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World Gravity Map: a set of global complete spherical Bouguer and isostatic anomaly maps and grids

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We present here a set of digital maps of the Earth's gravity anomalies (surface free air, Bouguer and isostatic), computed at Bureau Gravimetric International (BGI) as a contribution to the Global Geodetic Observing Systems (GGOS) and to the global geophysical maps published by the Commission for the Geological Map of the World (CGMW) with support of UNESCO and other institutions.

The Bouguer anomaly concept is extensively used in geophysical interpretation to investigate the density distributions in the Earth's interior. Complete Bouguer anomalies (including terrain effects) are usually computed at regional scales by integrating the gravity attraction of topography elements over and beyond a given area (under planar or spherical approximations). Here, we developed and applied a worldwide spherical approach aimed to provide a set of homogeneous and high resolution gravity anomaly maps and grids computed at the Earth's surface, taking into account a realistic Earth model and reconciling geophysical and geodetic definitions of gravity anomalies. This first version (1.0) has been computed by spherical harmonics analysis / synthesis of the Earth's topography-bathymetry up to degree 10800. The detailed theory of the spherical harmonics approach is given in Balmino et al., (Journal of Geodesy, 2011). The Bouguer and terrain corrections have thus been computed in spherical geometry at 1'x1' resolution using the ETOPO1 topography/bathymetry, ice surface and bedrock models from the NOAA (National Oceanic and Atmospheric Administration) and taking into account precise characteristics (boundaries and densities) of major lakes, inner seas, polar caps and of land areas below sea level. Isostatic corrections have been computed according to the Airy-Heiskanen model in spherical geometry for a constant depth of compensation of 30km. The gravity information given here is provided by the Earth Geopotential Model (EGM2008), developed at degree 2160 by the National Geospatial Intelligence Agency (NGA) (Pavlis et al., 2008) and the DTU10 (Andersen, 2010) who represents the best up-to-date global gravity models (including surface gravity measurements from land, marine and airborne surveys as well as gravity and altimetry satellite measurements). The surface free-air anomaly is computed at the Earth's surface in the context of Molodensky theory and includes corrections from the mass of the atmosphere.

The way gravity anomalies are computed on a worldwide basis slightly differs from the classical usage, but meets modern concerns which tend to take into account of the real Earth. The resulting anomaly maps and grids will be distributed for scientific and education purposes by the Commission for the Geological Map of the World (CGMW) (http://ccgm.free.fr) and by the Bureau Gravimetrique International (BGI) (http://bgi.omp.obs-mip.fr). Upgraded versions might be done as soon as new global gravity model will be available (including satellite GOCE data for instance). Institutions who are interested to contribute with new datasets of surface gravity measurements (i.e. ground, marine or airborne gravity data) are also invited to contact BGI (bgi@cnes.fr).