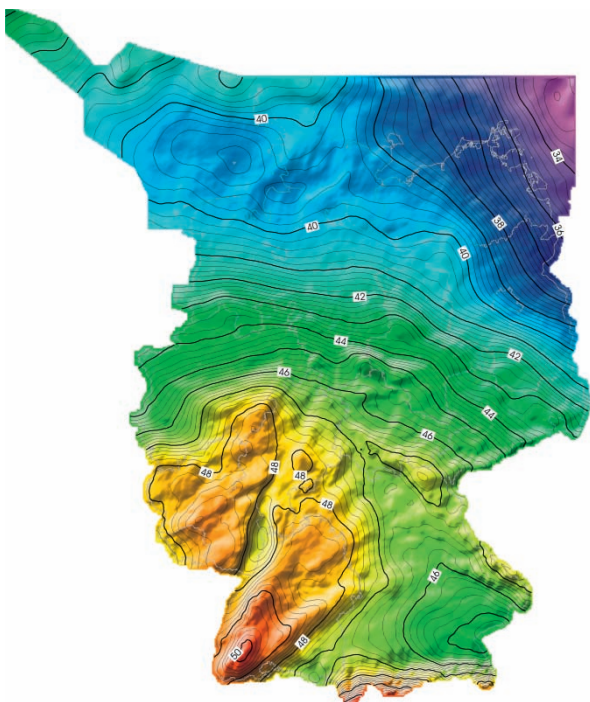




Federal Agency for
Cartography and Geodesy



Quasigeoid

of the Federal Republic of Germany

The height reference surface
of the Arbeitsgemeinschaft der
Vermessungsverwaltungen
der Länder (AdV)

Geoid and Gravity Field Models

Gravity not only causes that we stand with both feet on the ground, but it is also of importance with respect to the determination of our heights. The influence of the changing gravitational pull from the sun and the moon towards the sea level is clearly visible as tides. By comparison, the earth's gravity field has a clearly higher but temporally constant impact on the form of the sea level by the spatial distribution of its anomalies. Without knowledge of gravity no unambiguous heights above sea level can be computed. In Germany these physical heights of the DHHN92 are traditionally related to a reference point of the Amsterdam mean high tide sea level from 1683/84 (Normaal Amsterdams Peil).

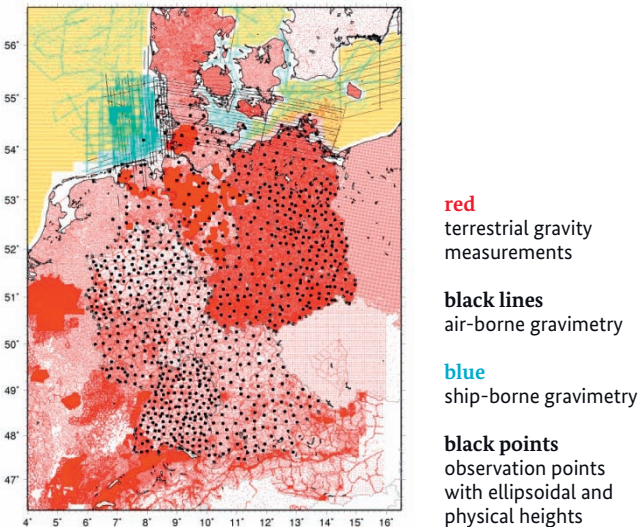
Over the last years satellite navigation systems such as the Global Positioning System (GPS) and the European counterpart GALILEO have become indispensable to the realization of a manifold of surveying activities. However, the so called ellipsoidal heights determined by means of these systems are not directly usable, given that they are fixed purely geometrically and do not refer to the sea level. Therefore, for the determination of practice-relevant physical heights a model of the height reference surface is required which in the field of geodesy is known as geoid or quasigeoid.

Whereas there is practically no water flow between points of equal physical height, it is quite possible that water flows between points of equal ellipsoidal heights (that are determined by means of the satellite data). The differences between the two height types vary in Germany between 34 m in the Baltic Sea and 50 m in the Alps as well as in the Black Forest. These variations are caused by irregular mass distributions in the earth's interior. Since the variation of the height reference surface modelled in the GCG2011 may amount already to several centimeters within a radius of a few kilometers, their knowledge is also of importance for regional and local surveying activities.

Height reference surface for Germany

Since height determination is increasingly based on modern satellite-assisted measurement techniques, the height reference surface for Germany must be provided with cm-precision. This enables computation of the physical height of any terrestrial point from its ellipsoidal height. A detailed height reference surface requires a high-resolution regional gravity field model as basis. Thus, satellite-based measurements of the Earth's gravity field and the related global gravity models can represent only large-scale structures. Determination of the height reference surface needs more detail terrestrial measurements.

Since the Mid-nineties BKG (Federal Agency for Cartography and Geodesy) has done substantial work in this field jointly with the Länder (states) surveying authorities. The height reference surface in Germany is based on terrestrial, airborne and marine gravity measurements, digital elevation models, and a network of points with ellipsoidal and physical heights obtained from GNSS and spirit levelling, respectively.



Database for quasigeoid modelling

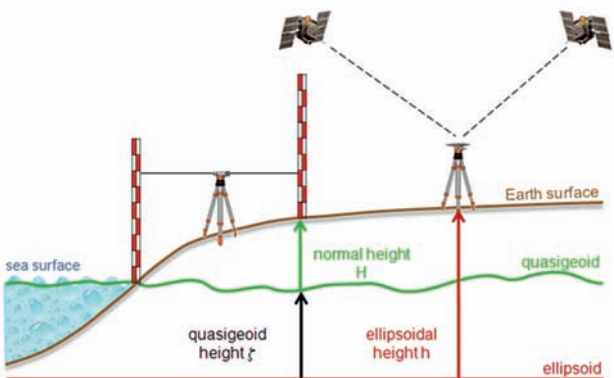
The current height surface – the GCG2011

The Bundesamt für Kartographie und Geodäsie (BKG) and the Institut für Erdmessung der Leibniz Universität Hannover (IfE) (Institute for Geodesy of Leibniz University Hannover) have developed a new model of the height reference surface of Germany in cooperation with the Arbeitsgemeinschaft der Vermessungsverwaltungen der Länder der Bundesrepublik Deutschland (AdV) (Working Committee of the Surveying Authorities of the States of the Federal Republic of Germany). The model named GCG2011 (German Combined Quasigeoid 2011) succeeds the model GCG05 published in 2005.

For the first time, the new model includes the area of Germany's Exclusive Economic Zone (EEZ) of the North Sea, which means the so-called 200 sea-mile-zone, thus providing a uniform solution that comprises the whole territory of the Federal Republic of Germany.

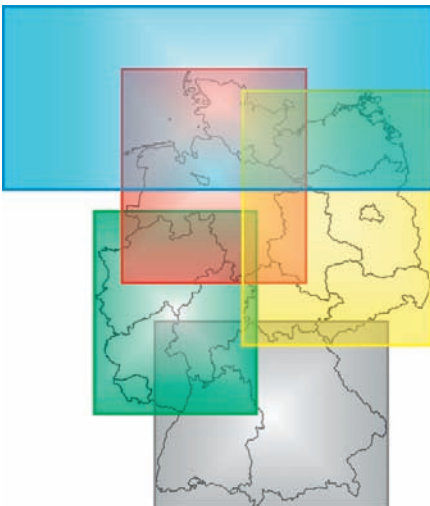
The GCG2011 is compatible with the ETRS89 reference system used by the satellite positioning service of the Länder (SAPOS[®]) as well as with the official DHHN92 height system. The physical heights in the DHHN92 that are used in practice can therefore be computed by means of the GCG2011 directly from the ellipsoidal heights determined through SAPOS[®]:

$$H_{\text{DHHN92}} = h_{\text{ETRS89}} - \zeta_{\text{GCG2011}}$$



Product description

- Quasigeoid heights adaptable to the reference systems ETRS89 and DHHN92
- Accuracy of the quasigeoid model (standard deviation):
 - Lowland / hill land: 1 - 2 cm
 - Mountainous regions: 3 - 4 cm
 - Marine areas: 4 - 10 cm
- Delivery of the quasigeoid model as a grid file 1' x 1,5':
 - ASCII file (also for software of TOPCON)
 - Binary file including interpolation program (MS WINDOWS, LINUX)
 - File in formats of the GNSS equipment manufacturers (TRIMBLE, LEICA, SOKKIA)
- Supply of the quasigeoid model for the whole territory of Germany, or, optionally for five sub-regions
- Distribution via the GeoDataCentre of BKG (<http://www.geodatenzentrum.de>)
- For single points online computation of quasigeoid heights is possible on the web site of BKG (see <http://www.bkg.bund.de/gcg2011>).



Sub-regions of the quasigeoid delivery

Information

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