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Thermo-chemical structure of the Earth's lithosphere and mantle, impact on surface topography and geoid

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A robust understanding of the Earth's chemical composition and thermal structure is fundamental in order to gather insights on the processes responsible for the planet formation and evolution. We present several mantle and lithosphere thermo-chemical (TC) models. The models are obtained inverting shear wave tomography models. The link between shear wave speed, temperature and composition, is established leveraging on mineral physics constraints and robust and well tested thermodynamic frameworks (self consistent in the case of the mantle). We test the effects of the obtained models on the surface topography and geoid undulations. We model both isostatic and dynamic topography. Dynamic topography is obtained with instantaneous mantle flow computation. Our results show that our knowledge of the mantle temperature is affected by strong uncertainties which translate in significant uncertainties on the dynamic component of topography. Compositional heterogeneities also play an important role, in particular, we observe that assuming enriched compositions in correspondence of the large low shear waves velocity provinces (LLSVPs) helps in increasing the fit between observed and synthetic geoid. In addition, modelling compositional heterogeneities in the lithosphere (depleted composition for the sub-continental lithospheric mantle) increase the correlation between residual and dynamic topography maps.