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Density heterogeneity of the North American upper mantle from satellite gravity and a regional crustal model

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We present a regional model for the density structure of the North American upper mantle. The residual mantle gravity anomalies are based on gravity data derived from the GOCE geopotential models with crustal correction to the gravity field being calculated from a regional crustal model.

We analyze how uncertainties and errors in the crustal model propagate from crustal densities to mantle residual gravity anomalies and the density model of the upper mantle.

Uncertainties in the residual upper (lithospheric) mantle gravity anomalies result from several sources: (i) uncertainties in the velocity-density conversion and (ii) uncertainties in knowledge of the crustal structure (thickness and average V_p velocities of individual crustal layers, including the sedimentary cover). In this study, we address both sources of possible uncertainties by applying different conversions from velocity to density and by introducing variations into the crustal structure which corresponds to the uncertainty of its resolution by high-quality and low-quality seismic models. We examine the propagation of these uncertainties into determinations of lithospheric mantle density. Given a relatively small range of expected density variations in the lithospheric mantle, knowledge on the uncertainties associated with incomplete knowledge of density structure of the crust is of utmost importance for further progress in such studies.

The new regional density model for the North American upper mantle complements an on-going study of the regional upper mantle velocity and density structure by other methods. Our new regional density model is compared to regional and world-wide petrological data on upper mantle densities constrained by mantle-derived xenoliths.