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Effect of crustal and mantle density structure on the quasigeoid-to-geoid separation

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We investigate the effects of topographic mass density as well as masses distributed below the geoid (i.e. the non-topographic effect) on the geoid-to-quasigeoid correction. The numerical procedures applied here to evaluate globally these effects utilize the expressions for gravimetric forward modelling in the spectral domain. Since the global crustal density models currently available have a limited accuracy and resolution, the computations are realized with a spectral resolution only up to the spherical harmonic degree of 360 (or 180), using the EIGEN-6C4 gravity model, the Earth2014 datasets of terrain, ice thickness and inland bathymetry and the CRUST1.0 sediment and (consolidated) crustal data. The results reveal that the topographic effect globally varies between -0.33 and 0.57 m, with maxima in Himalaya and Tibet. The effect of ice considerably modifies the geoid-to-quasigeoid correction over large parts of Antarctica and Greenland, where it reaches +/-0.2 m. The effects of sediments and bedrock are less pronounced, with the values typically varying only within a few centimetres. These results, however, have still possibly large uncertainties due to the lack of information on the actual sediment and bedrock density. The effect of lakes is mostly negligible; its maxima over the Laurentian Great Lakes and the Baikal Lake reach only several millimetres. The non-topographic density effect (of mass density heterogeneities below the geoid surface) is significant. It is everywhere negative and reaches extreme values of -4.43 m.