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Spectral and spatial characteristics of the refined CRUST1.0 gravity field

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We investigate the density structure of the oceanic and continental crust using the global crustal model CRUST1.0, which has been refined by incorporating additional global datasets of the topography/bathymetry (ETOPO1), the polar ice sheets (DTM2006.0 ice-thickness data) and the global geoid model (GOCO-03S). The analysis reveals that the average crustal density is 2830 kg/m^3, while it decreases to 2490 kg/m^3 when including the seawater. The average density of the oceanic crust (without the seawater) is 2860 kg/m^3, and the average continental crustal density (including the continental shelves) is 2790 kg/m^3. We further compile the gravity field quantities generated by the Earth crustal structures. The correlation analysis of results shows that the gravity field corrected for major known anomalous crustal density structures has a maximum (absolute) correlation with the Moho geometry. The Moho signature in these gravity data is seen mainly at the long-to-medium wavelengths. At higher frequencies, the Moho signature is weakening due to a noise in gravity data, which is mainly attributed to crustal model uncertainties. The Moho determination thus requires a combination of gravity and seismic data. In global studies, gravimetric methods can help improving seismic results, because (i) large parts of the world are not yet sufficiently covered by seismic surveys, and (i) global gravity models have a relatively high accuracy and resolution. In regional and local studies, the gravimetric Moho determination requires either a detailed crustal density model, or seismic data (for a combined gravity and seismic data inversion). We also demonstrate that the Earth long-wavelength gravity spectrum comprises not only the gravitational signal of deep mantle heterogeneities (including the core-mantle boundary zone), but also shallow crustal structures. Consequently, the application of spectral filtering in the gravimetric Moho determination will remove not only the gravitational signal of (unknown) mantle heterogeneities, but also the Moho signature at the long-wavelength gravity spectrum.

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