

Report on the management and delivery of GEBCO's bathymetric data products and services and maintenance of GEBCO's web site

Submitted by British Oceanographic Data Centre (BODC) of the National Oceanography Centre (NOC)

SUMMARY

Executive Summary: This document provides details of the work carried out at BODC in support of GEBCO since the previous GEBCO meetings in April 2022. Annex I includes statistics on the distribution of GEBCO's data sets. Annex II includes information on access to GEBCO web site.

1. Overview/Introduction

The BODC, of the UK National Oceanography Centre (NOC), acts as the Global Center for the Nippon Foundation-GEBCO Seabed 2030 Project. Its primary role is to compile the global GEBCO grid from data provided by the Seabed 2030 Regional Centers, and to maintain and deliver the grid, and related products and services, on behalf of GEBCO.

The Center also maintains and updates the GEBCO and Seabed 2030 web sites and carries out a number of activities in support of GEBCO's work.

Staff involved in work for GEBCO at BODC:

- Dr Helen Snaith, Head of the Seabed 2030 Global Center
- Ms Pauline Weatherall, GEBCO Grid Manager
- Dr Chris Thompson, IT Developer
- Plus additional IT support from BODC's IT team

This report is an update to that given to the 38th GEBCO Guiding Committee meeting, April 2022 - [GGC38-2.4](#).

2. Delivery of GEBCO's bathymetric data sets

2.1 Development and release of the GEBCO_2022 global grid

In July 2022, the GEBCO_2022 Grid was released. It is the fourth GEBCO grid produced through the framework of The Nippon Foundation-GEBCO Seabed 2030 project. The grid is a global terrain model for land and oceans at 15 arc-second intervals. As with previous releases, the data set is accompanied by a Type Identifier (TID) Grid that indicates the type of

data (e.g. multibeam, single beam or interpolated etc.) that the corresponding cell in the bathymetric grid is based on.

Acting as the Seabed 2030 Global Center, BODC was responsible for compiling the global bathymetric grid by combining regional bathymetric grids provided by the Seabed 2030 Regional Centers with a base grid (SRTM15_plus v2.4) developed at Scripps Institution of Oceanography (SIO).

Following feedback from TSCOM on issues in the 2021 grid, for the 2022 Grid, the sparse regional grids have been included on to the base grid using a 'remove-restore' blending procedure (Smith and Sandwell, 1997; Becker, Sandwell and Smith, 2009 and Hell and Jakobsson, 2011). This is a two-stage process of computing the difference between the new data and the 'base' grid and then gridding the difference and adding the difference back to the existing 'base' grid. The aim is to achieve a smooth transition between the 'new' and 'base' data sets with the minimum of perturbation of the existing base data set. For the polar regions, data sets were supplied in the form of complete grids these data sets were included using feather blending techniques from GlobalMapper software version 23.1.0 made available by Blue Marble Geographics.

An initial draft grid was produced and made available for review, via an application developed at the Center for Coastal and Ocean Mapping at the University of New Hampshire, USA. The Regional Centers, GEBCO TSCOM and SCRUM committees and members of the SRTM15_plus team were invited to provide feedback on the grid.

The feedback on the draft GEBCO grid was passed to the Regional Centers and SRTM15_plus team. Revised data sets were then generated and passed to the Global Center who compiled the final version of the GEBCO_2022 Grid, Type Identifier (TID) Grid and accompanying data contributors list and metadata.

Two versions of the GEBCO_2022 Grid are made available, one with land and ice surface elevation information and a version with under-ice topography information for Greenland and Antarctica. The sections of the global grid showing under-ice topography have been developed by the Arctic and North Pacific Seabed 2030 Center Team based at Stockholm University and the Southern Ocean Center team based at the Alfred Wegener Institute.

The GEBCO_2022 Grid and accompanying Type Identifier (TID) Grid can be accessed, in a number of formats as complete global grids or tiled data sets, from:

- https://www.gebco.net/data_and_products/gridded_bathymetry_data/

For user-defined geographic areas:

- <https://download.gebco.net/>

A list of the data sets included in the grid is given on GEBCO's web site:

https://www.gebco.net/about_us/acknowledgements/our_data_contributors/

A Digital Object Identifier (DOI) has been minted for the data set by BODC on behalf of GEBCO: GEBCO Compilation Group (2022) GEBCO_2022 Grid (doi:10.5285/e0f0bb80-ab44-2739-e053-6c86abc0289c). The data set already has three citations from published work.

For the period, 1st January 2022 – 30th September 2022, there have been over 547,000 downloads of GEBCO's bathymetric data sets via GEBCO's web site.

Statistics on downloads of all GEBCO's data sets can be found in Annex I.

2.2 Delivery of the GEBCO grid in projection co-ordinates for polar regions

To accompany the 2022 release of the GEBCO grid, data sets have been made available for polar regions in polar stereographic projection co-ordinates. The data are taken from two of the regional data sets that are included in the global GEBCO_2022 Grid and were developed in polar projection co-ordinates.

- **Arctic Ocean region (approx. north of 64°N)** - taken from version 4.2 of the International Bathymetric Chart of the Arctic Ocean (IBCAO). Developed at the Department of Geological Sciences, Stockholm University, Sweden, acting as part of the Arctic and North Pacific Regional Center for the Nippon Foundation-GEBCO Seabed 2030 Project. Projection details: WGS 84 / IBCAO Polar Stereographic (EPSG: 3996).
- **Southern Ocean region (south of 50°S)** – based on version 2.0 of the International Bathymetric Chart of the Southern Ocean - IBCSO v2. Developed at the Alfred Wegener Institute (AWI), Germany, acting as the Southern Ocean Regional Center for the Nippon Foundation-GEBCO Seabed 2030 Project. Projection details: WGS 84/ IBCSO Polar Stereographic projection (EPSG: 9354)

The polar projection data sets can be accessed via the GEBCO grid download app: <https://download.gebco.net/>.

2.3 Development of a Web Map Service (WMS) for the GEBCO_2022 Grid

A WMS has been setup for the GEBCO_2022 Grid. This includes displaying layers showing:

- shaded relief imagery
- colour shaded for elevation
- versions showing ice surface and sub-ice topography
- TID grid colour coded for TID value
- Inclusion of a layer showing areas based on measured data or pre-generated grids

Information on how to access the WMS layers can be found on GEBCO's web site: https://www.gebco.net/data_and_products/gebco_web_services/web_map_service/

Example GetMap call to display layer showing only those areas based on measured data or pre-generated grids:

```
https://www.gebco.net/data_and_products/gebco_web_services/web_map_service/mapserv?request=getmap&service=wms&BBOX=-90,-180,90,360&crs=EPSG:4326&format=image/jpeg&layers=gebco_latest_3&width=1200&height=600&version=1.3.0
```

WMS layers for previous GEBCO grid releases are also available:

https://www.gebco.net/data_and_products/gebco_web_services/web_map_service/previous_wms.html

Draft WMS layers for the polar regions are in development.

2.4 Delivery of the International Bathymetric Chart of the Arctic Ocean (IBCAO) V4.2 Grid

In August 2022, version 4.2 of the bathymetric grid for the Arctic Ocean area, IBCAO, was made available from GEBCO's website in netcdf and data GeoTiff formats:

https://www.gebco.net/data_and_products/gridded_bathymetry_data/arctic_ocean/

The [previous versions](#) of the grid are accessible from GEBCO's web site.

3.0 Maintaining and updating GEBCO's web site

GEBCO's web site (<https://www.gebco.net>) is maintained and updated at BODC on behalf of GEBCO. News items, meeting information and ad hoc page update requests from the GEBCO committees have been added to the site throughout the year.

As reported previously, BODC has worked on the migration of the GEBCO site to a new management platform (Drupal). This will allow users, external to BODC, to manage sections of the site and give more options for future development of the site. The site content has been migrated to the new management platform. This migration work was directly funded through an additional budget line provided through TSCOM

Annex II provides information on access to GEBCO's web site.

4.0 Acting as a trusted node for crowdsourced bathymetry data

BODC, as the Seabed 2030 Global Center, has implemented a workflow to be able to act as a trusted node for crowdsourced bathymetry data. This involves acting as an intermediary between data collectors and the data repository at the IHO DCDB, processing the collected data to a format that can be uploaded to the DCDB. This activity is funded through the Seabed 2030 project but directly supports the CSB working group and provides data to the DCDB.

We have been in correspondence with contributing organisations regarding their data submissions to the trusted node and during 2022 have received data from eight vessels.

5.0 Miscellaneous activities in support of GEBCO

5.1 Providing GEBCO data set user-support

At BODC, we answer enquiries relating to GEBCO's data sets and products. The enquiries may be of a number of forms:

- Feedback on the GEBCO grid/reporting errors – we work with the relevant Seabed 2030 Regional Center, and with the SRTM15_plus team at SIO, to investigate any errors reported

in the grid and provide feedback to the enquirer. We keep a log of 'known issues' in the grid on GEBCO's web site and aim to fix them in subsequent grid releases.

https://www.gebco.net/data_and_products/gridded_bathymetry_data/data_set_errata/

- Technical – we respond to enquiries relating to how the grid was produced; the grid file formats or advice on how to use the data in particular systems
- Information on sources of bathymetry data – users may ask about the availability of source bathymetric data sets for a particular region, we endeavour to advise about available source data sets and provide links to where the data can be accessed.

Enquiries come from all parts of the world and all sectors, i.e. commercial companies, academic institutions, students and private individuals.

A form has been setup on the GEBCO web site to allow users to provide feedback on how they are using GEBCO's data sets:

https://www.gebco.net/data_and_products/gridded_bathymetry_data/feedback/

5.2 Maintenance of mailing lists and Google drive space for committee use

BODC manages a google workspace, within the domain gebco.net, primarily for serving group mailing lists and shared drive space on behalf of GEBCO, its sub committees and working groups. The TSCOM, SCRUM and SCOPE chairs have dedicated email accounts setup on the workspace (tscom_chair@gebco.net, scrum_chair@gebco.net and scope_chair@gebco.net) and mailing lists have been set up for the committees, awaiting confirmation of membership. Each sub-committee also has a dedicated shared drive space, with additional space for the web working group and Cookbook Editorial Board. The gebco_folk@gebco.net mailing list also uses this service and mailing lists previously managed by IHO DCDB have also been migrated.

5.3 Identifying bathymetric data sets held in BODC's archive that can be included in the GEBCO grid

In order to assist with mapping the data gaps in the GEBCO grid, we have been working to identify bathymetric data sets held within BODC's archive system that can be used to help update the GEBCO grid. To date, seven data sets, based on multibeam data, have been contributed.

5.4 Be involved in the work of some of GEBCO's Sub-Committees and Working Groups

- Supplied two updated chapters for the work to revise the GEBCO Cookbook
- Involved in the work of the GEBCO Cookbook Editorial Board
- Provided feedback on the revised GEBCO World map that is being developed through the SCOPE Sub-Committee.
- Participated in TSCOM's intersessional meeting

5.5 Future plans and work in progress

- We will work with Seabed 2030 colleagues on investigations into the development and delivery of bathymetric grids at multiple resolutions.
- Work is in progress on the development of a Web Map Service for the delivery of imagery based on GEBCO's historical paper chart series – Editions 1-5.

6. Action

The GGC is requested to note the contents of this report.

Annex I - statistics on the distribution of GEBCO's data sets

Internet downloads of GEBCO's gridded bathymetric data sets

https://www.gebco.net/data_and_products/gridded_bathymetry_data/

To note: statistics relating to the number of downloads of GEBCO's data sets and access to its web sites are given for the reporting period: 1st January 2022 – 30th September 2022.

GEBCO's latest bathymetric grid, the GEBCO_2022 Grid, was released at the beginning of July 2022. GEBCO's previous grids: GEBCO_2021, GEBCO_2020, GEBCO_2019, GEBCO_2014 and the GEBCO One Minute Grid are made available as global grid files to download, through the '[historical data sets](#)' section of GEBCO's web site and for user-defined areas (for grids at 15 arc-second intervals) through the GEBCO download app (<https://download.gebco.net/>).

Downloads for reporting period (1st January 2022 – 30th September 2022) split by grid type:

- GEBCO_2022 Grid: 318,606 (global grids:281,533)
- GEBCO_2022 TID Grid: global grids:8,032

- GEBCO_2021 Grid: 204,650 (global grids:150,268)
- GEBCO_2021 TID Grid: global grids:10,515

- GEBCO_2020 Grid: 23,438 (global grids:21,372)
- GEBCO_2020 TID Grid: global grids: 239

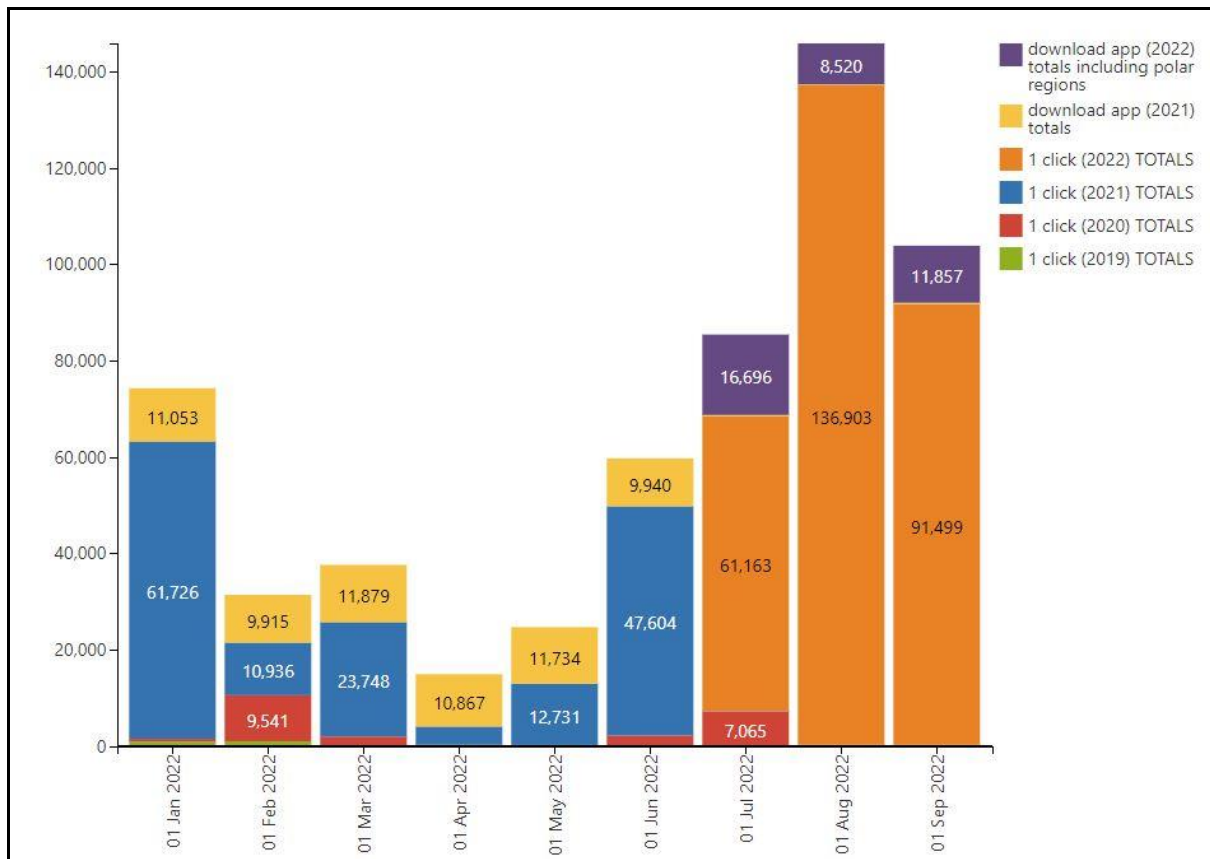
- GEBCO_2019 Grid: global grids:2,175

Historical data sets (global grids):

- GEBCO_2014 Grid (30 arc-second): 324
- GEBCO One Minute Grid: 306

The table below shows the number of downloads of imagery for each grid.

Grid name	Number of image downloads
GEBCO_2022	27,081 (since July 2022)
GEBCO_2021	29,775
GEBCO_2020	757
GEBCO_2019	923



The image above shows the number of downloads of bathymetry data via GEBCO's web site, i.e., complete global grids and data for user-defined areas.

Access to the International Bathymetric Chart of the Arctic Ocean (IBCAO) Grid

In August 2022, the IBCAO V4.2 grid was made available from GEBCO's web site, on behalf of the IBCAO project.

https://www.gebco.net/data_and_products/gridded_bathymetry_data/arctic_ocean/.

The data set is made available in netCDF and GeoTiff formats in polar stereographic projection co-ordinates. Versions of the data set are available with and without elevation information for the Greenland Ice Sheet.

The previous version of the grid is also available to download:

https://www.gebco.net/about_us/committees_and_groups/scrum/ibcao/#ibcao_historical

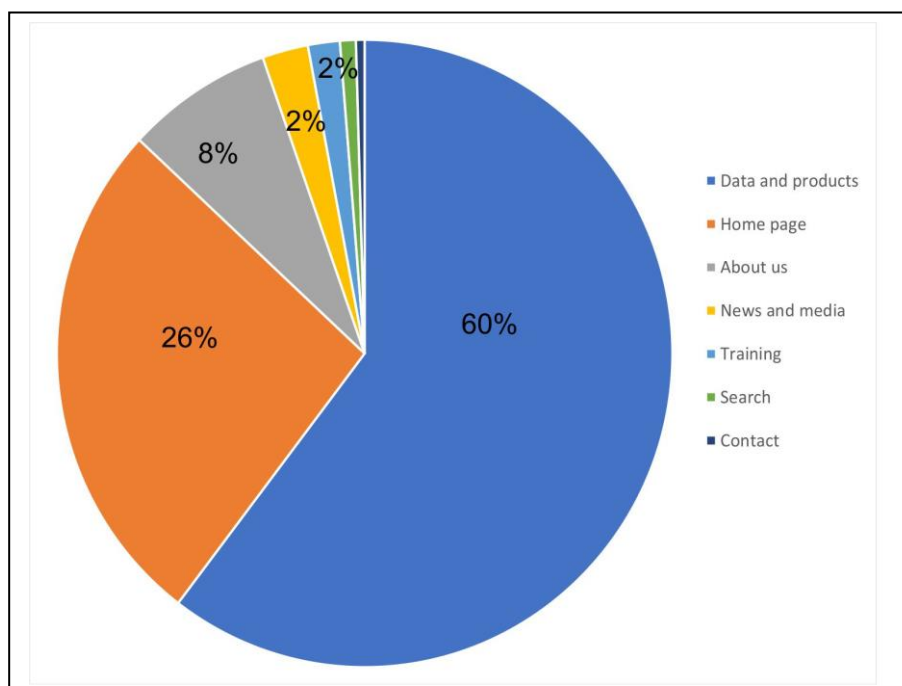
- Number of downloads of the IBCAO V4.2 Grid: 463 (since its release, August 2022)
- Number of downloads of the IBCAO V4.1 Grid: 14,439
- Number of downloads of the IBCAO V4.0 Grid: 1,612

Annex II – Access to the GEBCO web site

The GEBCO web site is maintained by BODC on behalf of the project. The following tables and images provide information and statistics on access to the web site for the period (1st January 2022 – 30th September 2022).

Access to GEBCO’s web site (www.gebco.net)

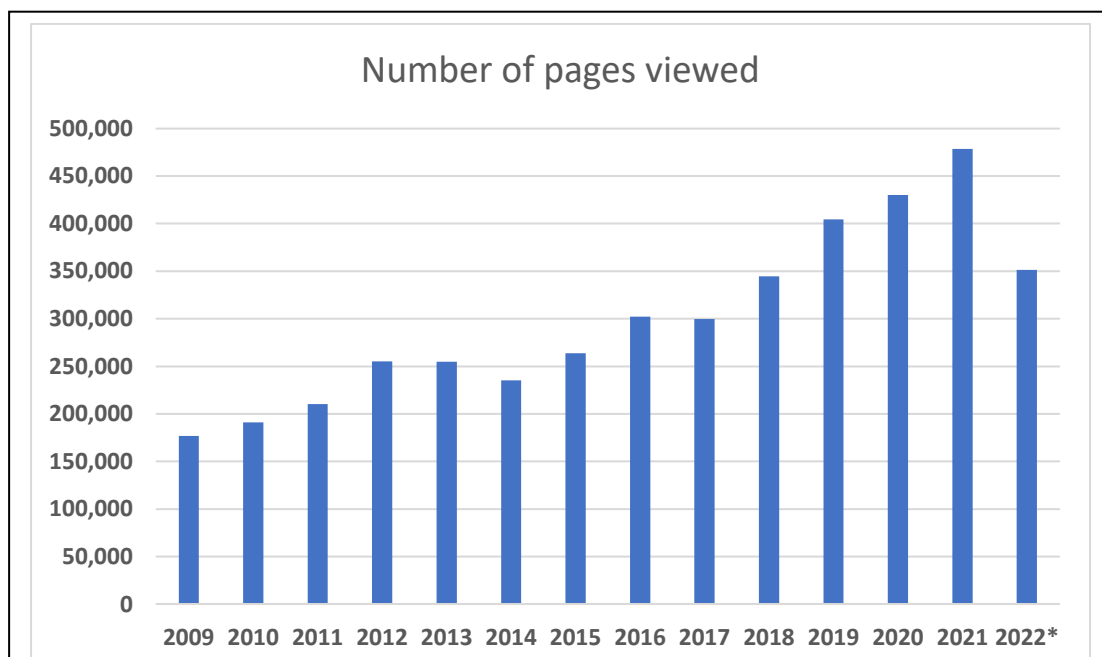
During the reporting period over 351,000 pages have been accessed on GEBCO’s web site. The image below shows the frequency of visits to the various areas of the web site.



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

Year	Number of pages viewed
2009	176,759
2010	191,037
2011	210,188
2012	255,241
2013	254,804
2014	235,273
2015	263,689
2016	302,252
2017	299,654
2018	344,657
2019	404,532
2020	430,198
2021	478,620
2022*	351,314

* Up to 30th September 2022



The figure above shows the number of visits to GEBCO’s web site per year since 2009. * Up to 30th September 2022

Number of visits to individual web pages

The following table details the number of visits to the ‘top 20’ most popular pages on GEBCO’s web site for the reporting period.

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 during 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* https://www.gebco.net/data_and_products/gridded_bathymetry_data/index.html	105,299	2:55
GEBCO home page https://www.gebco.net/index.html	92,953	1:00
Web Map Service (WMS) page https://www.gebco.net/data_and_products/gebco_web_services/web_map_service/index.html	26,909	1:57
GEBCO’s data and products https://www.gebco.net/data_and_products/index.html	11,217	0:31
Printable Maps https://www.gebco.net/data_and_products/printable_maps/	8,636	2:09
Arctic Ocean bathymetry (IBCAO)	6,672	1:56

https://www.gebco.net/data_and_products/gridded_bathymetry_data/arctic_ocean/index.html		
Undersea feature names https://www.gebco.net/data_and_products/undersea_feature_names/index.html	6,292	1:59
Seabed 2030 Project https://www.gebco.net/about_us/seabed2030_project/index.html	5,789	1:03
Training https://www.gebco.net/training/index.html	5,706	2:59
Information about the GEBCO_2019 Grid https://www.gebco.net//data_and_products/gridded_bathymetry_data/gebco_2019/gebco_2019_info.html	5,664	1:54
Information about the GEBCO_2021 Grid https://www.gebco.net//data_and_products/gridded_bathymetry_data/gebco_2021/index.html	4,784	2:10
Imagery index page https://www.gebco.net/data_and_products/imagery/index.html	4,119	0:55
International Bathymetric Chart of the Southern Ocean (IBCSO) https://www.gebco.net/data_and_products/gridded_bathymetry_data/southern_ocean/	3,485	1:22
GEBCO web services https://www.gebco.net/data_and_products/gebco_web_services/index.html	3,267	0:31
Information about the GEBCO_2020 Grid https://www.gebco.net//data_and_products/gridded_bathymetry_data/gebco_2020/index.html	3,232	2:08
GEBCO grid terms of use information https://www.gebco.net/data_and_products/gridded_bathymetry_data/gebco_2019/grid_terms_of_use.html	3,113	2:53
Historical GEBCO data sets https://www.gebco.net/data_and_products/historical_data_sets/index.html	3,002	1:51
Information on Polar grids https://www.gebco.net/data_and_products/gridded_bathymetry_data/polar_grids/index.html	2,728	0:32
Information on previous Web Map Services https://www.gebco.net/data_and_products/gebco_web_services/web_map_service/previous_wms.html	2,465	1:09
Contributing data https://www.gebco.net/about_us/contributing_data/	2,112	1:11

* 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
Sessions	The total number of visits to the site from this country/territory
Pages/session	The number of pages viewed per visit

Average time on site (minutes)	The average amount of time that visitors spent on the site
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Country/Territory	Sessions	Pages/session	Average time on site (minutes)
United States of America	30,235	1.9	1:28
China	17,554	2.19	2:05
United Kingdom	11,176	2.21	2:12
France	8,640	1.93	1:27
India	6,229	1.97	1:50
Indonesia	6,059	2.13	1:50
Canada	5,171	2.04	1:46
Japan	5,115	2.33	2:06
Germany	4,817	2.04	1:47
Spain	4,131	2.35	2:00
Italy	4,039	2.27	1:50
Australia	3,952	2.02	1:43
Russia	3,432	2.39	2:14
Brazil	3,080	2.12	2:03
Norway	2,728	2.19	1:56
Mexico	2,665	2.23	2:07
Netherlands	2,483	2.13	1:44
Philippines	2,237	1.99	1:59
South Korea	1,943	2.57	2:28
Turkey	1,769	2.28	1:50

The image below shows the geographic distribution of IP addresses accessing GEBCO's web site. The colour indicates the number of web site sessions for a particular country, from 1 (pale blue) to 30,235 (dark blue).

