



Report of the GEBCO Digital Atlas Manager (October 2015)

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Summary

This report covers the work carried out at the British Oceanographic Data Centre (BODC) of the UK National Oceanography Centre (NOC) for GEBCO since the previous GEBCO meetings in December 2014.

Annex I includes statistics on the distribution of GEBCO's data sets since the last GEBCO Guiding Committee meeting in June 2014. Annex II includes information on access to GEBCO's web site.

GEBCO's global 30 arc-second interval grid

The latest version of GEBCO's global gridded data set was released in December 2014 as GEBCO_2014. It includes a large number of new data sets including:

- International Bathymetric Chart of the Arctic Ocean (IBCAO) version 3



- International Bathymetric Chart of the Southern Ocean (IBCSO) version 1
- EMODNet Bathymetry grid – 2013 release
- Baltic Sea Bathymetry Data Base
- Waters around Australia: Australian Bathymetry and Topography Grid, June 2009
- Bathymetry data for all ocean regions: From the Global Multi-Resolution Topography (GMRT) Data Synthesis, provided by the Lamont-Doherty Earth Observatory of Columbia University
- Japan Coast Guard Grid for the North Western Pacific Ocean region
- South China Sea region: update based on sounding data extracted from Electronic Navigation Charts (ENC), provided by the East Asia Hydrographic Commission
- North American Great Lakes: Bathymetric grids provided by the US National Oceanic and Atmospheric Administration (NOAA), National Geophysical Data Center (NGDC), U.S
- North Atlantic Ocean, Gulf of Cadiz region: Bathymetric compilation produced under the European Science Foundation (ESF) EuroMargins SWIM project “Earthquake and Tsunami hazards of active faults at the South West Iberian Margin: deep structure, high-resolution imaging and paleoseismic signature”
- Indian Ocean, region off Sumatra: Bathymetric survey carried out by HMS Scott in 2005
- Waters off the West Coast of Africa: update based on bathymetry data from Olex
- Northwest European Continental Shelf area: update based on bathymetry data from Olex
- South Pacific Ocean, Coral Sea region, update to correct an error in the GEBCO grid due to the inclusion of an erroneous island (“Sandy Island”)
- Waters off Chile, update based on ENC sounding data provided by the Chilean Navy Oceanographic and Hydrographic Service

The grid was updated in March 2015 due to an error in the procedure used to include the IBCSO data set into the grid. This led to a half grid cell (30 arc-second) shift in longitude between GEBCO_2014 and the source data set. The error was corrected by reprocessing the inclusion of the IBCSO data set into GEBCO. A new version of the GEBCO_2014 grid was produced with a revised version number: 20150318. All errors in GEBCO’s gridded data sets are logged and available to view on the internet: http://www.bodc.ac.uk/help_and_hints/errata/gebco/gebco_08.html

Making GEBCO’s grids available

In February 2015, an application was launched for viewing and accessing GEBCO’s grids via the GEBCO web site (www.gebco.net/data_and_products/gridded_bathymetry_data/). This is in



addition to the previous means of accessing GEBCO's grids via GEBCO web pages hosted at BODC: http://www.bodc.ac.uk/data/online_delivery/gebco/.

As part of this software upgrade, the grid download application was extended to allow access to GEBCO's grids in Esri ASCII raster format and as a data GeoTiff as well as netCDF.

Statistics on access to GEBCO's gridded data sets can be found in Annex I.

Web services

GEBCO Web Map Service

A new version of the GEBCO Web Map Service (WMS) has been developed based on the GEBCO_2014 Grid. We now also include a layer based on the Source Identifier (SID) grid. This layer shows which cells are constrained by data, either soundings or existing grids. Cells based on interpolation are transparent.

In response to requests from users, the WMS has been upgraded to:

- Include an additional projection: European Petroleum Survey Group (EPSG) code: 3857.
- Support images centred on either 0° or 180° longitude (previously it was only possible to produce imagery centred on 0°).

Information about how to access the GEBCO Web Map Service can be found at: www.gebco.net/data_and_products/gebco_web_services/web_map_service/

Development of a queryable Web Map Service (WMS) for the GEBCO Source Identifier (SID) grid

The cells within the GEBCO SID grid are coded to indicate what the corresponding cell in the GEBCO_2014 Grid is based on. For example, a code of '3800' for a cell in the SID grid indicates that the grid cell at this location in the GEBCO_2014 Grid is based on the EMODnet 2013 grid. A list of the SID codes is included on GEBCO's web site

(www.gebco.net/data_and_products/gridded_bathymetry_data/gebco_30_second_grid/#format) and also in the documentation accompanying the data set.

A means to allow users to access metadata for each grid cell in the GEBCO SID grid via a queryable WMS has been developed. Using systems that can support a queryable WMS (e.g. Geographic Information Systems (GIS) or user-developed applications) it would be possible to display the SID grid as an image and click on a pixel to retrieve the SID number and linked metadata.

It is proposed to initially link to an overview definition describing the data set – as given in the documentation that accompanies the GEBCO_2014 Grid. This could be extended further in the future to break down the metadata into fields for various attributes such as 'data type', 'originator', 'source organisation' etc.

The metadata can be stored as part of the UK Natural Environment Research Council (NERC) Vocabulary Server – a system containing controlled terms to describe data, in this case, SID numbers



describing data sources. A demonstration set of metadata has been included in a collection in the NERC Vocab Server as an example: <http://vocab.nerc.ac.uk/collection/GGS/current/>

Development of a bathymetric contour data set from the GEBCO_2014 Grid

We periodically receive requests from users for bathymetric contours based on GEBCO's 30 arc-second grid. Some users are able to generate contours themselves from the gridded data set but some are not.

A draft data set has been developed that includes bathymetric contours at depths of 100m, 200m, 500m and at 500m intervals thereafter. The data set has been generated using contouring software included as part of the Esri ArcGIS Desktop software package.

The data set has been made available for comment to the TSCOM and SCRUM groups. It requires further 'tidying' of the contours to remove artifacts before it can be released.

It is aimed to release the data set initially for internet download as a global data file in Shapefile format.

Miscellaneous activities

Towards a new GEBCO grid

Work has been done to investigate the possibility of updating the base grid currently used in GEBCO_2014.

GEBCO-EMODnet collaboration work

As part of SCRUM activities and as a partner in the EMODNet Bathymetry project (www.emodnet-hydrography.eu/) I attended the EMODnet Bathymetry meeting in January 2015 at the offices of IFREMER in Brest, France.

EMODnet are using the GEBCO grid to 'gap fill' where they do not have high-resolution surveys. The 2013 release of EMODnet has been included in GEBCO's latest grid, GEBCO_2014.

The new EMODnet grid was released in February 2015 with a smaller grid interval (1/8 arc-minute) than the previous release (1/4 arc-minute).

In addition to updates in the areas covered in the previous release, the new grid includes additional data sets for the Black Sea, Baltic Sea (based on the Baltic Sea Bathymetry Database), Norwegian - Icelandic Seas and Canary Islands.

It was noted that there were some artifacts in the gridded data set, these were due to errors in the source data sets and also issues with 'gap filling' with GEBCO in areas where EMODnet do not have any data sets. It was decided to treat this as a draft release and then to work on resolving the artifact issues for a further release of the grid in the summer of 2015.

As a partner in EMODnet and link with GEBCO I provided a seamless merged EMODnet-GEBCO grid for European waters, which was used to help with the issue of artifacts in gap-filled areas.



The latest EMODnet grid was released in September 2015: http://www.emodnet-bathymetry.eu/content/news_details.asp?menu=0220000_000031

Involvement in writing the GEBCO_2014 grid release paper

I was involved in the collaborative work with GEBCO colleagues to produce a paper on the development of the GEBCO_2014 Grid. The paper was published in August 2015: Weatherall P., K. M. Marks, M. Jakobsson, T. Schmitt, S. Tani, J. E. Arndt, M. Rovere, D. Chayes, V. Ferrini, and R. Wigley (2015), A new digital bathymetric model of the world's oceans, Earth and Space Science, 2, doi: 10.1002/2015EA000107. This manuscript is available for free download from: <http://onlinelibrary.wiley.com/doi/10.1002/2015EA000107/full>

Access to GEBCO's data sets and products

GEBCO's bathymetric data sets are made available, on behalf of GEBCO, by BODC via the internet and on DVD as part of the GEBCO Digital Atlas (GDA).

Since the last GEBCO Guiding Committee meeting in June 2014 to 31st August 2015 there have been:

17,288 downloads of GEBCO's gridded data sets

This includes the GEBCO_08 Grid and accompanying SID grid (up to December 2014); the GEBCO_2014 Grid and accompanying SID (since its release in December 2014) and the GEBCO One Minute Grid (GEBCO's one-arc minute interval grid, largely based on its 2003 bathymetric contour data set).

Downloads of GEBCO's grids from December 2014 (launch of GEBCO_2014) to end August 2015, split by grid type:

- GEBCO_2014 Grid: **8,303**
- GEBCO_2014 SID Grid: **1,564**
- GEBCO One Minute Grid: **1,135**

Statistics showing the breakdown of data downloads by grid export format is given in Annex I.

During 2014, 60 copies of the GDA were distributed. This includes 55 copies sold (39 copies sold as part of a bulk order at a special price) and 5 complimentary copies distributed. Royalties contributed to GEBCO from the sale of the GDA for 2014 amounted to £2,867. This money has been transferred to the GEBCO account held at the IHB.

Since the GEBCO Guiding Committee meetings in June 2014 we have answered 154 general email enquiries relating to GEBCO's data sets and products.

Some users provide feedback or ask permission to use our data in their products and services. These uses are varied and include using imagery in publications and maps; imagery as background context to the user's own data sets and using the gridded data in computer modelling work. We also get feedback on our products and about potential errors in GEBCO's grids.

See Annex I for further information on data access statistics.



GEBCO's web site

Since July 2008, GEBCO's web site has been maintained and updated on behalf of GEBCO by BODC. It can be accessed at www.gebco.net.

In addition to general site maintenance and request for content updates by GEBCO colleagues, the following pages/sections have been added to GEBCO's web site during the year:

- GEBCO grid download application and associated documentation pages:
www.gebco.net/data_and_products/gridded_bathymetry_data/
- Pages added showing comparisons between GEBCO_2014 and GEBCO_08:
www.gebco.net/data_and_products/gridded_bathymetry_data/gebco_update_history/version_20141103/index.html
- Imagery developed based on the GEBCO_2014 Grid
www.gebco.net/data_and_products/gridded_bathymetry_data/grid_plots/
- the addition of 'news and events' items: www.gebco.net/about_us/news_and_events/ and www.gebco.net/about_us/news_and_events/index_2014.html
- presentation and poster information for the Ninth GEBCO Science Day:
www.gebco.net/about_us/gebco_science_day/
- the 'meetings and minutes' pages have been updated:
www.gebco.net/about_us/meetings_and_minutes/

Since the GEBCO Guiding Committee meeting in June 2014, we have had over 109,500 sessions on GEBCO's web site, accessing over 306,400 web pages.

We have also added 32 posts to GEBCO's Facebook page: <http://www.facebook.com/GEBCO> on a variety of topics relating to GEBCO, bathymetry and related applications.

See Annex II for further information on web site statistics.

Funding for BODC GEBCO activities

Funding for GEBCO Digital Atlas activities carried out by BODC is provided by the UK Natural Environment Research Council.

BODC gratefully acknowledges the receipt of funding (5K Euros per annum) for GEBCO web site maintenance work (part of the IHO funding for GEBCO work plan tasks).



Annex I

Distribution of GEBCO's bathymetric data sets and products

This includes:

- Downloads of GEBCO's gridded data sets from the Internet
- Downloads of the GEBCO Grid Viewing Software
- Distribution of the GEBCO Digital Atlas on DVD

Internet downloads of GEBCO's gridded bathymetric data sets

1st June 2014 – 31st August 2015 – approximate period since the last GEBCO Guiding Committee meeting

Total number of downloads of GEBCO's gridded data sets: **17,288**

Downloads of data since launch of GEBCO_2014 in December 2014:

- Downloads of the GEBCO_2014 Grid: **8,303**
- Downloads of the GEBCO_2014 SID grid: **1,564**
- Downloads of the GEBCO One Minute Grid: **1,135**

Previously, GEBCO's grids have been available to download in netCDF format. Since February 2015 the GEBCO_2014 Grid and SID grid have been available in additional export formats, i.e. Esri ASCII raster and Data GeoTiff.

The table below shows the number of downloads per export format for each data set (February – August 2015 – time period for which data records are currently available for this information).

Data set	1D NetCDF	CF NetCDF	Esri ASCII raster	Data Geotiff
GEBCO_2014	522	1,993	2,404	1,637
GEBCO_2014 SID	145	256	474	332
GEBCO One Minute	203	554		



Explanation of formats:

In netCDF format, GEBCO’s grids are available in the form of both two-dimensional (2D) and one-dimensional (1D) arrays of signed 2-byte integers. The 2D gridded data set uses the netCDF Climate and Forecast (CF) Metadata Convention. The 1D array grids are, primarily, for use with GEBCO's Grid Display and GEBCO Digital Atlas (GDA) software packages and so are only available as a global grid.

Esri ASCII raster format is an ASCII format developed for the export/exchange of Esri ARC/INFO rasters, it is used as an input format for a number of software packages.

The GeoTiff format contains geo-referencing (geographic extent and projection) information embedded within a Tiff file. The GEBCO_2014 Grid and SID grids are made available as single-channel INT16 (two byte signed integer) data values for user-defined areas in GeoTiff format.

Comparisons of number of downloads of GEBCO’s gridded data sets per year

Year	Number of data downloads
2014	13,204
2013	12,340
2012	11,058
2011	9,684

Internet downloads of viewing software for displaying and accessing data from GEBCO’s grids

Total number of downloads since 1st June 2014 - 31st August 2015: **2,067**

Distribution of the GEBCO Digital Atlas (GDA)

During 2014, 60 copies of the GDA were distributed. This includes 55 copies sold and 5 complimentary copies distributed.

Since its release in 2003, 1,746 copies of the GDA have been distributed.

The net income received from sales of the GDA is shared equally between BODC and GEBCO. Royalties contributed to GEBCO from the sale of the GDA for 2014 amounted to £2,867. This makes a total of £90,010 since the re-release of the GDA in 2003. So far for 2015, the number of copies of the GDA distributed is 27.

Royalties contributed to GEBCO for the sale of the GDA per year:

Year	Amount
2003	£10,222
2004	£9,053



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2005	£8,474
2006	£12,433
2007	£8,754
2008	£8,216
2009	£11,580
2010	£5,720
2011	£3,174
2012	£3,900
2013	£5,617
2014	£2,867



Annex II

GEBCO's web site was re-launched in July 2008. The web site is maintained, on behalf of GEBCO, by the British Oceanographic Data Centre (BODC).

Visits to GEBCO's web site

The following tables provide statistics about access to GEBCO's web site (www.gebco.net) for the reporting period 1st June 2014 to 15th September 2015.

In summary, there were 109,525 sessions on the site, accessing 306,465 web pages.

Number of visits to individual GEBCO web pages

The following table details the number of visits to the 'top 20' most popular pages on GEBCO's web site since the last GEBCO Guiding Committee meeting in June 2014.

Explanation of terms used:

Page title and URL	Title of the GEBCO web page viewed with URL
No. page views	The total number of pages viewed in the reporting period
Average time on page (minutes)	The average amount of time that visitors spent viewing this set of pages or page.

Page title and URL	No. of page views	Avg. time on page (minutes)
Gridded bathymetry data* www.gebco.net/data_and_products/gridded_bathymetry_data/index.html	77,202	03:06
GEBCO home page www.gebco.net/index.html	57,800	01:05
GEBCO world map www.gebco.net/data_and_products/gebco_world_map/index.html	15,229	02:12
GEBCO Digital Atlas www.gebco.net/data_and_products/gebco_digital_atlas/index.html	14,581	00:57
Web map service page www.gebco.net/data_and_products/gebco_web_services/web_map_service/index.html	12,210	03:12
GEBCO's data and products www.gebco.net/data_and_products/index.html	10,586	00:28
Information about the GEBCO_2014 Grid www.gebco.net/data_and_products/gridded_bathymetry_data/gebco_30_second_grid/index.html	10,486	01:07
GEBCO grid display software www.gebco.net/data_and_products/grid_display_software/index.html	9,196	02:31



Undersea feature names www.gebco.net/data_and_products/undersea_feature_names/index.html	8,733	03:12
Imagery index page www.gebco.net/data_and_products/imagery/index.html	7,593	00:34
World ocean bathymetry visualizations www.gebco.net/general_interest/bathymetry_visualisations.html	5,804	01:15
Regional mapping projects overview www.gebco.net/regional_mapping/mapping_projects/index.html	4,826	02:24
General interest – FAQ page www.gebco.net/general_interest/faq/index.html	4,651	03:12
Web map service overview page www.gebco.net/data_and_products/gebco_web_services/index.html	4,589	00:19
General interest page www.gebco.net/general_interest/index.html	3,946	01:01
NF/GEBCO Training project page www.gebco.net/training/training_project/index.html	3,847	04:30
Grid plots www.gebco.net/data_and_products/gridded_bathymetry_data/grid_plots/index.html	3,522	01:42
Contacts information www.gebco.net/about_us/contact_us/index.html	2,851	02:53
Hard copy charts www.gebco.net/data_and_products/gebco_web_services/index.html	2,285	01:12
Information about the GEBCO One Minute Grid www.gebco.net/data_and_products/gridded_bathymetry_data/gebco_one_minute_grid/index.html	2,265	00:41

* See Annex I for details on Internet downloads of GEBCO’s gridded bathymetric data sets.

Geographic distribution of Internet Protocol (IP) addresses accessing GEBCO’s web site

The table below details the geographic distribution by country (top 20 ‘number of visits’ listed) of IP addresses accessing GEBCO’s web site.

Explanation of terms used:

Country/Territory	The name of the country or territory of the origin of the IP address accessing GEBCO’s web site
Visits	The total number of visits to the site from this country/territory
Pages/visit	The number of pages viewed per visit
Average time on site (minutes)	The average amount of time that visitors spent on the site

Country / Territory	Visits	Pages / visit	Average visit duration (minutes)
United States	19,465	2.55	2:27



United Kingdom	9,430	2.81	3:18
France	6,235	2.69	2:37
Germany	4,470	3.09	3:22
Japan	4,212	3.15	3:28
China	4,196	3.12	4:40
India	4,137	2.71	3:30
Canada	3,965	2.63	2:59
Russia	3,768	2.54	2:58
Italy	3,444	3.11	3:06
Spain	3,405	3.45	3:42
Indonesia	3,289	3.25	5:13
Australia	2,613	2.67	3:17
Mexico	2,394	2.81	3:59
Brazil	2,161	2.65	3:18
South Korea	1,656	3.62	3:56
Netherlands	1,637	2.71	3:03
Chile	1,193	3.2	4:32
Portugal	1,173	3.2	3:33
Norway	1,109	2.78	3:13

The table below shows the pages viewed and number of visits per calendar year

Year	Number of pages viewed	Number of visitors
2009	176,759	47,494
2010	191,037	58,617
2011	210,188	49,639
2012	255,241	65,918
2013	254,804	56,315
2014	235,273	57,349



GEBCO's Facebook page (<https://www.facebook.com/GEBCO>)

Since the GEBCO Guiding Committee meeting in June 2014 we have posted 34 news items to GEBCO's Facebook page relating to GEBCO, bathymetry data and sea floor-related research and news items. As of 24th September 2015, GEBCO's Facebook posts have had 769 'likes'.

Link to item posted	Date posted	Number of people reached
Opportunistic Multibeam Surveying http://www.hydro-international.com/issues/articles/id1699-Opportunistic_Multibeam_Surveying.html	23/09/2015	169
Robots help to map England's only deep-water Marine Conservation Zone http://noc.ac.uk/news/robots-help-map-england%E2%80%99s-only-deep-water-marine-conservation-zone	09/17/2015	73
Major new release of EMODnet Digital Bathymetry http://www.emodnet-bathymetry.eu/content/news_details.asp?menu=0220000_000031	09/14/2015	36
CODEMAP2015 – JC125 WHITTARD CANYON https://codemap2015.wordpress.com/	08/13/2015	69
New Insights from Seafloor Mapping of a Hawaiian Marine Monument https://eos.org/project-updates/new-insights-from-seafloor-mapping-of-a-hawaiian-marine-monument	08/10/2015	58
Avoiding Rock Bottom: How Landsat Aids Nautical Charting http://landsat.gsfc.nasa.gov/?p=10737	08/03/2015	703
Axial Eruption Site Identified – Bathymetric Survey Data Available Online http://oceanobservatories.org/axial-eruption-site-identified-bathymetric-survey-data-available-online/	07/29/2015	155
NIWA, DOC, Victoria University and LINZ collaborate to map Kapiti's submarine landscape http://www.niwa.co.nz/news/niwa-doc-victoria-university-and-linz-collaborate-to-map-kapiti%E2%80%99s-submarine-landscape	07/07/2015	72
MBARI researchers discover deepest known high-temperature hydrothermal vents in Pacific Ocean http://www.mbari.org/news/news_releases/2015/pescadero/pescadero-release.html	06/09/2015	81



UKHO Data Archiving Centre INSPIRE Portal – Data Refresh https://www.gov.uk/government/news/ukho-data-archiving-centre-inspire-portal-data-refresh	05/21/2015	241
Dive In! Explore Thousands of Coastal and Seafloor Images along U.S. Coasts http://soundwaves.usgs.gov/2015/02/outreach.html	05/13/2015	142
INGV and CNR revealed the secrets of Pozzuoli seafloor https://www.researchitaly.it/en/researching/press-media-4/news/ingv-and-cnr-revealed-the-secrets-of-pozzuoli-seafloor/	04/29/2015	96
JC10 cruise to the CCZ underway! http://www.eu-midas.net/news/jc10-cruise-ccz-underway	04/22/2015	52