

The GEBCO_08 Grid

Introduction

The GEBCO_08 Grid is a continuous terrain model for ocean and land with a spatial resolution of 30 arc-seconds.

The bathymetric portion of the grid was largely generated by combining quality-controlled ship depth soundings, with predicted depths between the sounding points guided by satellite-derived gravity data. Individual gridded bathymetric data sets have been included in some areas. Further information on the data sources used to generate the grid is given in the 'Contents' section below.

The grid was initially developed as a collaborative effort by the following organisations:

The General Bathymetric Chart of the Oceans (GEBCO)
International Hydrographic Bureau (IHB)
The US National Geospatial-Intelligence Agency (NGA)
The US National Oceanic and Atmospheric Administration (NOAA)
The US Naval Oceanographic Office (NAVO)
Scripps Institution of Oceanography (SIO)
The UK Natural Environment Research Council (NERC)

Data set update history

1. Included in version 20091120 of the GEBCO_08 Grid, released in November 2009:

Version 2.23 of the International Bathymetric Chart of the Arctic Ocean (IBCAO) was supplied to GEBCO on behalf of the IBCAO by Prof. Martin Jakobsson, Stockholm University, Sweden. The grid, at 30 arc-second intervals, was included in the GEBCO_08 grid between 64°N and 90°N; 180°W and 180°E.

The edge-matching of the data sets at 64°N was carried out using a feather-blending routine, part of the Global Mapper v11.01 software package.

Further details about the IBCAO data set along with grids and maps for downloading can be found at <http://www.ibcao.org>

Contents

Bathymetry data

The bathymetry data were produced by combining the published Smith and Sandwell global topographic grid (1) between latitudes 80°N and 81°S (version 11.1, September, 2008) with a database of over 290 million bathymetric soundings.

Within the Smith and Sandwell global topographic grid, the predicted depths are based on version V16.1 of the Sandwell and Smith gravity anomaly from Geosat and ERS 1 satellite altimetry (2), created in March 2007.

Bathymetric sounding data sets and compilation grids of measured bathymetry from a number of sources have been used to generate the grid, including:

- Bathymetric soundings from the GEODAS data set maintained by the International Hydrographic Organization (IHO) Data Center for Digital Bathymetry (DCDB) at the US National Geophysical Data Center (NGDC). (3)
- Bathymetric grids and data files from the marine geology and geophysics community, including contributions from the Lamont Doherty Earth Observatory (LDEO) Ridge Multibeam Synthesis Project (4), GEOMAR, National Science Foundation (NSF) Polar Programs, the School of Ocean and Earth Science and Technology (SOEST) at the University of Hawaii at Manoa and the WHOI/GLOBEC programme.
- Swath bathymetry grids from Scripps Institution of Oceanography multibeam cruises.
- Multibeam grids contributed by the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) (5).
- The US National Geophysical Data Center (NGDC) Coastal Relief Model (6).
- Multibeam grids from “Law of the Sea” work for areas around Alaska and the Arctic, the Marianas, Kingman Reef and Palmyra Atoll, the Western Atlantic Ocean and the Gulf of Mexico from the Center for Coastal and Ocean Mapping/Joint Hydrographic Center at the University of New Hampshire, USA (7).
- Bathymetric soundings contributed by the Institut Français de Recherche pour L’Exploitation de la Mer (IFREMER) from centre beam data from over 100 cruises.
- The Arctic bathymetry (north of 64°N) is taken from version 2.23 of the International Bathymetric Chart of the Oceans (IBCAO) (8).
- The Geological Survey of Ireland (GSI) provided a bathymetric grid for Irish designated waters based on multibeam surveys carried out between 2000 and 2006 as part of the Irish National Seabed Survey (9).
- OLEX, a private company in Norway made available to GEBCO a sub-sample of their marine sounding data, which greatly improves the GEBCO DTM in shallow water areas, especially in the North Atlantic (10).
- In some shallow water areas (shallower than 300m), bathymetry data have been provided by a number of the International Hydrographic Organization's (IHO) Member States. This work has been done through a project, coordinated by the International Hydrographic Bureau (IHB), to extract shallow water bathymetry data from Electronic Navigation Charts (ENCs).

Land data

For the area north of Antarctica, the land data are based on the 1-km averages of topography derived from version 2.0 of the US Geological Survey SRTM30 gridded digital elevation model data product (11) created with data from the US National Aeronautics and Space Administration (NASA) Shuttle Radar Topography Mission (12) and, for high latitudes where SRTM data are not available, the US Geological Survey GTOPO30 data set (13).

For the area around Antarctica, the land data are taken from the Geoscience Laser Altimeter System (GLAS) instrument on the Ice, Cloud, and land Elevation Satellite (ICESat) laser altimetry digital elevation model (14).

GEBCO_08 Source Identifier (SID) Grid

The GEBCO_08 Grid is accompanied by a 'source identifier' (SID) grid. This data set identifies which grid cells in the GEBCO_08 Grid are based on bathymetric soundings or bathymetric depth values from grids and which cells contain predicted depth values. Further information about the format of the data set is given below.

For future release, it is planned that the SID grid will contain an identifier code, which will identify the individual surveys used to generate the data set.

Development of the GEBCO_08 grid

The SRTM30_plus data set (15), from which the GEBCO_08 grid derives, was originally developed in 2004. Since then there have been four releases of this grid. The latest, version 5.0, on which this data set is based, was released in September 2008.

This version has gone through six iterations of identifying apparent bad sounding tracks, editing the offending profiles and constructing a new grid.

The grid is a development product, which will undergo periodic update. We expect that errors will be found, mostly in the predicted bathymetry, and we also expect some artifacts where the areas of predicted bathymetry joins surveyed areas.

See the GEBCO_08 Grid errata page for information on known bugs in the dataset.
http://www.bodc.ac.uk/help_and_hints/errata/gebco/gebco_08.html

If you find any anomalies in the grid then please report them via e-mail (enquiries@bodc.ac.uk), giving the problem location, and we will investigate.

Data Format - GEBCO_08 Grid and Source Identifier (SID) Grid

Within the netCDF files for the GEBCO_08 Grid and GEBCO_08 SID Grid, the data are stored as one-dimensional arrays of 2-byte signed integer values.

The complete data sets give global coverage and each file consists of 21,600 rows x 43,200 columns, resulting in 9,331,200,000 data points. The data start at the Northwest corner of the files, i.e. for the global files, position 89° 59' 45''N, 179° 59' 45''W and are arranged in latitudinal bands of 360 degrees x 120 points/degree = 43,200 values. The data range eastward from 179° 59' 45''W to 179° 59' 45''E. Thus, the first band contains 43,200 values for 89° 59' 45''N, then followed by a band of 43,200 values at 89°59' 15''N and so on at 30 arc-second latitude intervals down to 89° 59' 45''S.

The data values are pixel centre registered i.e. they refer to data values at the centre of grid cells.

The data are suitable for use with the Generic Mapping Tools (GMT) software system <http://gmt.soest.hawaii.edu/>.

Data coding

GEBCO_08 Grid

The data values within the GEBCO_08 Grid represent elevations in metres, with negative values for bathymetric depths and positive values for topographic heights.

GEBCO_08 SID Grid

The SID grid data values are coded as follows:

- 0 data value in the GEBCO_08 Grid at this location has been interpolated with the help of satellite-derived gravity data
- 9999 the data value in the GEBCO_08 Grid at this location has been constrained by bathymetric sounding data during the gridding process
- 1000 the data value in the GEBCO_08 Grid at this location is taken from version 2.23 of the International Bathymetric Chart of the Arctic Ocean (IBCAO)
- 8888 data value in the GEBCO_08 Grid at this location has a positive value (+ve), i.e. is coded as land

Data set attribution

If the data sets are used in a presentation or publication then we ask that you acknowledge the source. This should be of the form (including the appropriate version number):

For the GEBCO_08 Grid:

‘The GEBCO_08 Grid, version 20091120, <http://www.gebco.net>’.

For the GEBCO_08 SID Grid:

‘The GEBCO_08 SID Grid, version 20091120, <http://www.gebco.net>’.

The version number of the grid is given in the header information within the grid file.

Terms of use

Data within the GEBCO_08 Grid are subject to copyright and database right restrictions.

Reproduction of the gridded bathymetry data in derivative form for scientific research, environmental conservation, education or other non-commercial purposes is authorised without prior permission, providing the source material is properly credited.

The production of these gridded data sets is the result of an international collaboration of numerous scientists and hydrographers who have devoted much of their time and effort, often on a voluntary basis. This work was stimulated by a wish to create an authoritative, high-quality bathymetry of the world's oceans for the benefit of all.

Therefore, we ask that you contact us first, should you wish to pass on the data to third parties or use the data for commercial purposes.

In the first instance, please contact the British Oceanographic Data Centre (BODC) enquiries@bodc.ac.uk and include a clear statement of the purpose for which the material will be used and the manner in which it will be reproduced.

In the case of commercial activities, a contribution may be requested for the further improvement of GEBCO's data sets.

Disclaimer

THE GEBCO_08 GRID IS NOT TO BE USED FOR NAVIGATION OR FOR ANY OTHER PURPOSE RELATING TO SAFETY AT SEA.

Information in the GEBCO_08 grid has been obtained from sources believed to be reliable but its accuracy and completeness cannot be guaranteed. Whilst every effort has

been made to ensure its reliability within the limits of present knowledge, no responsibility can be accepted by those involved in its compilation or publication for any consequential loss or damage arising from its use.

The GEBCO_08 grid is essentially a deep ocean product and does not include detailed bathymetry for shallow shelf waters. Even to the present day, most areas of the world's oceans have not been fully surveyed and, for the most part, bathymetric mapping is an interpretation based on random tracklines of data from many different sources. The quality and coverage of data from these sources is highly variable. Although the GEBCO_08 grid is presented at 30 arc-second intervals of latitude and longitude, this does not imply that knowledge is available on sea floor depth at this resolution - the depth in most 30 arc-second squares of the world's oceans has yet to be measured.

References and links

- (1) Smith, W. H. F., and D. T. Sandwell, Global seafloor topography from satellite altimetry and ship depth soundings, *Science*, v. 277, p. 1957-1962, 26 Sept. 1997
ftp://topex.ucsd.edu/pub/global_topo_1min
<http://topex.ucsd.edu/sandwell/publications/74.pdf>
- (2) Sandwell, D. T., W. H. F. Smith, Marine gravity anomaly from Geosat and ERS 1 satellite altimetry, *Journal of Geophysical Research*, v. 102, No. B5, p. 10039-10054, 1997.
ftp://topex.ucsd.edu/pub/global_grav_1min
<http://topex.ucsd.edu/sandwell/publications/71.pdf>
- (3) GEODAS data set at the IHO Data Center for Digital Bathymetry at the US National Geophysical Data Center (NDGC)
<http://www.ngdc.noaa.gov/mgg/bathymetry/iho.html>
- (4) Lamont Doherty Earth Observatory (LDEO) Ridge Multibeam Synthesis Project:
<http://ocean-ridge.ldeo.columbia.edu/general/html/home.html>
- (5) JAMSTEC Data Site for Research Cruises
<http://www.jamstec.go.jp/cruisedata/e/>
- (6) The US National Geophysical Data Center (NGDC) Coastal Relief Model: Divins, D.L., and D. Metzger, NGDC Coastal Relief Model,
<http://www.ngdc.noaa.gov/mgg/coastal/coastal.html>
(Data from Puerto Rico and Hawaii is not presently included.)
- (7) Center for Coastal and Ocean Mapping/Joint Hydrographic Center (CCOM/JHC): Law of the Sea Data, UNCLOS, Article 76, extended continental shelf, foot of slope, multibeam bathymetry, seafloor mapping, University of New Hampshire, USA

(8) The International Bathymetric Chart of the Arctic Ocean (IBCAO) version 2.23: Citation: Jakobsson, M., Macnab, R., Mayer, M., Anderson, R., Edwards, M., Hatzky, J., Schenke, H-W., and Johnson, P., 2008, An improved bathymetric portrayal of the Arctic Ocean: Implications for ocean modeling and geological, geophysical and oceanographic analyses, v. 35, L07602, Geophysical Research Letters, [doi:10.1029/2008GL033520](https://doi.org/10.1029/2008GL033520)

(9) Gridded bathymetry data for Irish designated waters, based on multibeam surveys, provided by the Geological Survey of Ireland (GSI). High-resolution grids of the GSI multibeam data can be accessed from: <https://jetstream.gsi.ie/iwdds/index.html>

(10) Gridded bathymetry data for shallow water areas around the Northwest European Shelf derived from single beam-echosounder data collected by fishing vessels. The data have been provided by Olex AS.

(11) SRTM30 data and documentation:
<ftp://e0srp01u.ecs.nasa.gov/srtm/version2/SRTM30/>

(12) Shuttle Radar Topography Mission (SRTM)
<http://www2.jpl.nasa.gov/srtm/>

(13) GTOPO30 Global 30 Arc Second Elevation Data
<http://edc.usgs.gov/products/elevation/gtopo30/gtopo30.html>

(14) The Geoscience Laser Altimeter System (GLAS) instrument on the Ice, Cloud, and land Elevation Satellite (ICESat) laser altimetry digital elevation model: DiMarzio, J., A. Brenner, R. Schutz, C. A. Shuman, and H. J. Zwally. 2007. GLAS/ICESat 500 m laser altimetry digital elevation model of Antarctica. Boulder, Colorado USA: National Snow and Ice Data Center. Digital media

(15) SRTM30_plus, J.J. Becker, David T. Sandwell et al
ftp://topex.ucsd.edu/pub/srtm30_plus