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Global maps of the CRUST 2.0 crustal components stripped gravity disturbances

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[1] We use the CRUST 2.0 crustal model and the EGM08 geopotential model to compile global maps of the gravity disturbances corrected for the gravitational effects (attractions) of the topography and of the density contrasts of the oceans, sediments, ice, and the remaining crust down to the Moho discontinuity. Techniques for a spherical harmonic analysis of the gravity field are used to compute both the gravity disturbances and the topographic and bathymetric corrections with a spectral resolution complete to degree 180 of the spherical harmonics. The ice stripping correction is computed with a spectral resolution complete to degree 90. The sediment and consolidated crust stripping corrections are computed in spatial form by forward modeling their respective attractions. All data are evaluated on a 1 × 1 arc degree grid at the Earth's surface and provided in Data Sets S1–S5 in the auxiliary material for the scientific community for use in global geophysical studies. The complete crust-stripped gravity disturbances (globally having a range of 1050 mGal) contain the gravitational signal coming dominantly from the global mantle lithosphere (upper mantle) morphology and density composition and partially from the sublithospheric density heterogeneities. Large errors are expected because of uncertainties of the CRUST 2.0 model (i.e., deviations of the CRUST 2.0 model density from the real Earth's crustal density heterogeneities and the Moho relief uncertainties).

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1. Introduction

[2] In gravimetry the technique known as "stripping" has been used whenever a part of the Earth's subsurface mass density distribution was known (represented by a model produced as a result of other geoscientific investigations), in order to unmask the remaining gravitational signal of the unknown (and sought) anomalous subsurface density distribution. The strongest signal in gravity data is due to topographic relief onshore and ocean bottom relief offshore. When these two surfaces are known, the gravitational effects of the reference (e.g., constant average) topographic masses onshore and seawater density contrast offshore can be removed from the gravity data by means of topographic and bathymetric corrections respectively. The next strongest signal in the gravity data is due to the crustal/lithospheric thickness and density composition (as a result of the combination of its isostatic and tectonophysical states). An isostatic compensation scheme may be adopted to compute an isostatic correction to gravity data, or a crustal/lithospheric model is adopted or produced to compute the crustal or lithospheric stripping correction. In this latter step various approaches may be taken depending on the purpose of the study [cf., e.g., *Kaban et al.*, 1999, 2003, 2004; *Kaban and Schwintzer*, 2001] for global studies and [e.g., *Bielik*, 1988; *Artemjev and Kaban*, 1994; *Artemjev et al.*, 1994; *West et al.*, 1995; *Kaban*, 2001, 2002; *Zeyen et al.*, 2002; *Bielik et al.*, 2004; *Dérerová et al.*, 2006; *Braun et al.*, 2007; *Tassara et al.*, 2007; *Tesauro et al.*, 2007; *Alvey et al.*, 2008; *Jiménez-Munt et al.*, 2008, and references therein] for large regional investigations. In regional studies the stripped gravity data are typically interpreted by integrated forward modeling with use of all possible geophysical constraints. For global studies the best currently available global crustal model is CRUST 2.0 [*Bassin et al.*, 2000], which is an upgrade of the CRUST 5.1 model [*Mooney et al.*, 1998]. The publically available CRUST 2.0 model contains information on subsurface spatial distribution and density of the following global components: ice, soft and hard sediments, upper, middle and lower (consolidated) crust.

[3] When the gravimetric inverse problem is formulated in terms of attraction, the anomalous gravity data required as observables in the inversion/interpretation become, by definition, the gravity disturbances [e.g., *Vajda et al.*, 2006, 2007]. The use of gravity disturbances in global and regional studies eliminates the need of the "geophysical indirect effect" correction [e.g., *Hackney and Featherstone*,

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2003; *Hinze et al.*, 2005; *Vajda et al.*, 2006, and references therein]. The normal gravity is subtracted from the actual observed gravity in the definition of the gravity disturbance. This has two implications [e.g., *Vajda et al.*, 2006, 2008]. First, the surface of the reference ellipsoid (not the geoid) is the bottom interface of topographic masses globally, as well as the upper interface of all density contrasts defining the stripping corrections. Second, a model normal mass density distribution inside the reference ellipsoid generating the normal gravity field is the background density distribution model against which the density contrasts used in stripping corrections are defined. These two conditions have to be satisfied in order to keep the equivalence between decomposing the real Earth's subsurface density distribution and the observed gravity disturbances [cf. *Vajda et al.*, 2008].

[4] Our aim here is to evaluate on a global scale the gravity disturbances corrected for the attraction of the topography (ellipsoid-referenced topographic correction), the ocean density contrast (ellipsoid-referenced bathymetric stripping correction), and the crustal density contrast (down to the Moho interface). We take into account the global distribution of ice, sediments, and consolidated crustal components based on the CRUST 2.0 model (crustal stripping correction). The crustal stripping correction is computed and applied in several consecutive steps: (1) stripping the attractions of the density contrasts (relative to the constant reference crustal density of 2670 kg/m^3) of the ice, and the soft and hard sediments; (2) stripping the attractions of the density contrasts (relative to the constant reference crustal density of 2670 kg/m^3) of the upper, middle, and lower consolidated crust of the CRUST 2.0 model; and (3) stripping the attraction of the density contrast of the entire crust (volumetric domain between the reference ellipsoid and the Moho interface) of constant density of 2670 kg/m^3 relative to a constant reference density of the encompassing mantle. The reason for the stepwise compilation of the crustal stripping correction and of the complete crust-stripped gravity disturbances is the following. The application of the topographic and stripping corrections of steps 1 and 2 removes the topographic masses above the reference ellipsoid and transforms the volumetric domain between the reference ellipsoid and the Moho interface globally (disregarding the heterogeneities within topography other than sediments and ice, and disregarding the crustal heterogeneities not accounted for by the CRUST 2.0 density model) into a model crust of a constant 2670 kg/m^3 density. The gravity disturbance respective to this stripping stage is respective to a model Earth of no topography, constant crust down to the Moho interface, and real density below the Moho interface. The strongest signal in such a gravity disturbance is the attraction of the density contrast of the Moho interface relative to the mantle. We expect that this type of gravity disturbance is best suited for refining the geometry of the Moho interface by means of gravimetric interpretation. The final step, step 3, transforms the constant 2670 kg/m^3 density model crust into mantle, removing the signal of the Moho interface density contrast from gravity data. The complete crust-stripped gravity disturbances ideally contain only the gravitational signal of the sub-Moho density inhomogeneities. They are therefore best suited for studying the upper mantle (mantle lithosphere) and deeper mantle.

[5] The gravity disturbances with the individual corrections applied are mapped in section 3, and the data sets are made available to the scientific community for geophysical studies in Data Sets S1–S5 in the auxiliary material.[1] We refer to the bathymetrically stripped and topographically corrected gravity disturbances briefly as "BT gravity disturbances." To decompose the complete crust-stripped gravity disturbances into individual contributions (attractions) of the crust density heterogeneities and interfaces and to interpret/invert the individual signals is a nonunique and altogether complex matter that needs to be approached with the help of all possible additional geoscientific constraints. The approach taken depends on the objective of the study. We aim here only at providing the stepwise complete crust-stripped gravity data to the geophysical community for further global studies.

[6] The gravity disturbances and the topographic and bathymetric corrections are computed globally at the Earth's surface in a spectral form up to degree 180 of the spherical harmonics (which represents roughly 100 km in terms of half wavelength). The ice stripping correction is computed with a spectral resolution complete to degree 90. All the corrections and the stepwise corrected gravity disturbances are computed at the Earth's surface on a 1 $\times$ 1 arc degree grid of the geocentric spherical coordinates. We shall follow a sign convention, whereby an attraction to be corrected for is subtracted from gravity data, while a correction (negative attraction) is to be added to the gravity data.

2. Global Topographical and Stripping Corrections

2.1. Topographic Correction

[7] The global ellipsoid-referenced topographic correction (removal of the attraction of topography above the reference ellipsoid [cf. also *Mikuška et al.*, 2006]) was computed in spectral form as follows. First the 5 $\times$ 5 arc min global elevation data from the ETOPO5 (provided by the NOAA's National Geophysical Data Centre) were used to generate the Global Elevation Model coefficients. These coefficients were utilized to compute the geoid-referenced topographic correction with a spectral resolution complete to degree and order 180. The average topographic density 2670 kg/m^3 was adopted [cf. *Hinze*, 2003]. The expressions for modeling the quantities of the gravitational field from the spectral coefficients can be found in the studies by *Vaníček et al.* [1995] and *Novák and Grafarend* [2006]. The geoid-referenced topographic correction to the gravity disturbances varies from −623 to 72 mGal with the mean of −15 mGal and the standard deviation of 92 mGal. The absolute maxima are located in the mountainous regions and the absolute minima over the oceanic areas and the flat continental regions.

[8] The difference between the geoid-referenced and ellipsoid-referenced global topographic corrections is the gravitational attraction of the ocean saltwater offshore enclosed between the surfaces of the geoid and reference ellipsoid ("liquid topography"), accounting for the water surplus or deficiency, and the gravitational attraction of the

[1]Auxiliary materials are available at ftp://ftp.agu.org/apend/jb/2008jb006016.

Table 1. Statistics of the Topographic and Stripping Corrections to the Gravity Disturbances

Correction	Min (mGal)	Max (mGal)	Mean (mGal)	SD (mGal)
Topographic	−619	71	−16	92
Bathymetric stripping	129	755	328	162
Ice stripping	3	300	22	56
Sediment stripping	−7	122	35	22
Consolidated crust stripping (relative to 2670 kg/m^3)	−871	−264	−421	126
Reference crust stripping (relative to mantle)	570	1991	940	284

topographic masses onshore (of constant average topographic density) enclosed again between the same two surfaces. The spectral coefficients taken from the EGM08 (N. K. Pavlis et al., An Earth gravitational model to degree 2160: EGM 2008, paper presented at Session G3 of GRACE Science Applications, European Geosciences Union, Vienna, 2008a; N. K. Pavlis et al., EGM2008: An overview of its development and evaluation, paper presented at IAG International Symposium on Gravity, Geoid and Earth Observation 2008, International Association of Geodesy, Chania, Crete, Greece, 23–27 June 2008b) complete to degree and order 180 were used to compute the global geoidal undulations. The attraction of the liquid topography (of constant mean ocean saltwater density 1030 kg/m^3) is positive everywhere over the oceans, because the computation points (offshore) are on the geoid (sea surface), thus either above water surplus (positive geoidal undulations) or below water deficit (negative geoidal undulations). It varies between 0.0 and 4.5 mGal with the mean of 0.7 mGal and the standard deviation of 0.8 mGal. The attraction of the solid topographic masses onshore enclosed between the surfaces of the geoid and reference ellipsoid varies between −12.2 and 10.3 mGal with the mean of −0.4 mGal and the standard deviation of 2.0 mGal. The ellipsoid-referenced topographic correction is obtained by subtracting from the geoid-referenced topographic correction the attractions of topographical and ocean masses enclosed between the surfaces of the geoid and reference ellipsoid. Its statistics are given in Table 1.

2.2. Bathymetric Stripping Correction

[9] The ellipsoid-referenced bathymetric stripping correction, which is the removal of the attraction of the ocean water density contrast enclosed between the surfaces of the reference ellipsoid and sea bottom, was computed as follows. First the 5 × 5 arc min global bathymetry data from the ETOPO5 were used to generate the Global Bathymetric Model coefficients. These coefficients were utilized to compute globally the geoid-referenced bathymetric stripping correction with a spectral resolution complete to degree and order 180. The mean value of the ocean density contrast −1640 kg/m^3 (i.e., the difference between the mean ocean saltwater density 1030 kg/m^3 and the reference crustal density 2670 kg/m^3) was adopted. The geoid-referenced bathymetric stripping correction to the gravity disturbances varies from 129 to 753 mGal with the mean of 327 mGal and the standard deviation of 161 mGal. The maxima are located above the oceanic trenches, and the minima in the central parts of the continental regions. The oceanic trenches and the convergent ocean to continent tectonic plate boundaries represent the regions with the largest variations of the bathymetric correction.

[10] The ellipsoid-referenced bathymetric stripping correction was obtained by subtracting from the geoid-referenced bathymetric correction the attraction of the ocean saltwater density contrast (−1640 kg/m^3) offshore enclosed between the surfaces of the geoid and reference ellipsoid. The latter varies between −7.2 and 0.0 mGal with the mean of −1.0 mGal and the standard deviation of 1.2 mGal. The statistics of the ellipsoid-referenced bathymetric stripping correction are given in Table 1.

2.3. Ice Stripping Correction

[11] The discrete data of the ice thickness with a 2 × 2 arc degree geographical resolution from the CRUST 2.0 were used to generate the Global Ice Thickness Model coefficients. The ice thickness and elevation spectral coefficients were utilized to compute globally the ice stripping correction with a spectral resolution complete to degree and order 90. The mean value of the ice density contrast −1757 kg/m^3 (i.e., the difference between the mean ice density 913 kg/m^3 and the reference crustal density 2670 kg/m^3) was adopted. The statistics of the ice stripping correction to the gravity disturbances are given in Table 1.

2.4. Sediment Stripping Correction

[12] The 2 × 2 arc degree global data of the soft and hard sediment thickness and density from the CRUST 2.0 were used to compute globally the sediment stripping correction. The sediment density contrast was defined relative to the reference crustal density 2670 kg/m^3. The statistics of the sediment stripping correction to the gravity disturbances are given in Table 1. The maxima are located over the areas with the largest sediment deposits in the continental shelves and the Caspian Sea region. The minima are in Greenland and Antarctica, and across central parts of the Pacific, Atlantic, and Indian Oceans.

2.5. CRUST 2.0 Upper, Middle, and Lower Crustal Components Stripping Correction

[13] The 2 × 2 arc degree global data of the density and thickness of the upper, middle, and lower crust components from the CRUST 2.0 were used to compute globally the stripping correction of the remaining consolidated crust. The density contrasts of the three crustal components are defined relative to the reference crustal density of 2670 kg/m^3. The statistics of the consolidated crust stripping correction to the gravity disturbances are given in Table 1.

2.6. Reference Crust Stripping Correction

[14] The global reference crust (of constant 2670 kg/m^3 density) stripping correction was computed, using a constant density contrast relative to the encompassing mantle of −520 kg/m^3. The choice of this value is justified in section 3. The statistics of the reference crust stripping correction to the gravity disturbances are given in Table 1.

3. Stepwise CRUST 2.0 Crustal Components Stripped Gravity Disturbances

[15] The Global Geopotential Model coefficients taken from the EGM08 complete to degree and order 180 were used to compute the gravity disturbances. The computation

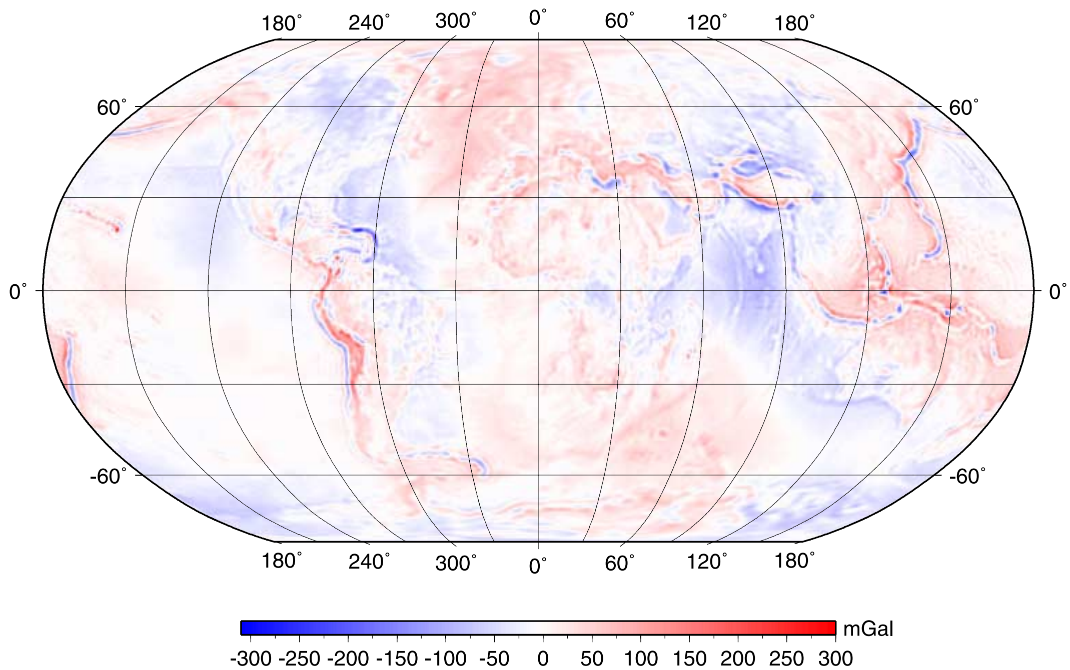

Figure 1. The gravity disturbances evaluated at the Earth's surface.

was realized at the 1 × 1 arc degree grid of points at the Earth's surface. The expressions for computing the quantities of the gravity field in terms of spherical harmonics can be found for instance in the book of *Heiskanen and Moritz* [1967, Chapter 2–17]. The gravity disturbances are shown in Figure 1, and the corresponding statistics are given in Table 2. The stepwise complete crust-stripped gravity disturbances were obtained from the gravity disturbances by subsequent applications of the individual corrections of section 2. Statistics of the stepwise complete crust-stripped gravity disturbances are summarized in Table 2. The topographically corrected gravity disturbances are shown in Figure 2. Compared with the observed gravity disturbances they changed significantly in the mountainous regions – they became predominantly negative revealing to a large extent the presence of the isostatic compensation.

[16] The bathymetric stripping correction transforms the volumetric domain of the oceans from water density to the constant reference density of 2670 kg/m^3. The bathymetrically stripped and topographically corrected gravity disturbances, briefly BT gravity disturbances, are shown in Figure 3. Since the bathymetric stripping correction over the continental areas is small and has mostly a long-wavelength character, the higher-frequency spectrum of the gravity disturbance signal onshore remains almost unchanged. Over the oceans, the application of the bathymetric stripping correction to the topographically corrected gravity disturbances revealed the main structures of the ocean floor relief and the global pattern of the lithospheric plates predominantly due to a diverse from continental and varying density and thickness of the oceanic lithospheric plates.

[17] The ice and sediment stripping corrections transform the volumetric domains of the global ice mass (Greenland and Antarctica) and global sediments from their actual densities (soft and hard sediments of the CRUST 2.0 model have laterally varying densities) to the constant reference crustal density of 2670 kg/m^3. The ice and sediment stripped BT gravity disturbances are shown in Figure 4. Compared to the bathymetric stripping and topographic corrections, the signature of the ice and sediment stripping corrections is less noticeable. The ice stripping correction changed the BT gravity disturbances in the regions with the largest thickness of the polar ice sheet in Greenland and Antarctica. The sediment stripping correction primarily changed the BT gravity disturbances over the areas with the largest sediment thickness at continental shelves and in the Caspian Sea region.

[18] The remaining consolidated crust stripping correction transforms the volumetric domains of the upper, middle, and lower CRUST 2.0 crustal components from their laterally varying densities to the constant reference density of 2670 kg/m^3. When this stripping correction is applied to the ice and sediment stripped BT gravity disturbances, it produces stripped gravity disturbances that correspond to a model Earth consisting of no topography, a constant 2670 kg/m^3 reference density crust down to the Moho interface, and the real Earth's sub-Moho density distribution. We have called these gravity disturbances the consolidated crust-stripped gravity disturbances and shown them in Figure 5. Their statistics are given under Table 2. The

Table 2. Statistics of the Stepwise Corrected Gravity Disturbances

Gravity Disturbances	Min (mGal)	Max (mGal)	Mean (mGal)	SD (mGal)
Earth's	−303	293	−0.7	29
Topographically corrected	−549	303	−16	94
BT	−412	708	31	217
Ice and sediment stripped BT	−384	744	369	186
Consolidated crust-stripped (relative to 2670 kg/m^3)	−1236	437	−52	301
Complete crust-stripped (relative to mantle)	299	1350	889	123

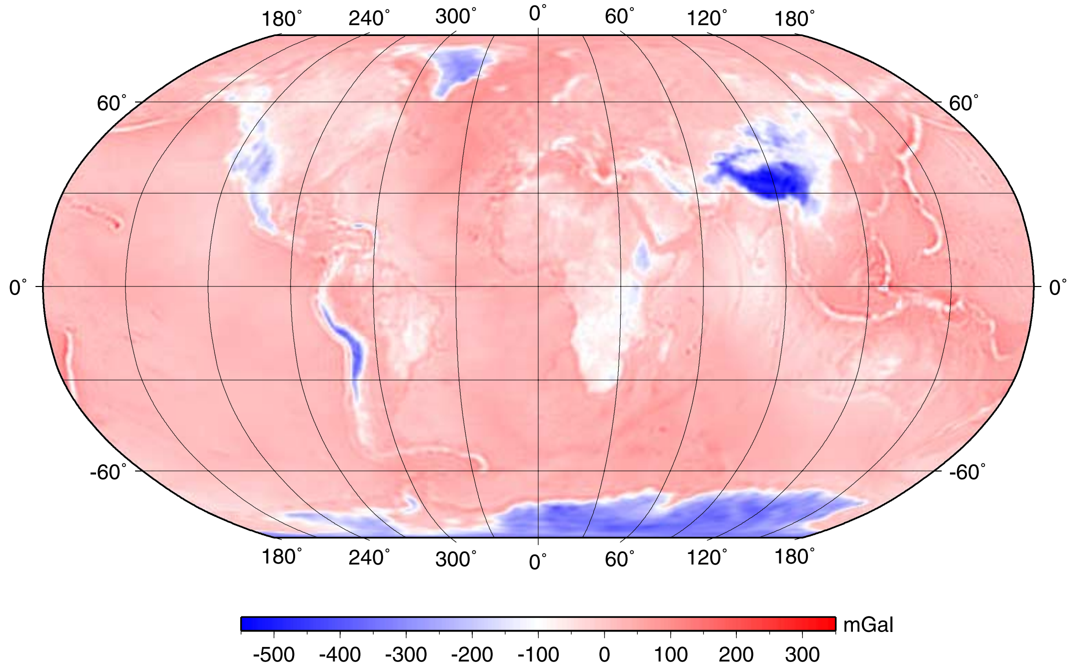

Figure 2. The topographically corrected gravity disturbances evaluated at the Earth's surface.

consolidated crust-stripped gravity disturbances have the strongest correlation with the Moho interface (correlation coefficient of about 0.9) and therefore are best suited for the refinement of the Moho density interface by means of the gravimetric modeling or inversion.

[19] In the next and herein final step, we want to strip the attraction of our reference crust of constant density (2670 kg/m^3), taken relative to the mantle, from the consolidated crust-stripped gravity disturbances. This is the stripping correction of section 2.6. For this purpose we first estimated the value of the density contrast of the reference crust (of 2670 kg/m^3 density) relative to a constant (unspecified) mantle density, by minimizing the correlation of the compete crust-stripped gravity disturbances with the Moho interface. This has been done by a trial-and-error method (see Figure 6). The zero correlation is reached at -520 kg/m^3. The application of the reference crust stripping correction (section 2.6) to the consolidated crust-stripped gravity disturbances (sections 2.1 through 2.5) results in the complete crust-stripped gravity disturbances.

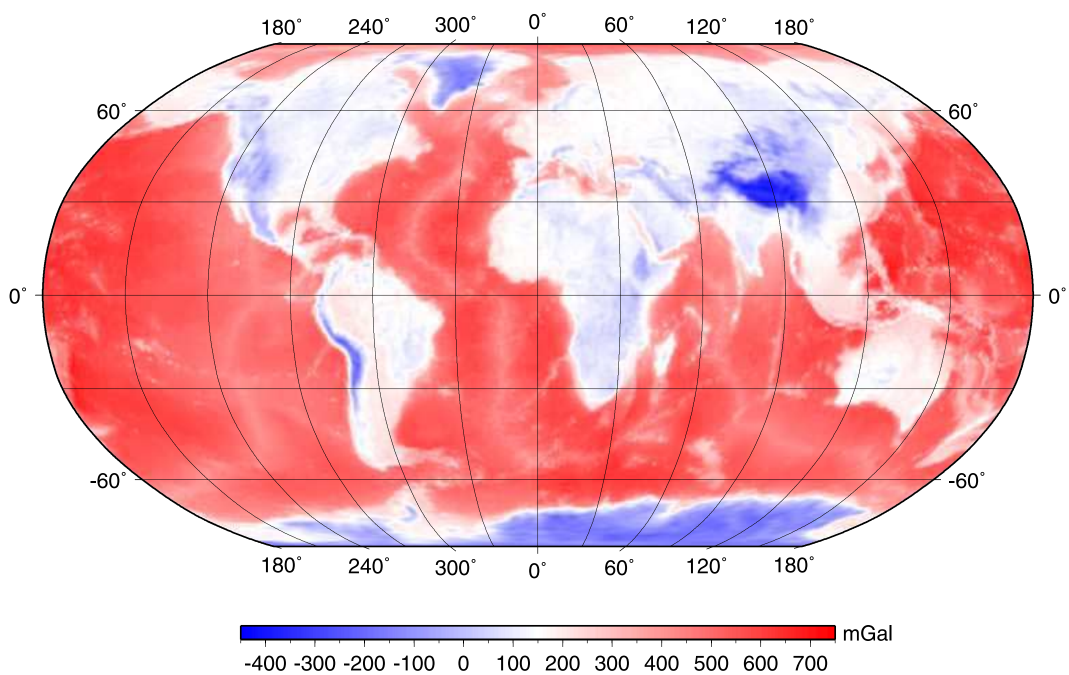

Figure 3. The bathymetrically stripped and topographically corrected gravity disturbances evaluated at the Earth's surface.

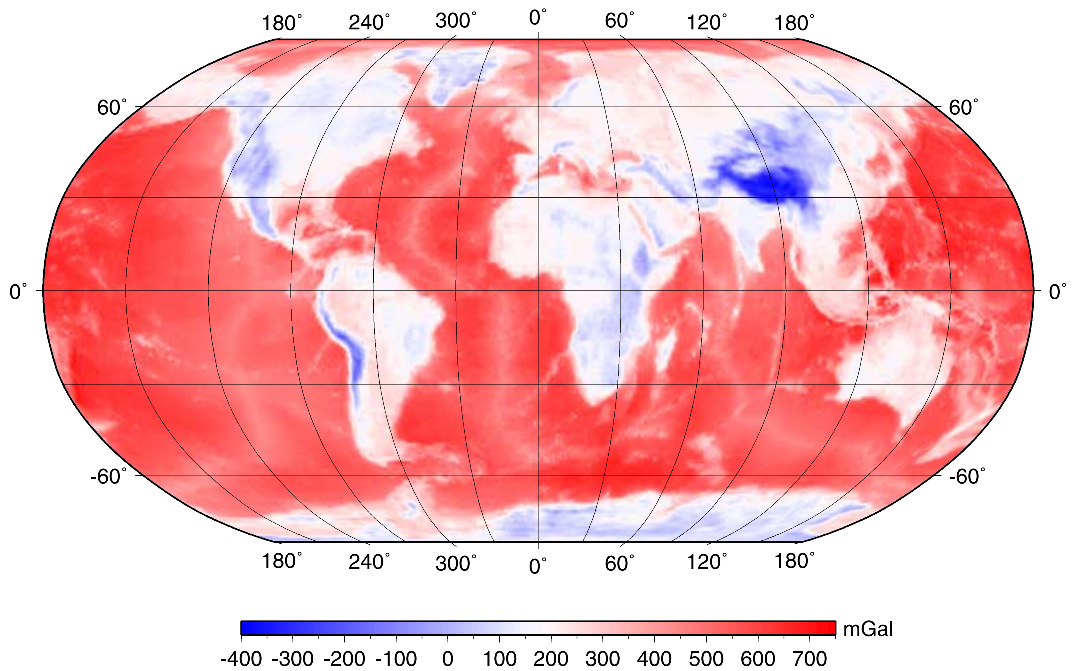

Figure 4. The ice-, sediment-, and bathymetry-stripped and topographically corrected gravity disturbances evaluated at the Earth's surface.

[20] The complete crust-stripped gravity disturbances correspond to a model Earth consisting of no topography, a volumetric domain between the reference ellipsoid and the Moho interface of a constant density of 3190 kg/m^3 and a real density distribution below the Moho interface. The complete crust-stripped gravity disturbances should ideally contain only the signal due to the density inhomogeneities and density contrast interfaces bellow the Moho interface. However, the signal due to the deviations of the CRUST 2.0 model from the real crust is also presented (see discussion in section 4). In the map of these gravity data (Figure 7) the strongest signal is expected to come from the thickness and density of the lithosphere, over which a weaker signal from the sublithospheric mantle is superposed. The range of the complete crust-stripped gravity disturbances (Figure 7) compared to the range of the observed gravity disturbances (Figure 1) indicates that the isostatic compensation takes place not only within the crust, but essentially also within

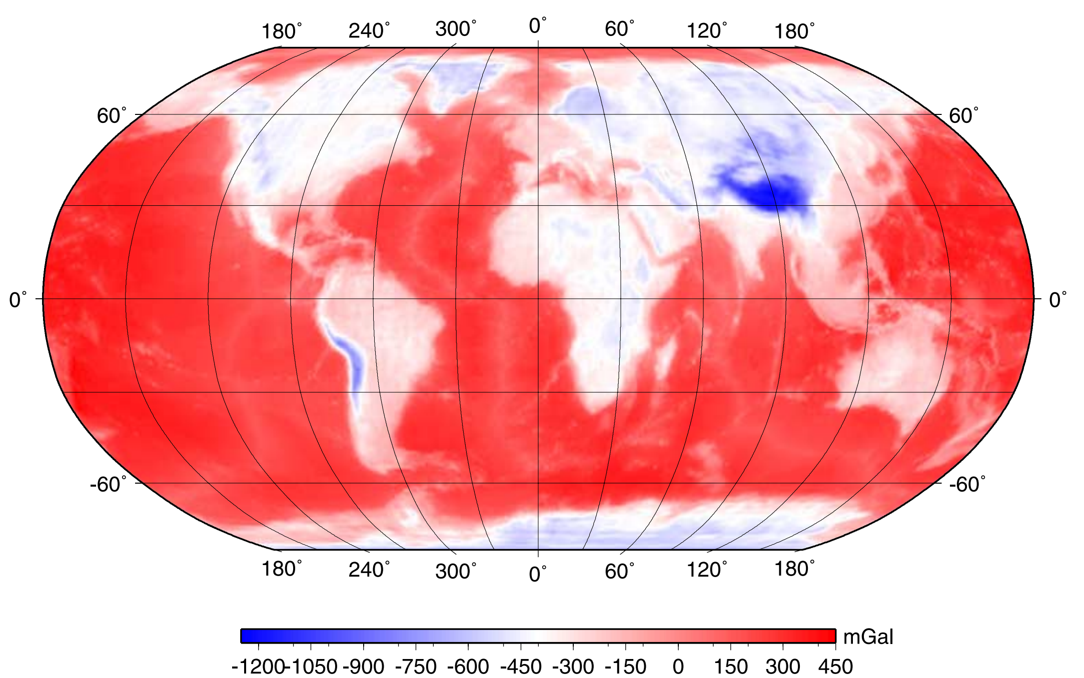

Figure 5. The consolidated crust-stripped (relative to the reference crustal density of 2670 kg/m^3) gravity disturbances evaluated at the Earth's surface.

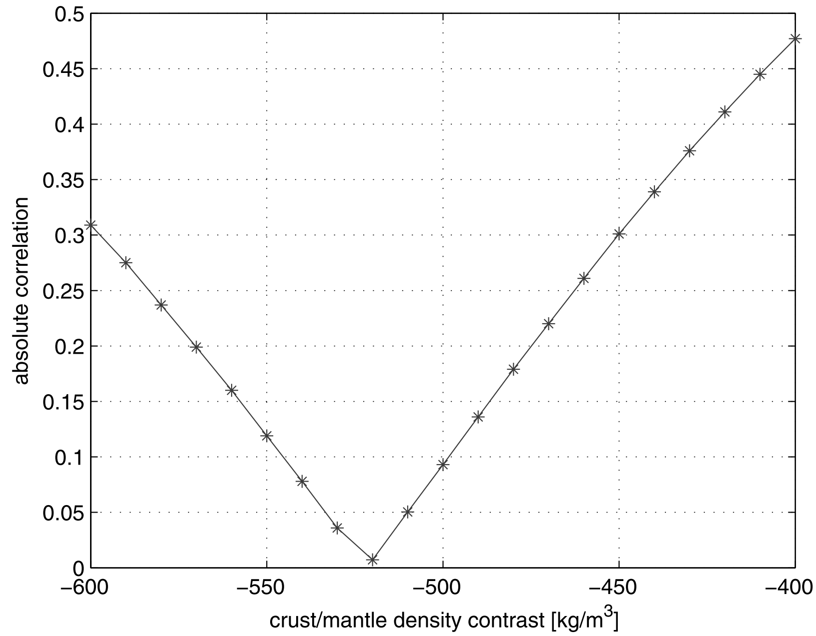

Figure 6. The absolute Pearson's correlation between the complete crust-stripped (relative to the mantle) gravity disturbances and the Moho interface for different values of the crust/mantle density contrast. The zero correlation occurs at the crust/mantle density contrast of −520 kg/m^3.

the mantle lithosphere [cf. *Kaban et al.*, 1999, 2004]. Signatures of mid-ocean ridges and other tectonic plate boundaries are also clearly visible in the map of Figure 7.

4. Discussion and Potential Applications

[21] It is important to consider the model uncertainties associated with the topography and crust when computing the stripping corrections. The uncertainties in modeling the global topographic correction due to geologic density inhomogeneities (other than ice and sediments) relative to the average topographic density are difficult to estimate in the global field due to the lack of knowledge on the actual topographic density globally. They may be anticipated at the level of a few tens of mGal. The uncertainties in modeling the global bathymetric stripping correction due to the deviation of the actual saltwater density from the constant model ocean water density (of about −10 to 20 kg/m^3 [cf.,

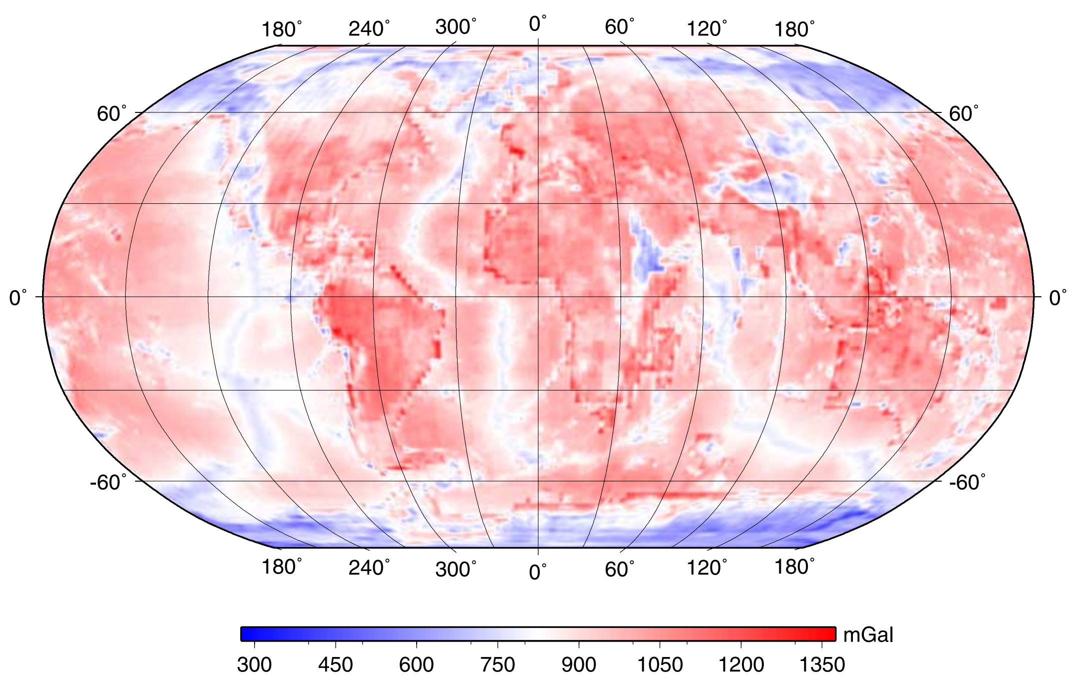

Figure 7. The complete crust-stripped (relative to the mantle) gravity disturbances evaluated at the Earth's surface.

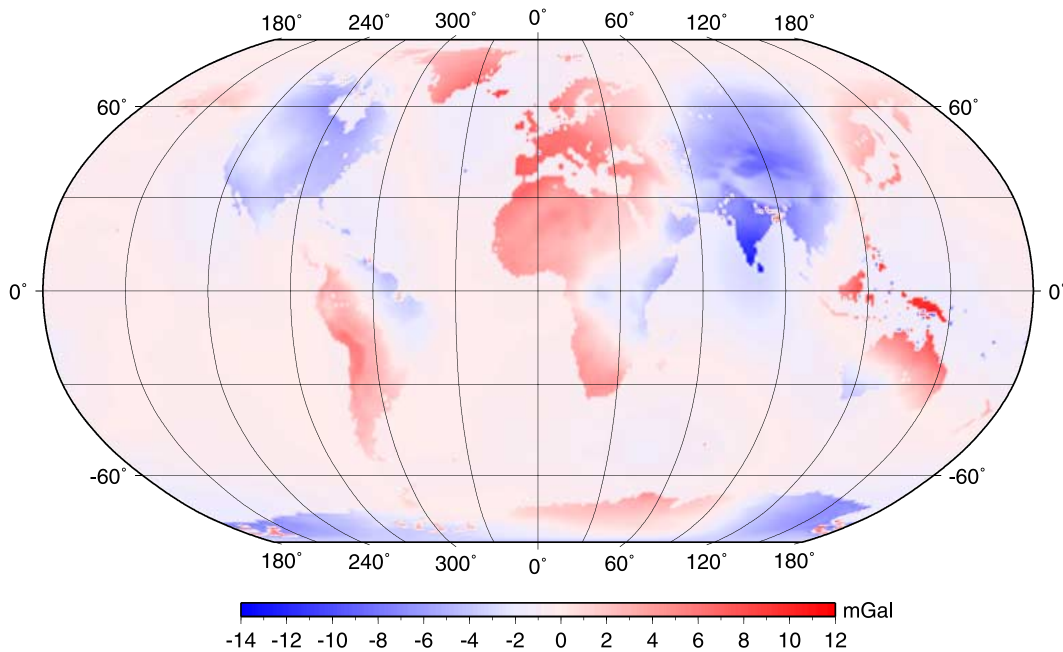

Figure 8. The difference between the ellipsoid-referenced and geoid-referenced bathymetric stripping and topographic corrections.

e.g., *Garrison*, 2001]) are up to about 15 mGal in the offshore areas. The uncertainties in the ice, sediments, and remaining consolidated crust (down to the Moho discontinuity) stripping corrections are also hard to estimate, but may be anticipated at the level from a few tens to about 100 mGal over continents and up to 40 mGal over oceans [cf. *Kaban et al.*, 2003, section 2]. They are due mainly to the heterogeneities of the consolidated crust, especially over continents, and the Moho uncertainty (especially under significant orogens).

[22] In Introduction we argued that the gravimetric interpretation of gravity data requires the computation of the ellipsoid-referenced topographic and stripping corrections, as opposed to the geoid-referenced ones. Figure 8 shows the difference between the ellipsoid-referenced and geoid-referenced bathymetric stripping and topographic corrections (i.e., the combined contribution of the gravitational attractions of the ocean saltwater offshore, the topographic masses onshore, and the ocean saltwater density contrast offshore; all three enclosed between the surfaces of the geoid and reference ellipsoid). Although this difference, globally having a range of about 30 mGal, is below the level of uncertainties of the crustal model, and could be neglected, it is a better practice to consider it, since it is a systematic error that can be evaluated.

[23] We have chosen to compute the global corrections and the global gravity data complete to degree 180 or 90 of spherical harmonics depending on the resolution of the input data. A higher spectral resolution may be adopted once a global crustal (or lithospheric) model of higher resolution becomes available. Our objective was to compute and apply global crustal component stripping corrections based purely on a best currently available global crustal model. The CRUST 2.0 model consists of the soft and hard sediment model components, using a varying (cell to cell) lateral density of the sediments. The soft sediments vary in density from 1700 to 2300 kg/m^3 and reach a maximum thickness of about 2 km, while the hard sediments vary between 2300 and 2600 kg/m^3 and become up to 18 km thick at places. The soft and hard sediment components, and their density variability, reflect to a certain degree the increasing density of sediments with depth due to compaction. In regional studies, a more accurate dependence of the sediment density on depth may be adopted for sedimentary basins [cf., e.g., *Artemjev et al.*, 1994, Figure 1]. An improvement can be achieved in the global gravimetric studies once a more accurate global crustal (or lithospheric) model of higher resolution becomes available.

[24] The topographically corrected gravity disturbances corrected also for the attractions of the density contrasts of the global seawater, global ice, global sediments, and global remaining crystalline (consolidated) crust down to the Moho interface, all contrasts taken relative to the constant reference density of 2670 kg/m^3, are the best suited gravity data for a purely gravimetric refinement of the Moho interface. However, such a gravimetric refinement of the Moho interface would translate also the signal of the topographic and crustal model uncertainties and the signal coming from the mantle lithosphere and deeper mantle into false information on Moho interface. Such are the limits of gravimetric methods without using additional geophysical or geoscientific constraints due the gravimetric signal superposition.

[25] The complete crust-stripped gravity disturbances, globally having a range of 1050 mGal (see Figure 7), clearly indicate that a significant part of the isostatic compensation takes place in the upper mantle [cf. *Kaban et al.*, 1999, 2004]. The complete crust-stripped gravity disturbances contain signals coming from the global upper mantle morphology and density composition (reflecting global past and present tectonics with respective thermal and stress fields, and the tendency toward isostatic balance),

and from the sublithospheric (deeper mantle) density anomalies (reflecting the lithosphere-mantle interactions and the mantle convection). However, the data also contain a still significant contribution of the crustal model uncertainties caused by deviations of the CRUST 2.0 model density from the real Earth's crustal density.

[26] With regard to potential applications, *Kaban et al.* [1999, 2004] used the crustal density model (CRUST 5.1 and 2.0 respectively) to compute isostatically balanced (lithospheric compensation) density anomalies inside the entire lithosphere. Subsequently they computed a global gravity field, in terms of gravity disturbances (calling them gravity anomalies) and geoidal heights, stripped of the gravitational effect of their isostatically compensated model lithosphere. Their "isostatic gravity anomalies" are "lithosphere-stripped gravity disturbances" based on their isostatically balanced lithosphere model. They also computed the dynamic and residual topography. The lithosphere-stripped gravity disturbances are in the sequel assumed to represent the gravitational signal of the mantle convection and deep density inhomogeneities including remnants of subducted slabs. Having a different objective of the study, namely the density (and its separation into thermal and compositional constituents) of continental (cratonic) roots, *Kaban et al.* [2003] compute the "mantle gravity anomalies" that are actually "continental crust-stripped and oceanic (age-thermally constrained) lithosphere-stripped gravity disturbances" evaluated in spectral form complete to degree 20. *Kaban and Schwintzer* [2001] construct a mantle density model based on a crust-stripped gravity field (complete to degree 20 using CRUST 5.1 model) and a seismic tomography model, focusing on the oceanic upper mantle. In spite of the investigations already performed, there is still room for further improvements, in terms of the ever present ambiguity resolving issue associated with separating the individual constituents of the residual gravity field, by incorporating new or more accurate geophysical/geoscientific constraints, and by improving the crustal or lithospheric models used in applications of the stripping corrections.

5. Conclusions

[27] We have computed the global topographic correction and the global stripping corrections for the major known density contrasts within the Earth's crust based on the CRUST 2.0 model. The density contrasts include the effects of seawater, ice, sediments and crystalline crust and were taken relative to adopted value of the reference crustal density of 2670 kg/m^3. These stripping corrections were applied to the topographically corrected gravity disturbances. The consolidated crust-stripped gravity disturbances are highly correlated with the Moho density interface from the CRUST 2.0 model. In our final stripping correction we removed the attraction of the constant density contrast of the reference crust relative to the encompassing mantle, using a constant density contrast of -520 kg/m^3 in the volumetric domain between the reference ellipsoid and the Moho interface. The value of the density contrast was found by minimizing the correlation between the complete crust-stripped gravity disturbances and the Moho interface. The application of this last stripping correction to the consolidated crust-stripped gravity disturbances produces the complete crust-stripped gravity disturbances by removing the gravitational signal of the crust/mantle (Moho) density interface. The complete crust-stripped gravity disturbance corresponds (ideally) to a model Earth of no topography, a constant density of 3190 kg/m^3 in between the reference ellipsoid and the Moho interface, and a real density distribution below the Moho interface.

[28] The discussed corrections and the corrected gravity disturbances, evaluated globally at the Earth's surface on a 1 × 1 arc degree grid of the geocentric spherical coordinates, are made available to the Earth sciences community in Data Sets S1–S5 in the auxiliary material.

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