correlating the fields with the geologic lineaments and surface deposits (as e.g. for Africa Braitenberg et al., 2011) comes now the second step of modeling the density variations, starting from what is known already, and to determine what the novelties are which we recover with the GOCE-observations. This requires collecting the known information, assigning densities to the layers, calculating the gravity field and gradients and inverting the residuals formed by the difference between expected field and observations. Not indifferent is the choice of making the calculations at satellite observation height or at topography level, and has consequences on the adequateness of the computational software and lateral and depth extent of the model. We integrate known crustal layers as sediments and seismologic depths of the crust-mantle interface, where available, and determine the gravity residual. We discuss the residual in terms of the principal geological units and proceed to the inversion. The inverse problem of the gravity field being ill-posed, the solution depends on the model situations and constraints we choose to set. We set up the specific inversion-scheme based on the geodynamic context and invert for intra-crustal density variations that correct the starting structure. Our main conclusions regard an upper crustal body that crosses the Sahara and that we interpret to mark a major geologic boundary not seen on the surface, but evident from gravity. Another conclusion regards the fact that the magmatism found to the south of this boundary is partially trapped at lower crustal levels, increasing considerably the volume and timing of the mantle melting process.

Braitenberg, C., Mariani, P., Ebbing, J., Sprlak, M., 2011. The enigmatic Chad Lineament revisited with global gravity and gravity-gradient fields. In Ed: van Hinsbergen, Douwe J. J., Buiter, Susanne J. H., Torsvik, Trond H., Gaina, Carmen, Webb, Susan J., Geological Society Special Publications 357:329-341.