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Towards an integrated model of Earth's crustal density structure: gravity and topography effects on global scale

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An accurate knowledge of the Earth's crustal density structure plays a central role in our understanding of its composition and thermal conditions and it is also crucial to obtain a correct seismic interpretation of the Earth's mantle. The goal this work is to improve our understanding of the crust's physical parameters using a multidisciplinary approach based on different kinds of geophysical and geodynamical observations and with a stress on the importance of mineral properties.

Starting from the most updated and used global crustal model, CRUST 2.0 (Bassin et al., 2000), in which the density structure of the crust is inferred by interpreting data coming from seismic reflection profiles through Vp-density empirical relationship (Christensen and Mooney, 1995), we have explored the effect of phase transitions and different chemical compositions on the crust physical properties, surface topography and gravity potential field.

Our first step is to compute the crustal density structure through a self-consistent thermodynamical modeling of average compositions for upper, middle and lower crust (Rudnick and Gao, 2003), taking in to account both anhydrous and hydrated conditions. This way, the relationship between Vp and density exploits further petrological constraints and knowledge of mineral properties. We also build a density model where we use a 3-D thermal structure based on heat-flow measurements. Subsequently we determine the influence on gravity, geoid and topography of the CRUST2.0 and the computed density distributions by using the same mantle structure. For this purpose, we perform an instantaneous mantle-flow computation using the code StagYY (Tackley, 2008).

The comparison between computed results and measured data permitted us to assess the importance of taking into account information coming from mineral physics and gravity field measurements in order to produce a well constrained and physically reliable global crustal model.

Our preliminary result shows the strong potential of such an interdisciplinary approach to study the Earth's interior.