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The link between upper mantle seismic velocity anomalies and the gravity field of Northern Africa

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For Northern Africa, few regional experiments have been carried out in the past and for large areas crustal thickness estimates are based only on gravity inversion and geological reasoning. Simple Airy type isostatic estimates of crustal thickness show large differences to the few available seismic estimates and show large residuals. E.g., for the Hoggar swell, these residuals have been interpreted as been related to dynamic topography. In order to understand the structure and evolution of North Africa it is necessary to integrate information from both seismic velocity models and from gravity data. Given the paucity of recent local-regional seismic studies throughout much of northern Africa using teleseismic data provide the best capability for imaging the velocity variations in the upper mantle. We make use of a shear-wave velocity model for the upper mantle to study the contribution of density variations in the mantle to the gravity field and potential and on crustal thickness estimates. The use of gravity data and its potential allows to decipher between sources in the crust and upper mantle, as the undulations of the geoid are more sensitive to large-scale, deep sources.
We calculate the base lithosphere from the velocity model and then calculate the crustal thickness by isostatically balancing the lithosphere. This new model shows crustal thickness results within the uncertainties of existing seismic data and gives a reasonable fit to the observed gravity field. E.g., for the Hoggar swell a dynamic contribution to the gravity field is not necessary, when considering the entire lithospheric structure. Geoid residuals will be used to discriminate between the effect of temperature, composition and tectonothermal age on the velocity and density structure of the lithosphere.