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INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
(of UNESCO)

INTERNATIONAL HYDROGRAPHIC ORGANIZATION

General Bathymetric Chart of the Oceans (GEBCO)

Twenty-fifth Meeting of the Technical Sub-Committee on Ocean Mapping (formerly the Sub-Committee on Digital Bathymetry)

28th and 30th September 2009

at

Service Hydrographique et Océanographique de la Marine (SHOM), Brest, France

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1. OPENING OF THE MEETING

1. The Twenty-fifth Meeting of the joint IOC-IHO General Bathymetric Chart of the Oceans Technical Sub-Committee on Ocean Mapping (TSCOM XXV) was held at the Service Hydrologique et Océanographique de la Marine (SHOM), Brest, France on 28th and 30th September 2009.

2. Those present, in addition to Walter Smith, the Chairman, were Bob Anderson, Yannick Beaudoin[1], James Braud, Juan Brown, Etienne Cailliau, Norman Cherkis, Vincent Donato (Item 3.7, Day 2 only), Bruce Goleby, Robin Falconer, Jenifer Foulkes, Chris Fox, John Hall, Ben Hell (Day 2), Colin Jacobs, Martin Jakobsson (Day 2), Jiye Jin, Marie-Francoise Le Quentrec-Lalancette (Day 2), Shao Hua Lin, Karen Marks, Dave Monahan, Eric Moussat, George Newton, Tony Pharaoh, John von Rosenberg, Hans-Werner Schenke, Steve Shipman (Day 2), Hyo Hyun Sung, Shin Tani, Lisa Taylor, Gunnar Tietze (Day 1), Paola Travaglini, Nataliya Turko, Fabienne Vallée[2] (Day 1), Pauline Weatherall, Bob Whitmarsh, Rochelle Wigley and Kunio Yashima. The meeting was assisted by a team led by Henri Dolou, SHOM.

1.1 WELCOME

3 The attendees were welcomed by M. Henri Dolou, Head of Quality, Methods, Standardization and Management Control, on behalf of Dir Gén Gilles Bessero who was unable to be present.

1.2 LOGISTICS

4 The Chairman, Dr Smith, thanked M. Dolou for his welcome and for all the logistical support provided to set up the meeting. The meeting started at 09.11.

1.3 ADOPTION OF THE AGENDA

5. The Agenda (Annex 1) was adopted.

2. INTRODUCTIONS

6. The Chairman said that he would not make any distinction in the proceedings between Sub-Committee members, advisers to TSCOM or observers. The Chairman invited those present to consider the draft Agenda. M. Moussat noted that several relevant new projects were being planned or proposed in Europe, such as EMODNET, and they should consider working with GEBCO. It was agreed to take this item later.

7. The Chairman invited those present to introduce themselves.

3. ON-GOING ACTIVITIES

3.1 REPORT OF THE GEBCO DIGITAL ATLAS MANAGER

8. Ms Weatherall presented her report (Annex 2). She reviewed the status of GEBCO's data sets.

[1] UNEP/GRID-Arendal
[2] Science Park Brest Iroise

9. She said that a lot of new data had been received in the previous 16 months, for example 2888 files of depths from Canadian coastal waters and over 12,232 soundings from the South China Sea. A full list is available in Annex 2. She noted that GEBCO data remained in demand. They could now be accessed over the internet and with viewing software. Sales of the GDA continued at a high level and support had been provided to 168 users.

10. Regarding development work, Web Map Service now allowed access to a version of the GEBCO_08 grid.

11. Finally Ms Weatherall noted that BODC had taken over operation of the GEBCO web site in summer 2008. A growing number of hits was being recorded. News and Events pages had also been added and a page of FAQs was also being developed.

12. In answer to a question Ms Weatherall confirmed that other grids, such as IBCAO, could be incorporated into GEBCO. It was also suggested that GEBCO publicise its web site and the fact that the 1 arc.min GEBCO_08 grid was based entirely on soundings.

3.2 REPORT OF THE BATHYMETRIC EDITOR

13. Mr Jacobs presented his report (Annex 3). He outlined how source data are to be (eventually) stored on an Oracle database at BODC, with parameters and attributes likely to follow the model used by IBCAO. He noted that publication of the GEBCO_08 grid had in reality made the GEBCO 6th series redundant but it may be possible to investigate the costs of printing a 1:10M scale chart series of the GEBCO_08 grid. The grid had been updated with bathymetry provided by the Geological Survey of Ireland (GSI) and OLEX. Mr Jacobs reported that he had obtained data from three new sources, the Dutch Hydrographic Office, UK habitat mapping programmes and UK UNCLOS mapping programmes. Unfortunately some projects, e.g. SWIM (an EU-funded multibeam mapping project), are reluctant to provide their data.

14. Finally Mr Jacobs remarked that he had twice tried to contact the GEBCO scholars who said they wanted to be involved in the regional study groups but the response had been very disappointing. He also noted that, because of budget constraints, he had spent over half his time since the last GEBCO meeting working on non-GEBCO projects.

15. Dr Fox asked about how much work was involved in blending grids with the latest software. He guessed that it was too much work for Mr Jacobs alone and wondered whether others, such as regional experts, could help. Mr Jacobs replied, citing grid blending for the IBCAO as an example. The software 'predicted' bathymetry where there were gaps in the observations. He mentioned that Ms Weatherall had the resources and hardware to carry out the blending. In his experience there was very little feedback when maps or grids were sent out for review.

16. Dr Fox responded that the NGDC did a lot of gridding within US waters and it was unsatisfactory to duplicate work already being done elsewhere. He thought that it was a job for TSCOM to identify suitable software that could be used as the standard. The Chairman agreed, if that was the wish of the Guiding Committee, but it raised the problem of how to keep track of the latest version of the grid if the blending was carried out by multiple groups.

17. Ms Taylor asked how people could be encouraged to submit bathymetric data to the DCDB. She acknowledged that not everyone wanted the public to have immediate access to their multibeam data; a time delay might be required. She agreed to talk to Mr Jacobs [Action: Ms Taylor].

18. The Chairman asked whether there was a link between SCUFN and the DCDB that would allow GEBCO to capture the bathymetric information submitted with a proposed name. Ms Taylor

responded 'not yet' but added that there were plans to make it happen in 2009-10 although she was not yet ready to create a Working Group. Dr Schenke reported that SCUFN had already decided on a strategy that allowed coarser data than the original to be submitted to data editors. Most data were acceptable and included track control.

19. Dr Turko commented about making maps from the Grid_08 data set. She noted that no comments had been received from a group of experts set up in Russia.

3.3 REPORT OF THE IHO DATA CENTER FOR DIGITAL BATHYMETRY MANAGER

20. Ms Taylor presented her report [see Guiding Committee Annex 3].

21. Mr Jacobs asked why, if the GEBCO grid was used in ETOPO1, the reverse was not true. Ms Taylor replied that this could done in principle but the GEBCO grid was used on the GEBCO web site.

22. Dr Goleby (GeoScience Australia), asked whether the Gazetteer of Undersea Feature Names contained names from sources other than GEBCO. Ms Taylor replied that ACUF is represented at SCUFN meetings to ensure names were harmonised as much as possible and that SCUFN would welcome input from other sources too. Dr Schenke added that SCUFN has a small Working Group to harmonise names in specific areas (Antarctica, Europe).

23. The Chairman enquired about the future of ETOPO1 since it appeared that NGDC was developing products in parallel with GEBCO. Ms Taylor replied that NGDC wanted to enhance the GEBCO grid. When ETOPO1 was first developed it had little in common with the GEBCO grid but she was glad to see this changing. She didn't want NGDC to be in competition with GEBCO.

24. Dr Brown asked whether VDatum would be extended beyond US waters because it would be needed when incorporating shallow-water data. Both Ms Taylor and Dr Fox agreed that this was really a job for the IHO and its member states.

3.4 LETTER TO HYDROGRAPHIC OFFICES

25. Mr Pharaoh reported on progress with acquiring data from Hydrographic Offices. He recalled that he had drafted a Circular Letter to IHO Member States asking for data and concurrently he had also written to the 14 Regional Hydrographic Commissions. He had obtained data from SE Asia (South China Sea area). He had held back the Circular Letter from the remaining two RHCs until they had held their annual meetings. RHCs from which he had had replies include those covering areas off US/Canada, South Africa, E Asia and Central America and from the Caribbean Sea, Baltic Sea, Mediterranean Sea and Black Sea. Once all the RHCs had met he would summarise all the data received in the Circular Latter to be dispatched in November 2009.

26. He noted that in the feedback that he had received from the RHCs there was a lot of interest in GEBCO but also a lot of confusion over the relationship between GEBCO and Google. He stressed the importance of GEBCO communicating with the RHCs to keep up the flow of data [Action Chairman].

27. The Chairman said that he had heard that the SE Asia RHC had agreed to share its bathymetric data and asked whether GEBCO could expect to received this data without any restriction. Mr Pharaoh replied that the South China Sea data were not high-resolution; the chart was at a scale of 1:700,000. He hoped that similar data would be released in other RHC areas.

28. Dr Fox asked whether 'getting access' to data meant that it could be re-distributed by GEBCO. Mr Pharaoh said that this aspect had not always been considered by the data provider. The Chairman concluded that the main concern was whether GEBCO could use the data. He suggested that Mr Pharaoh should amend the draft letter to propose a number of choices or scenarios that the data providers could adopt and thanked him for his efforts to build bridges between GEBCO and the HOs.

3.5 GRID AND SID STATUS

29. Ms Weatherall stated that the GEBCO_08 grid had been released in January 2009. This 30 arc.sec grid contained Source Identifier (SID) metadata. In addition, in November 2008, version 2 of the 1 arc.min grid had been released. This included data from IBCAO v.2.23 and some shallow-water data as well. It showed which cells in the grid remained to be filled with a sounding.

3.6 NEWLY RELEASED ARCTIC DATA

30. Mr Newton reported [Annex 4] on his efforts to release bathymetry acquired by US submarines in the Arctic. He said his role had been to act as a facilitator. In the last 12-13 years the US Navy had agreed to declassify bathymetric data acquired by submarines between 1957 and 2000 including the SCICEX cruises. The latest request for data had been in 2006 for data acquired on 12 cruises in 1993-2000. It had taken two and a half years, because of financial constraints, and the available data were restricted to international waters. Mr Newton thanked Mr Cherkis for cleaning up the data which amounted to 12,500 soundings which had been passed on to GEBCO.

31. Mr Newton continued that he was now trying to obtain data collected in 2000-2005 which might become available in the next two years. He was also trying to impress the importance of bathymetry on the US Navy and to persuade them to collect more data. He reported that Dr Coakley was investigating fitting multibeam sonar on existing submarines. Finally Mr Newton noted that in the last few days the US Navy had announced that improvements in inertial navigation had led to the availability of more accurate tracks for the period 1993-2000.

32. The Chairman thanked Mr Newton for his sterling efforts on behalf of GEBCO.

3.7 REPORT ON IHO WORKING GROUP ON SHORELINES

33. Mr Donato (SHOM) reported on the activities of the IHO Working Group on shorelines. He began by remarking on the problem of defining the length of a shoreline. Because of its fractal nature its length could be described as infinite. He took the French coastline as an example. Wikipedia claimed the French coast was 3427 km long, SHOM claimed 5853 km and SHOM's latest 1:10,000 chart claimed 14,837 km of coastline. This was a serious problem because the EU fishing quota was a function of the length of coastline.

34. Mr Donato continued that the Working Group was set up at the 20th Committee on Hydrographic Requirements for Information Systems (CHRIS) in 2008 and he explained that he was the coordinator based in SHOM. The principle objective was to harmonize methods that could be used internationally for determining the coastline and to conclude with a written report.

35. The primary problem of the fractal nature of the coastline had been overcome. It had been decided purely for convenience to use the high-water mark, as seen on imagery, as the reference line. Questions remained about the user's needs, the scale of the image, which generalized method to

use, how to deal with dynamic coastlines, how to measure river mouths and how to include artificial structures.

36. Mr Donato concluded by saying that the Working Group had to be pragmatic. It was making progress working mainly by email.

37. Mr von Rosenberg commented that the NGA continued to provide on-line initial estimates of the shoreline estimated from Landsat 10-30 m pixels but this left 10% of the coastline with gaps. The NGA also used the high-water mark, at the 100,000 scale although some preferred 25,000 scale.

38. The discussion that followed raised questions about the resolution of the shoreline, how the high-water mark was related to the z=0 datum and the definitions of shoreline and coastline. Ms Foulkes (Google) said that Google had obtained a digital shoreline but she didn't know whether it was based on high-water or low-water marks.

39. The Chairman thanked Mr Donato for his very instructive briefing.

3.8 LIAISON WITH EAST ASIAN REGIONAL HYDROGRAPHIC COMMISSION

40. See paragraph 3.4.

3.9 REMARKS FROM GOOGLE

41. Ms Foulkes of Google spoke about the use of bathymetry in Google Ocean. She noted that there were over 500 million users of Google Earth who communicated in over 40 different languages. Bathymetry, which was one of 20 layers of content, had been added in February 2009 with the help of about 100 partners. The motivation behind this step had been public benefit and not profit. She said that the problem now was to continuously improve what she described as 'the canvas' and she sought feedback to help with this objective.

42. Technically the current bathymetry embeds high resolution grids and not raw swath bathymetry. More gridded data are welcome but Google would like to obtain them from a single source to reduce Google's workload. Sources would always be attributed and acknowledgment given on each image. Google would be happy to make use of the GEBCO Gazetteer too.

43. Ms Foulkes continued that current layers include photos and videos. Data were also displayed in near real-time from certain buoys. So far sea-floor imagery, such as back-scatter, had not been used although potentially a resolution of 2 cm was feasible. Eventually Google wanted to expand beyond US waters and include data about coral reef watch, for example.

44. Dr Schenke said he had spotted some undersea feature names on the Google images and wondered where they came from. Ms Foulkes replied that all names had come from either NGA or ACUF.

45. In reply to Mr Jacobs, Ms Foulkes stated that the base bathymetry was Smith & Sandwell v. 7.0. He continued that Irish colleagues had asked him why GEBCO data was not shown on Google. Ms Foulkes replied that the GEBCO attribution was a mistake before she was in charge of Google bathymetry. The Chairman noted that there had been a lot of confusion in the lead up to the launch in February to do with the inclusion of ENC data from many sources. Mr Jacobs pointed out that GEBCO updates had been included in Dave Sandwell's latest version.

46. Ms Foulkes stated that Google can update the whole grid only once a year, because it takes so long, but it can patch in high-resolution grids more frequently. Dr Brown replied that the GEBCO and Google updates ought to be synchronised. Ms Taylor expressed the view that coordination should include the IHO and BODC too to avoid dissipation of effort.

47. Mr Cherkis asked about adding GLORIA sidescan images from the mid-1970s surveys for the USGS of the US EEZs. Dr Fox concurred and stated that NGDC was trying to recover these images and noted that these data might be important to fill gaps. Ms Foulkes said she was happy to be guided by the experts.

48. Dr Falconer wondered whether Google found that working with GEBCO was like working with other NGOs. Ms Foulkes replied affirmatively saying that there were tools to help US NGOs to load data into Google. There were also funds available on application for software development and outreach by not-for-profit organisations and educational institutions like GEBCO.

49. Ms Foulkes concluded by asking what was the best route for Google to keep on improving bathymetry and whether there were features that should be added to be more useful or helpful to users. The Chairman proposed to return to these topics later (see paragraph 4.7).

4. FUTURE PROJECTS

4.1 WORKING GROUP ON METADATA

50. The Chairman stated that the goal of the Metadata Working Group, led by Mr Pharaoh, was to enable GEBCO to manage its data without setting standards that are too high. Mr Pharaoh responded by saying that data in different centres were organised to different standards. In some cases the standards were very obtuse so GEBCO needed to develop a relatively simple product specification. The Chairman replied that the principal aims should be: 1, to enable GEBCO to automatically discover and ingest new data through the internet; 2, to enable GEBCO to better manage its internal data processing (for example, by tracking quality/control efforts and deconflicting decisions), and 3, to enable GEBCO products to be automatically discovered by end users who search the internet.

51. It was agreed that the other working group members would be M. Moussat, Mr Hell, Ms Weatherall, Ms Travaglini, Dr Goleby, someone from NGDC and someone from the Hydrographic and Oceanographic Department, Japan Coast Guard. Any draft report was to be circulated more widely for feedback before it was published [Action Mr Pharaoh].

52. The Working Group met informally the same day after the TSCOM meeting.

4.2 COOKBOOK WORKING GROUP

53. The Cookbook Working Group, led by Dr Jakobsson, is tasked with writing a ‘cookbook’ to nurture and guide nascent regional mapping projects. Its purpose might also be to remind GEBCO as a whole of the technical mechanisms used to produce its grids. It might be helpful to include numerical experiments comparing different methods such as interpolation schemes and testing. It was agreed that members would include Mr Hell, Ms Wigley, Ms Weatherall, Mme. Le Quentrec-Lalancette , Mr Braud and someone from NGDC and someone from LDEO [Action: Chairman to contact LDEO].

54. The Working Group met informally the same day after the TSCOM meeting.

4.3 CITATION OF GEBCO PRODUCTS

55. This item was referred to the Guiding Committee.

4.4 FUTURE GRIDS

56. It was noted that the on-going efforts to update the grid are working well. A dialog has begun with Google to harmonize the GEBCO and Google update schedules. The Cookbook Working Group will investigate best practices for updates. Therefore the Chairman suggested that this topic was well in hand.

4.5 INTERPOLATION SCHEMES

57. This item was delegated to the Cookbook Working Group.

4.6 FEEDBACK FROM THE SCIENCE DAY

58. Mr Jacobs wondered how Mediterranean multibeam data could be downloaded from the Ifremer data portal. Dr Marks noted that each bathymetric portal was independent of the others and this was liable to be a problem.

59. Dr Jakobsson had liked the talk on gridding algorithms that incorporated statistics.

60. Dr Falconer had been intrigued by the talk on Olex which had shown a good example of 'going forward' by 'going back' and graphically demonstrated the value of even single-sounding data. A company in New Zealand had adopted the same approach as Olex with soundings down to 2000m. Mr Tani concurred and noted that shallow-water soundings from fishermen were far better than 'depths' computed from satellite bathymetry.

61. Dr Fox said that he had hoped that Google would prove to be a scientific tool but he now realised its huge capacity for outreach. He added that Google needed to be aware that the GEBCO grid was best for 'background' bathymetry. Mr Braud agreed. He also noted that Dr Jakobsson's talk had shown the need for expert skills to provide Google with a coherent grid. He added that he liked the talk on a high-resolution geoid because it showed how satellite altimetry can be improved.

62. Mr Beaudoin offered to coordinate outreach on behalf of GEBCO.

63. Ms Taylor referred to a comparison of the GEBCO and ETOPO1 grids. She pointed out that a whole data report had been written on this plus a full internet page (http://www.gebco.net/about_us/gebco_science_day/documents/poster_analysis_of_bathy_data.pdf). She considered it more productive to look forward to how to achieve the best global grid. Other issues were data availability and the restrictions placed on some data whereas GEBCO wanted open availability and unrestricted use of data. The Chairman cautioned that these were policy issues and all that GEBCO could hope for was to create the best grid from public sources. Ms Taylor countered that even so, to obtain the most accurate global grid, there was a need for better communications between groups working on similar topics. Dr Brown noted that GEBCO's objective is to deliver a publicly available grid, irrespective of the sources used, so that proprietary data can be included.

64. Dr Fox said that in the USA there was always an underlying copyright problem. He thought there was a need for bathymetry and satellite altimetry 'depths' to converge. The Chairman replied that

attempts to merge the two data sets had been going on since 2004. Copyright had caused problems. For example, the University of California was claiming copyright but this might not be valid and may have to be challenged in law but this was for the Guiding Committee to consider.

65. The Chairman asked whether it was inevitable that similar products were developed in parallel or whether the community should aim for a single product. Dr Fox replied that at NGDC they had combined ocean (GEBCO) and land grids to provide the best global DTM. Ms Taylor recalled that when ETOPO2 was upgraded to ETOPO1 there were two issues; first, they had wanted to improve the Smith & Sandwell altimetry, by including grids such as IBCAO, but it had been copyright protected and so this hadn't been done. She said that she didn't want to see competing grids that were more or less the same; it was more important to learn from the past and move on.

66. M. Moussat said that the concept of a 'best' grid depended on the application and different standards might need to be applied to global and regional grids, for example. GEBCO might need to supply a grid that would meet the requirements of the user.

67. Dr Falconer noted that the GEBCO_08 grid had been updated and merged with the IBCAO grid. He asked what would happen if more data became available. Where was the technical capability to carry out a further upgrade? Ms Weatherall said that a mechanism existed. Dr Fox then asked what was the best way to deliver data to Ms Weatherall and could a *pro forma* method be announced on the GEBCO website?

68. The Chairman objected that this would lead to a 'patchwork quilt' approach which would encounter edge matching problems; he thought that what was needed was a more sophisticated approach of re-building each version of the grid from the source data. Dr Falconer responded that there was still no standard patch working software and enquired what TSCOM was going to do about it. Ms Taylor noted that patch working was what Google did; she thought that GEBCO should set higher standards. For example, GEBCO could work with the data provider to use a sub-set of the data if the edges were badly interpolated. In her opinion it was a misuse of resources to re-work the original data. Dr Jakobsson said that in his view GEBCO should be pragmatic and flexible in its approach although there was a need to discuss how edge-matching should be standardised.

69. The Chairman said that arguing the pros and cons of satellite and non-satellite altimetry depths was unhelpful. He thought that one way forward was to create a grid of uncertainty estimates. There was no doubt that GEBCO needed to keep adding data to its grid.

70. Dr Jakobsson remarked that this was a good forum to brainstorm the technical aspects of updating grids. For example, he would like to understand the gridding algorithms used to create the Smith & Sandwell grid. The Chairman concurred saying such a discussion might provide TSCOM with clarity on what it was going to do in the next year. M. Moussat noted that the EU project EMODNET, in which he was involved, faced the same problem. They were adopting a basic set of rules which equally could be applied to the GEBCO grid. Ms Taylor agreed that TSCOM needed to concentrate on the most urgent technical issues at the heart of improving the GEBCO grid.

4.7 RELATIONSHIP WITH GOOGLE

71. Ms Foulkes said that Google wanted guidance on how to obtain the highest-resolution bathymetry. She noted that Google was also in contact with other groups such as the GeoMapApp group at Lamont-Doherty Earth Observatory and NGDC although mostly for regional purposes. At present Google used the global Smith & Sandwell bathymetry but it wanted to be able to patch in high-resolution grids too.

72. The Chairman commented that if one took a 30 arc.sec grid as the base map it would not necessarily match any subsequent high-resolution patches. However GEBCO had agreed some time ago that the 1 arc.min grid would continue as a global, albeit low-resolution, product. He asked how often Google intended to update the GEBCO base grid.

73. Ms Foulkes replied that Google wished to do this annually with a 're-blending' of the high-resolution grids each time. The Chairman wondered whether Google and GEBCO could work better at the technical level to reduce the work involved.

74. Dr Jakobsson responded that the IBCAO had lots of high-resolution grids which could go to Google. There was always a lag before such grids were put in the public domain because clearance was required. The Chairman objected that if all such high-resolution grids went directly to Google then GEBCO would lose out. Ms Taylor agreed; she said that it made more sense for GEBCO to get the high-resolution grids first because Google didn't want to have to deal with multibeam data. She recommended that GEBCO work much more closely with LDEO.

75. Dr Falconer asked whether Google preferred to receive regular patches from GEBCO or to work with the individuals providing the data? Ms Foulkes replied the LDEO provide regular patches already and she preferred that approach. She preferred to work with a single source who represented the experts in the field. Dr Fox commented that NGDC already works closely with LDEO who also want to be involved with GEBCO.

76. The Chairman asked if Google would be happy to use GEBCO as a 'one-stop shop' for bathymetry. Ms Foulkes responded that she would need to talk to all three parties LDEO, NGDC and GEBCO. In the longer-term GEBCO could be such a point of contact but she would want to know how quickly GEBCO could provide data.

77. The Chairman added that GEBCO likes to add value to datasets it obtains. He noted that LDEO doesn't correct the low-resolution base map, they just add in high-resolution grids.

78. In answer to a question, Ms Foulkes said that Google wanted to display sidescan images, and even photos, to show shipwrecks.

79. Finally Ms Foulkes summarised that she was looking for guidance on bathymetry and that she would be happy to adopt names from the GEBCO Gazetteer if they were 'better' than NGA/ACUF.

80. Dr Schenke responded that Google really ought to use a single source for feature names otherwise some feature positions might vary with the source used. He said that SCUFN was preparing shape files for features in the Gazetteer which would be ready in about six months time. Ms Foulkes responded that Google was unable to harmonise features from different sources. She foresaw that if a 'huge number' of polygons was involved this could potentially cause a 'traffic-load' problem. She thought that feature names would have to be treated as an extra layer. Dr Schenke emphasised that SCUFN was the worldwide expert group on naming undersea features. Ms Taylor proposed that SCUFN could help Google by providing more than one geometry, one being simpler, for some features.

81. The Chairman summarised by saying that GEBCO would continue to update the global 30 arc.sec grid but also at the same time it would work with Google over how to ingest regional high-resolution grids. Exactly how this was done technically would have to be addressed later. It was also agreed that GEBCO would provide feature names to Google.

82. Dr Falconer concluded that the Guiding Committee needed to formally re-state how GEBCO was to work with Google in future [Action Guiding Committee].

5. ANY OTHER BUSINESS

83. The Chairman invited comments on future projects.

84. Dr Marks remarked that there had been no discussion of predicted bathymetry which was a very important part of the GEBCO product.

85. Ms Taylor repeated her assertion that better understanding is needed of how conceptually the GEBCO grid is being improved. Prof Monahan said the Guiding Committee also needed to know.

86. Ms Weatherall replied that BODC has all the source data used to create the GEBCO grid plus the algorithms that were used. Dr Fox asked how new data were added. Mr Braun objected that TSCOM was starting to go over the same ground as had been covered in Tokyo in 2008. The Chairman agreed that the way to avoid this was for a 'Cookbook' to be written.

87. Dr Jakobsson opined that TSCOM should be talking about technical issues at different levels, for example, how to handle the vertical datum in Olex data. He continued that, in most cases of deep water bathymetry, the tidal datum is not an issue.

88. Mr Jacobs said he thought that TSCOM should focus its attention on particular problems. For example, a 30 arc.sec grid was available over the poles and GEBCO should aim to fill the gap between there and lower latitudes with its best data.

89. The Chairman summarised the options for how it should work as follows; TSCOM 1) discusses some exciting technical issues, 2) just accepts all data offered and works on processing it, 3) goes out and acquires source data or 4) continues to discuss the subject every year.

5.1 SEAWORLD EXPO

90. Dr Tietze (GeoTopic Hydrographic Services, Germany) described the World Exhibition that would take place in Shanghai in 2010 from 1st May for six months. It would be planned around the theme of urbanism. The Exhibition would then move to Korea in 2012. He said that he wanted to create a Sea World Exhibition or Expo within the main event in which there would be displays on transport, climate change, Law of the Sea, security, safety etc. in a maritime pavilion. This idea, in which the port city of Brest was already involved, had been favoured by the Organising Committee. He regretted that time was short to plan exhibits. No one government was behind the idea, it would be a truly international project (although it appeared that the IHO was not involved). He introduced Mme Vallée who is acting as the Co-ordinator with the Chinese Organising Committee. He requested that the Chairman of GEBCO should write a letter of support and that the GEBCO email list could be used to advertise the idea. Above all, the idea needed support from a broad community to tell the general public about the oceans [Action Chairman GEBCO].

91. Dr Hall commented that this might be an opportunity to upgrade the World Map. Dr Falconer stressed that time was very short and asked what physical facilities were being offered. Dr Tietze replied that space was being donated freely by the Organising Committee and that there were few constraints but funding would have to be found from sponsors. Dr Schenke suggested a poster exhibition.

5.2 NEW DIGITAL ELEVATION MODEL

92. The Chairman initiated a short discussion of a new digital elevation model (DEM) which he said was better than SRTM products and wondered whether it should be included above 60° latitude in the next GEBCO grid. Dr Fox interjected that this was really a task for GEO which was putting together a global grid of the land. He was going to the 6th Plenary Session of GEO in Washington DC and suggested that it would be good for GEBCO to form a partnership with GEO. The Chairman agreed that this could lead to a better grid.

6. CLOSURE OF THE MEETING

93. The Chairman thanked the SHOM hosts of the meeting for their excellent logistical arrangements. There being no other business the Chairman closed the meeting at 14.37.

ANNEX 1

Twenty-fifth Meeting of the GEBCO Technical Sub-Committee on Ocean Mapping at Service Hydrographique et Océanographique de la Marine (SHOM) in Brest, France, 28 and 30 September 2009

AGENDA

1. Opening the meeting
1.1 Welcome remarks from SHOM
1.2 Logistics
1.3 Adoption of the agenda

2. Introductions

3. On-going activities. What have we been doing?
3.1 Report of the GDA Manager (Weatherall)
3.2 Report of the Bathymetric Editor (Jacobs)
3.3 Report of the IHO DCDB Director (Taylor)
3.4 Report on the status of the letter to HOs drafted at meeting XXIV (Pharaoh)
3.5 Grid and SID status, and web-enabling (Weatherall)
3.6 Report on newly released Arctic data (Newton)
3.7 Report on IHO WG on shorelines (Donato)
3.8 Liaison with East Asian Hydrographic Commission, and other regional efforts
3.9 Remarks from Google (Foulkes)

4. Future projects
Where do we want to go? What do we need to do to get there?
4.1 WG on Metadata (Pharaoh)
4.2 WG to write a "cookbook" for how to build a regional bathy model
4.3 DOIs and ISI citation of GEBCO work products
4.4 The way forward for grids (single or multi-scale) and the GDA
4.5 Interpolation schemes, and how to test them
4.6 Any reactions/responses to things learned at Science Day
4.7 Relationship with Google (Foulkes)
4.8 EMODNET (Moussat)

5. Any other business

6. Closure of the meeting

ANNEX 2

Report of the GEBCO Digital Atlas Manager (June 2008 – September 2009)

This report covers the work carried out at the British Oceanographic Data Centre (BODC) for GEBCO since the previous GEBCO meetings in May 2008.

GEBCO's gridded bathymetric data sets

GEBCO released its first bathymetric grid in 2003, the GEBCO One Minute Grid, a global one-arc interval grid based largely on the bathymetric contours in the GEBCO Digital Atlas (GDA) and using data from the Global Land One-kilometre Base Elevation (GLOBE) data set for land areas. This data set has proved very useful to a wide range of users. However, due to nature of its source material there were limitations in some regions, such as the Pacific Ocean, where the grid is based on bathymetric contours at 500m intervals, largely digitised from charts at a scale of 1:10 million.

In 2008 GEBCO 'adopted' a 30 arc-second interval grid, developed by a number of agencies, as its latest gridded bathymetric data set. The grid is based on a database of ship-track bathymetric soundings with interpolation between soundings guided by satellite-derived gravity data. Data for land areas are taken from the US National Aeronautics and Space Administration (NASA) Shuttle Radar Topography Mission (SRTM30) data set.

The 30 arc-second grid was released as a GEBCO product (the GEBCO_08 Grid) via the Internet in January 2009. The data set is made available alongside the GEBCO One Minute Grid.

Through correspondence between GEBCO colleagues and Google, the GEBCO_08 Grid was made available to Google for use as a base layer in Google Earth.

Further information concerning the distribution and requests for use of GEBCO's data sets and products can be found in Appendix I of this report.

Release of the GEBCO_08 Grid

Updates included in version 20090129 of the GEBCO_08 Grid – released in January 2009:

1. Gridded bathymetry data for Irish designated waters, based on multi-beam surveys, provided by the Geological Survey of Ireland (GSI).
2. 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, Norway.

This update work was carried out by Colin Jacobs.

Further update work has been done to include version 2.23 of the International Bathymetric Chart of the Arctic Ocean (IBCAO) at 30 arc-second intervals. The data file was provided to GEBCO, on behalf of the IBCAO, by Prof. Martin Jakobsson.
The data set has been incorporated into the GEBCO_08 Grid using a blending algorithm (grdblend) from the Generic Mapping Tools (GMT) software system.

A copy of the source sounding data used to develop the 30 arc-second grid is now located at BODC. It is planned that this will be used, in conjunction with satellite-derived gravity data and gridding algorithms to update the grid in the future.

Information on data sets received for updating GEBCO's grids is given below.

In September 2009, Colin Jacobs and I visited Martin Jakobsson at Stockholm University to find out more about data storage, visualisation and quality control work done for the IBCAO project.

Source Identifier Grid (SID) Grid

The GEBCO_08 Grid is accompanied by a 'source identifier' or 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 or which cells contain predicted depth values.

The grid will be released shortly via the Internet. Initially, this will be in the form of a 'yes/no' file, i.e. a grid cell will be labelled as either '1' or '0' depending on if it is based on sounding data or interpolated from satellite-derived gravity data.

It is planned that metadata, for example to identify particular data sets and/or data contributors, will be linked to SID file grid cells.

As an example, metadata for the SID file (grid cells referenced by an identification number/key) could be made accessible in Extensible Markup Language **(**XML) via the Internet. The following example links to metadata, 'made up' for this example, linked by reference ID '1'.

Example of how metadata for the SID grid could be made available via the Internet:

http://vocab.ndg.nerc.ac.uk/term/GGS1/current/1

In the above example, the UK Natural Environment Research Council (NERC) DataGrid project vocabulary server system is used to make the metadata available.

The metadata information is separated into 'sub-fields' separated by tags which would allow the metadata to be parsed by client software.

Release of an updated version of the GEBCO One Minute Grid

As reported previously, work has been done on updating the GEBCO One Minute Grid. A revised version of the data set was released in November 2008. This update includes:

- Version 2.23 of the International Bathymetric Chart of the Arctic Ocean
- Shallow water bathymetry updates (from the ENC data extraction project) for:
  waters around India and Pakistan
  waters around the Korean Peninsula
  waters around South Africa
- Updates for some reported bug fixes in version 1.0 of the GEBCO One Minute Grid

It is not currently proposed that any further updates are carried out on the GEBCO One Minute Grid.

Bathymetric data sets received for updating GEBCO's data sets

The following lists the data sets supplied to GEBCO, since the last meeting, for updating its data sets and products.

Data set	Data set supplier/originator	Status
Gridded bathymetry data for Irish designated waters in the North Atlantic Ocean (within a polygon defined by 25°W-6°W; 46° 50'N - 57° 30'N). The grid is at 0.002 degree spacing and was generated from a number of multi-beam surveys carried out between 2000 and 2007.	Data passed to BODC, for use by GEBCO, by Colin Jacobs on behalf of the Geological Survey of Ireland.	Included in GEBCO_08 Grid.
Bathymetry data from the Olex system - collected by a number of fishing vessels using the ship's echo-sounder. The data set is mainly in shallower water areas and mainly in Northwest European Continental Shelf regions but there are data for other areas world-wide. The data set consists of an ASCII file of latitude, longitude and depth values. The data point represents the depth value of a 450m square tile located at that point. Data for shallow water regions of the NW European Continental Shelf have been included in the GEBCO_08 Grid.	Data passed to BODC, for use by GEBCO, by Colin Jacobs on behalf of Olex AS, Norway.	Part of the data set has been included in the GEBCO_08 Grid. Data passed for use in IBCAO.
One arc-minute interval grid of version 2.23 of the International	Martin Jakobsson (on behalf of IBCAO)	Included in GEBCO One

Bathymetric Chart of the Arctic Ocean (IBCAO).		Minute Grid.
30 arc-second interval version of the bathymetric grid for the International Bathymetric Chart of the Arctic Ocean (IBCAO) version 2.23.	Martin Jakobsson (on behalf of IBCAO)	Included in GEBCO_08 Grid north of 64ºN (to be released)
Bathymetric grids for coastal waters off Canada (between approximately 140°W-50°W). The data are from cruises of the Canadian Coast Guard ship (CCGS) Amundsen and other platforms The data set consists of 2,248 files. Each file covering 15' of latitude and 30' of longitude. The data are gridded at a resolution of 10 metres. The grid files are supplied as IEEE floating-point format 32-bit signed binary files.	Jonathan Beaudoin of the University of New Brunswick. Thanks to Ms Paola Travaglini for facilitating the release of the data set.	To be included in GEBCO_08 Grid (data passed to IBCAO project)
Bathymetry data for the Pacific-Cocos Nazca Triple Junction area of the Pacific Ocean, in the region enclosed by a box of approximate geographic co-ordinates: 125°W-115°W; 5°S - 3°N. The data set consists of a grid and transit leg data .The bathymetry data are from the cruise SO180 with SONNE from Tahiti to Valparaiso, Chile. The data have been processed and gridded to a 100m x 100m grid.	The data are made available by the IFM-GEOMAR Leibniz-Institut fur Meereswissenschaften an der Universitat Kiel, Germany. Thanks to Dr. John Hall for providing the link for access to this data set.	To be included
Shallow water bathymetry data, in the form of bathymetric contours, sounding points, coastline and quality of data information, for the South China Sea region (102°E-122°E; 5°S-25.5°N). The data have been extracted from Electronic Navigation Charts (ENCs).	Data passed to BODC by Tony Pharaoh (IHB) on behalf of the East Asia Hydrographic Commission.	To be included
Ship track bathymetry data - South Atlantic Ocean off Brazil	Cmdr. Izabel King Jeck (Centre of Hydrography, Brazilian Navy).	To be included
A collection of bathymetric data sets covering a range of geographic areas – discovered through searching the Internet	Tony Pharaoh, IHB	To be included
Bathymetric grid at 30 arc-second intervals for the Weddell Sea region	Dorothea Graffe, Alfred Wegener Institute (AWI), Germany	To be included

Bathymetric grid for the area around the Antarctic Peninsula	Michele Rebesco, Osservatorio Geofisico Sperimentale (OGS), Italy	To be included

Making GEBCO's data sets available

GEBCO's bathymetric data sets are made available by BODC via the Internet and on DVD.

Internet access

The Internet application for delivering GEBCO's gridded data has been updated, by Dr. Ray Cramer at BODC, in order to deliver both the GEBCO One Minute Grid and GEBCO_08 Grid.

Through this application, the user can select to download the complete global grid file(s) or select an area, from either grid, via an interactive map or by defining geographic co-ordinates in a dialog box.

The user can also overlay the Source Identifier (SID) Grid on the GEBCO_08 Grid. The SID grid will also be available to download shortly.

The application can be accessed from:

http://www.gebco.net/data_and_products/gridded_bathymetry_data/
https://www.bodc.ac.uk/data/online_delivery/gebco/

Since its release on 29th January 2009, there have been 1,019 downloads of the complete GEBCO_08 Grid and 1,982 downloads of user-defined subsets of this data set.

Since 1st June 2008 there have been 3,265 downloads of the complete GEBCO One Minute Grid and 2,853 downloads of users-defined subsets of this data set.

Further statistics detailing access to GEBCO's gridded data sets from the Internet can be found in Appendix I of this report.

Grid viewing software

Free software is available from the Internet for viewing and accessing data from the GEBCO's gridded data sets, this is a 'cut-down' version of the GDA software interface. Since its release in January 2007, there have been over 5,300 downloads of the software.

The software was updated, by Ray Cramer, in February and April 2009 to allow users to view and access data from the GEBCO_08 Grid as well as the GEBCO One Minute Grid. A further data export option was included to allow users to export data in an ASCII form suitable for conversion to an ESRI raster file.

Sine 1st June 2008 there have been 3,135 downloads on the software.

The software can be accessed from the following links:

http://www.gebco.net/data_and_products/grid_display_software/
http://www.bodc.ac.uk/products/software_products/gebco_grid_display/

Further statistics about downloads of the software can be found in Appendix I of this report.

GEBCO Digital Atlas (GDA)

The GEBCO Digital Atlas is a collection of GEBCO's digital bathymetric data sets. The data sets can be viewed and accessed through a software interface.

The GDA is now available on DVD and includes both gridded data sets and revised software interface.

The GDA Software Interface has been updated to allow access to both the GEBCO_08 Grid and GEBCO One Minute Grid and to include an option to export the data in a simple ASCII form for conversion to an ESRI raster.

The software interface is available to download from the web:

http://www.gebco.net/data_and_products/gebco_digital_atlas/
http://www.bodc.ac.uk/help_and_hints/software_updates/gebco.html

Since June 2008, 182 copies of the GDA have been distributed. This includes 94 commercial sales and complimentary copies supplied to training courses, e.g. 10 copies supplied to a Partnership for Observation of the Global Oceans (POGO) training in marine data management course.

Since the launch of the Centenary Edition of the GDA CDROM in 2003, 1,381 copies of the data set have been distributed.

The royalties owed to GEBCO from the sale of the GDA for 2008 amounted to £8,216. Since the launch of the Centenary Edition of the GDA in 2003, royalties have amounted to £57,152.

Further statistics about the distribution of the GDA can be found in Appendix I of this report.

Data set user support

We have dealt with 168 email enquiries concerning GEBCO's data sets and products since June 2008. A number of these enquiries include requests for use of GEBCO's data sets in commercial products or to reproduce imagery from the GEBCO world map.

Further information concerning some of these requests can be found in Appendix I.

Data delivery development work: CF compliant netCDF and web services for the GEBCO_08 Grid

Creating a version of the GEBCO_08 Grid using climate and forecast (CF) metadata conventions

In order to assist users to compare and contrast data sets from different sources it is important that terms used to describe the contents of data sets are defined. This is equally important to allow software tools to be able to 'understand' the contents of data sets and to be able to display data and perform operations on specified subsets of the data with little human intervention.

The CF conventions for climate and forecast metadata (http://cf-pcmdi.llnl.gov/) have been designed to promote the processing and sharing of netCDF files. The conventions define metadata that provide a description of what the data in each variable represents, and their spatial properties.

The CF conventions have been adopted by a number of projects and groups. This convention is designed to be backward compatible with the Cooperative Ocean/Atmosphere Research Data Service (COARDS) conventions.

One of the requirements of the CF conventions is to use a 'standard name' to define the data set variables. A list of standard names is provided.

http://cf-pcmdi.llnl.gov/documents/cf-standard-names/

Work has been done at BODC, by Mr. Steve Loch, to create a CF compliant netCDF version of the GEBCO_08 Grid.

Sample metadata from this draft cf-netCDF data set is coded as follows:

```
netcdf gebco30 {
dimensions:
        lat = 21600 ;
        lon = 43200 ;
variables:
        int crs ;
                crs:grid_mapping_name = "latitude-longitude" ;
                crs:longitude_of_prime_meridian = 0. ;
                crs:semi_major_axis = 6378137. ;
                crs:inverse_flattening = 298.257223563 ;
        short depth(lat, lon) ;
                depth:standard_name = "sea_floor_depth_below_sea_level" ;
                depth:long_name = "Elevation relative to sealevel" ;
                depth:units = "m" ;
                depth:scale_factor = 1. ;
                depth:add_offset = 0. ;
        double lat(lat) ;
```

```
            lat:long_name = "latitude" ;
            lat:units = "degrees_north" ;
            lat:actual_range = -90., 90. ;
      double lon(lon) ;
            lon:long_name = "longitude" ;
            lon:units = "degrees_east" ;
            lon:actual_range = -180., 180. ;

// global attributes:
            :Conventions = "CF-1.4" ;
            :title = "GEBCO_08 Grid" ;
            :institution = "BODC on behalf of GEBCO" ;
            :source = " " ;
            :history = "Created on 2009 02 02" ;
            :references = "GEBCO_08 Grid, version 20090202, www.gebco.net" ;
            :comment = "The data in the GEBCO_08 Grid should not be used for navigation
or any purpose relating to safety at sea." ;
            :node_offset = 1 ;
}
```

Creating a Web Map Service (WMS) for the GEBCO_08 Grid

A Web Map Service (WMS) is a mechanism for making georeferenced map images accessible over the Internet. The specification was developed by the Open Geospatial Consortium (OGC).

The WMS can be accessed by a number of client servers such as Geographic Information System (GIS) and other mapping/display packages.

In a way, a WMS can be said to enable ‘data mash-up’, i.e. allowing users to bring together a variety of different types of data sets from a number of sources to be visualized spatially and compared.

I have been investigating the use of MapServer software, to create a WMS for the GEBCO_08 Grid. I am grateful for help and feedback with this work from Mr. John Cartwright of the US National Geophysical Data Center (NDGC).

The demonstration version of the WMS can be accessed from the following links:

1. GetCapabilities request, returns an XML format file with information about the available layers and WMS parameters, such as geographic coverage and supported datums (you may be asked to save this information in a file before it can be accessed).

http://www.gebco.net/data_and_products/web_map_service/mapserv?request=getcapabilities&service=wms&version=1.1.1

2. GetMap request, returns a map file using parameters provided by the user:

http://www.gebco.net/data_and_products/web_map_service/mapserv?request=getmap&service=wms&BBOX=-180,-90,180,90&srs=EPSG:4326&format=image/jpeg&layers=gebco_grid&width=900&height=750&version=1.1.1

Hosting a Nippon Foundation/ GEBCO student work placement

I was pleased to have the opportunity to work with Ms. Christina Lacerda during her two-week placement at BODC during July 2009. Christina is working on a proposed International Bathymetric Chart of the South Western Atlantic (IBCSWA) project.

Gebco's web site

GEBCO's new-look web site was launched in July 2008 at the domain www.gebco.net. The web site is maintained and updated at BODC.

Throughout the year, the web page content has been updated to reflect the release of new data sets and/or on request for content update by GEBCO colleagues.

In addition, new pages are in development for the 'General interest' section with details on 'Frequently Asked Questions' (FAQs) about GEBCO and its data sets and products. This page content has been provided by Colin Jacobs. A web page is in development concerning the work done with GEBCO colleagues to extract shallow water bathymetry data from Electronic Navigation Charts (ENCs).

The 'news and events' web pages (http://www.gebco.net/about_us/news_and_events/) have been kept updated with information on data set and software releases. Users can be kept informed about the release of news items via a Really Simple Syndication (RSS) feed.

Since its launch in July 2008, there have been over 51,000 visitors to the site, viewing over 167,000 pages. Further statistics concerning access to GEBCO's web site can be found in Appendix II.

Pauline Weatherall
British Oceanographic Data Centre (BODC)
Proudman Oceanographic Laboratory
6 Brownlow Street
Liverpool
L3 5DA
UK

paw@bodc.ac.uk
http://www.bodc.ac.uk

Appendix I

Distribution of GEBCO's bathymetric data sets and products

This includes:

- Downloads of data sets from the Internet
- Distribution of the GEBCO Digital Atlas and Grid Viewing Software
- Enquiries received concerning the use of GEBCO's data sets and the GEBCO world map

1. Internet downloads of GEBCO's gridded bathymetric data sets

GEBCO_08 Grid (since release, 29 January 2009)

Full global data set: 1,019
User-selected sub-regions of the global grid: 1,982

GEBCO One Minute Grid (since 01 June 2008)

Full global data set: 3,265
User-selected sub-regions of the global grid: 2,853

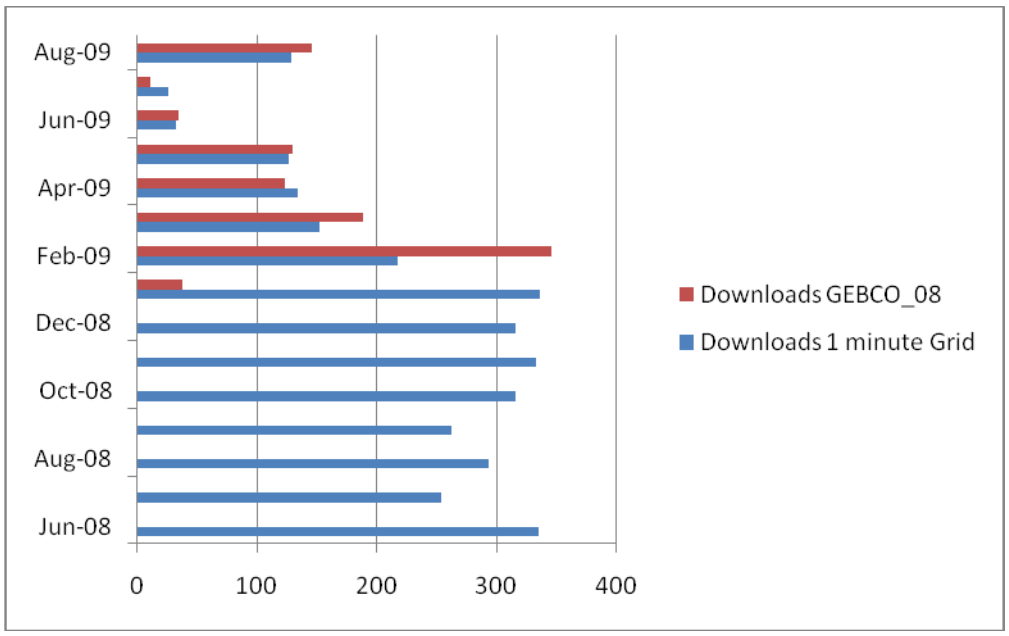


Fig. 1 Internet downloads of GEBCO's complete global grid files (upper bars GEBCO_08; lower bars 1 minute grid)

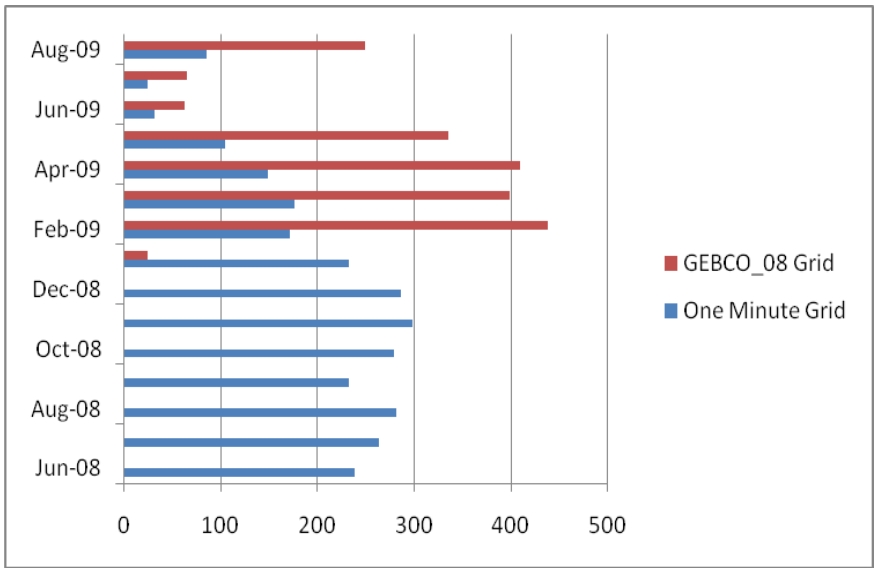
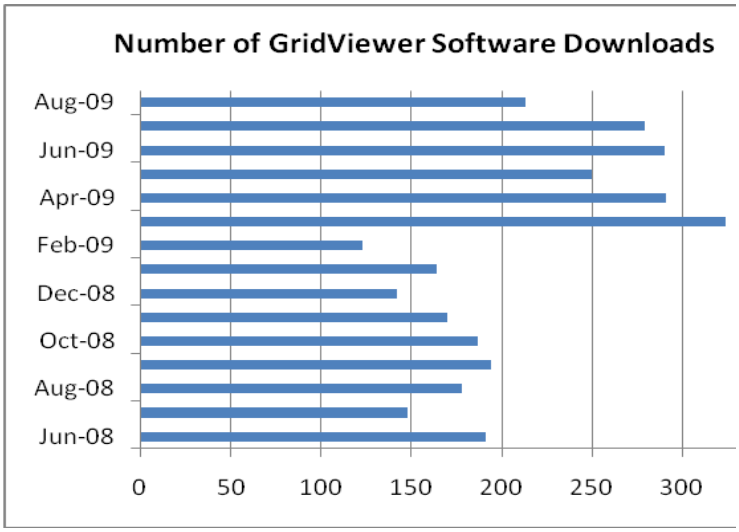


Fig. 2 Internet downloads of user-defined sub-sections of GEBCO's grid files (upper bars GEBCO_08; lower bars 1 minute grid)

2. Internet downloads of viewing software for displaying and accessing data from GEBCO's grids

Total number of downloads since 01 June 2008: 3,135

Month	Number of GridViewer downloads
Jun-08	180
Jul-08	149
Aug-08	178
Sep-08	194
Oct-08	187
Nov-08	170
Dec-08	143
Jan-09	163
Feb-09	123
Mar-09	324
Apr-09	291
May-09	250
Jun-09	290
Jul-09	280
Aug-09	213

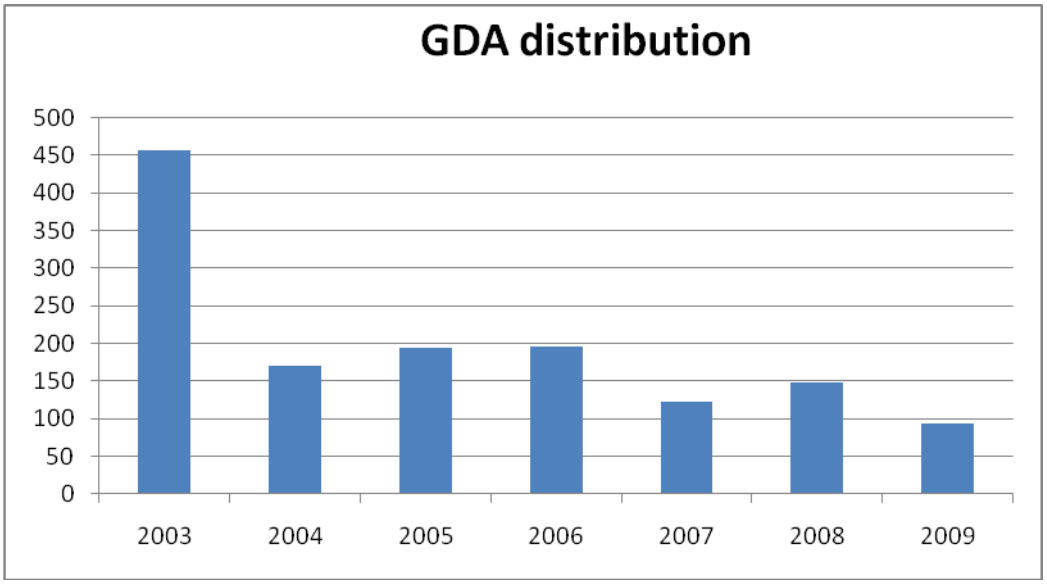


3. Distribution of the GEBCO Digital Atlas (GDA)

Since 1st June 2008 182 copies of the GDA have been distributed. This includes copies sold to commercial companies and complimentary copies given to participants on training courses.

Since its release in 2003, 1,381 copies of the GDA have been distributed.
Royalties contributed to GEBCO from the sale of the GDA for 2008 amounted to £8,216. This makes a total of £57,152 since the release of the GDA in 2003.

The following diagram details the number of copies of the Centenary edition of the GDA distributed since its release in 2003.



4. Use of GEBCO's data sets and products

GEBCO data sets are used by a diverse user community and included in a number of products. The following is a selection of requests received for use of GEBCO data in products and imagery. For enquirer confidentiality reasons, the names of the majority of the requesting organizations have not been included in these lists.

GEBCO's gridded data sets and bathymetric contours

- GEBCO_08 Grid made available to Google for use as a base layer in version 5.0 of Google Earth.
- Request for use of data from the GEBCO_08 Grid as background imagery in a GIS application, to be made available as a download for an iphone (ongoing).
- Use of data from the GEBCO_08 Grid by a mobile phone company as background imagery for web map application and as background imagery in a mobile phone application (ongoing).
- Use of the GEBCO_08 Grid as background imagery in a GIS type product by an oil and gas exploration company, based in the UK.
- Use of data sets from the GDA in a printed maps and digital imagery by a graphics company based in the UK.

- Request for use of data from the GDA for the area around Japan in the production of a 1:5 million scale map.
- Use of the GEBCO One Minute Grid in a software package for route, station and cast planning, request from a software company based in Germany.

GEBCO world map

- Creating a graphic of the worlds tectonic plates for a children's museum,
- Poster for a wall display in a Dean's university office
- Use of imagery in a computer treasure hunt game
- Use in a brochure, advertising a school in Brazil
- for use in on-line training material and publications
- Use of imagery in the production of a 3D globe
- Imagery in a brochure by an oil company
- Use in an environmental documentary to illustrate the 'plastic stew' between San Francisco and Hawaii.
- Use as imagery in a brochure for ocean technical equipment company
- Use as imagery in a brochure advertising a gas metering company
- For use as background display in a PC-based Electronic Navigation Systems for marine navigation. For background or overview type display only, not for navigation.
- Use in a presentation given at UDT (Underwater Defence Technologies) Pacific 2008 Conference.
- Use as imagery in a travelling exhibition called 'Creatures of the Abyss'
- Use in a TV show about the World Oceans – shown on TV in Germany
- Inclusion in educational material for a geography course for 11-14s in the UK.
- Use of imagery in a shop display, request from a shop in Canada
- Use as background imagery in a computer strategy game
- use as background imagery on a web site for a running club/organization

Appendix II

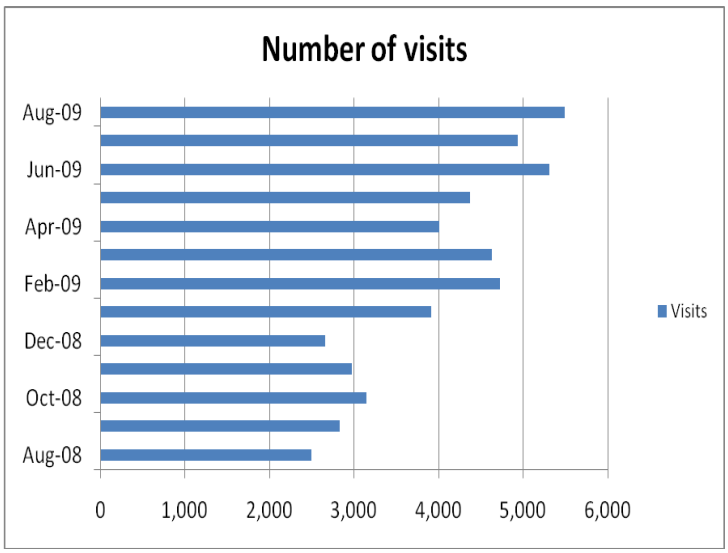
The following tables and diagrams provide statistics about access to GEBCO's web site (www.gebco.net) for the period 1st August 2008 to 31st August 2009.

In summary, there were over 51,000 visitors to the site, viewing over 167,000 pages.

1. Visits to GEBCO's web site http://www.gebco.net

Total number of visits to the site: 51,469

Month	Number of visits
Aug 2008	2,492
Sept 2008	2,825
Oct 2008	3,143
Nov 2008	2,970
Dec 2008	2,655
Jan 2009	3,914
Feb 2009	4,722
Mar 2009	4,625
Apr 2009	4,011
May 2009	4,368
Jun 2009	5,314
Jul 2009	4,936
Aug 2009	5,494



2. Number of visits to individual GEBCO web pages

The Following details the number of visits to individual web pages on GEBCO's web site.

Explanation of terms used:

Page title	Title of the GEBCO web page viewed
Number of page views	The total number of pages viewed. Repeated views of a single page are counted.
Number of unique views	The number of visits during which one or more of these pages was viewed.
Average time on page	The average amount of time that visitors spent viewing this set of pages or page.

Page title	**Number of page views**	**Number of unique views**	**Average time on page (minutes)**
GEBCO world map	38320	25729	2.1
GEBCO gridded bathymetry data*	31803	23814	2.1
General Bathymetric Chart of the Oceans (GEBCO)	28685	22162	0.9
The Centenary Edition of the GEBCO Digital Atlas	10867	8526	0.9
GEBCO grid display software	8121	6603	1.5
GEBCO data and products	6809	4722	0.4
GEBCO undersea feature names	6111	5096	1.8
3-D visualisation of the GEBCO One Minute grid	5241	4613	1.2
Release of the GEBCO_08 Grid	4974	3764	0.6
GEBCO hard copy charts	3302	2473	0.9
Contact us - General Bathymetric Chart of the Oceans (GEBCO)	3204	2531	2.4
GEBCO Postgraduate Certificate in Ocean Bathymetry	2057	1772	3.3
Links to associated organisations projects and useful data sets	1824	1593	1.4
News and Events for the General Bathymetric Chart of the Oceans	1669	1273	1.1
GEBCO committees and groups	1666	1371	2.0
GEBCO training information	1533	1233	0.9
GEBCO posters and publicity	1451	1295	1.1
General Bathymetric Chart of the Oceans overview	1401	1112	1.2
General interest - bathymetry data	1327	1091	1.1
About us - General Bathymetric Chart of the Oceans (GEBCO)	1186	891	0.6

GEBCO meetings and minutes	1022	752	1.7
Annual GEBCO Bathymetric Science Day	926	759	1.3
News and Events in 2009 for the General Bathymetric Chart of the Oceans	695	516	0.7
History of GEBCO, 1903-2003	556	476	0.8
GEBCO — Search the General Bathymetric Chart of the Oceans (GEBCO) web site	539	218	0.5
GEBCO Guidelines	510	450	1.1
GEBCO project history	466	380	1.5
The shape of the ocean floor shown in the GEBCO_08 Grid	263	229	1.4
TSCOM XXV and 4th GEBCO Science Day	239	194	2.0
Comments and reviews of the GEBCO Digital Atlas (GDA)	203	187	1.7
Call for papers for GEBCO Scicence Day 2009	136	111	0.6
GEBCO_08 Grid displayed in Google Earth	59	50	0.5
Release of version 2.12 of the GDA Software Interface	50	42	1.9
Latest release of the GEBCO Gazetteer	47	36	0.5
GEBCO grid display software version 2.11	33	31	0.9
GEBCO Nippon Foundation Training Course	19	14	0.7
News and Events in 2008 for the General Bathymetric Chart of the Oceans	19	14	0.3
News and Events in 2006 for the General Bathymetric Chart of the Oceans	16	6	0.6
News and Events in 2007 for the General Bathymetric Chart of the Oceans	11	8	0.5

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

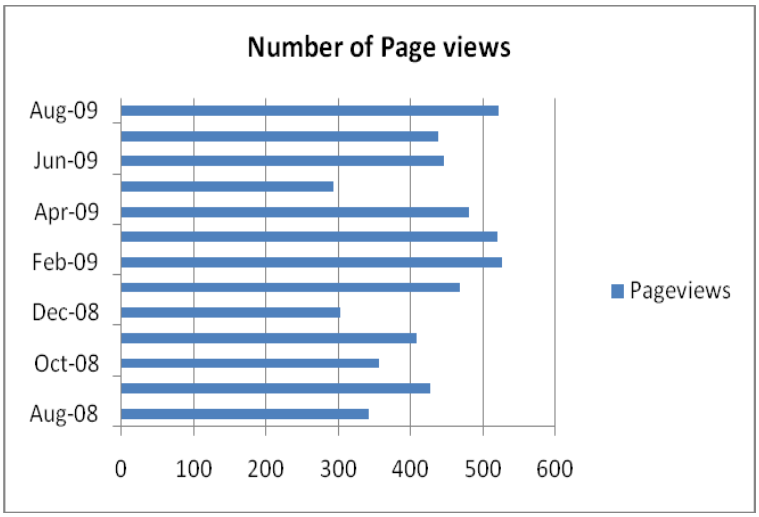
3. Visits to GEBCO's Undersea Feature Names (UFN) web page and access to documents and data sets

The following provides information on visits and access to GEBCO's undersea feature names gazetteer web pages, documents and data sets.

Explanation of terms used:

Number of page views	The total number of pages viewed. Repeated views of a single page are counted.
Average time on page	The average amount of time that visitors spent viewing this set of pages or page.

Month	Page views
Aug-08	342
Sep-08	428
Oct-08	356
Nov-08	409
Dec-08	303
Jan-09	468
Feb-09	527
Mar-09	521
Apr-09	481
May-09	294
Jun-09	447
Jul-09	438
Aug-09	522



Page/document	Page views	Average time on page (minutes)
January 2009 version of the GEBCO UFN gazetteer spreadsheet in Microsoft Excel form	316	3.7
January 2009 version of the GEBCO UFN gazetteer spreadsheet in Adobe PDF form	285	3.5
September 2007 version of the GEBCO UFN gazetteer spreadsheet in Microsoft Excel form	211	5.2
September 2007 version of the GEBCO UFN gazetteer spreadsheet in Adobe PDF form	188	3.1
Adobe PDF version of Edition 3 of the IHO/IOC document B6 in English/French	166	2.9
Adobe PDF version of Edition 3 of the IHO/IOC document B6 in English/Spanish	87	3.0
SCUFN name proposal form in English	74	1.7

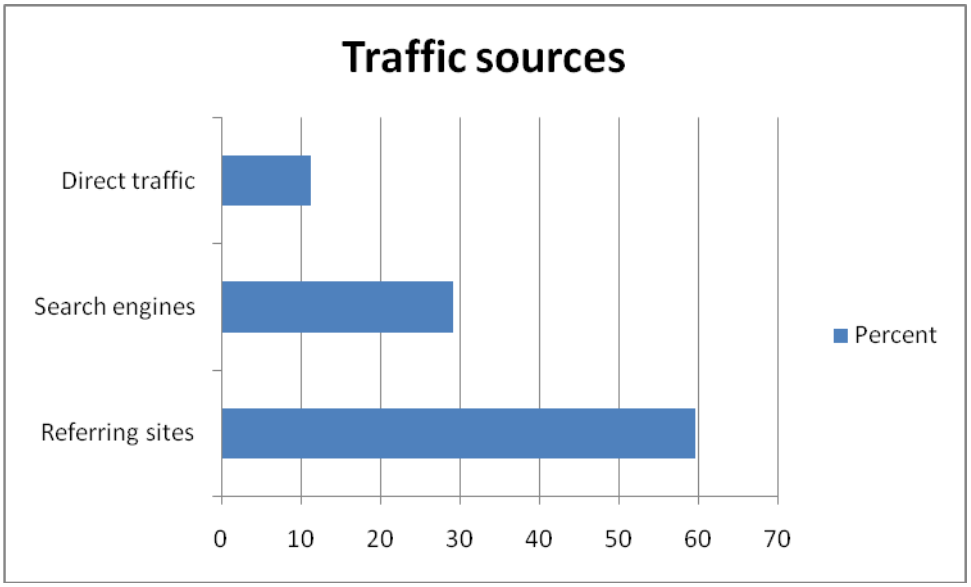
	Adobe PDF version of Edition 4 of the IHO/IOC document B6 in English/French	45	3.2
	SCUFN name proposal form in Spanish	38	1.5
	Adobe PDF version of the document 'Romanization of Russian geographical names'	25	1.3
	Microsoft Word version of the document 'Romanization of Russian geographical names'	17	1.4
	SCUFN name proposal form in French	11	1.3

4. Traffic sources to GEBCO's web site

The following section details the routes used to find GEBCO's web pages.

Explanation of terms used:

Direct traffic	The user has entered the URL of web page directly
Search engines	Web pages found by searching using a keyword in a search engine such as Google or Yahoo etc.
Referring sites	Web page found by following a link from another web site



The table below details on how users are finding GEBCO's web site, either directly, using keywords in a search engine or from referral sites. The 'top 50' traffic sources are listed.

Explanation of terms used:

Source	The source of traffic to the site, e.g. the name of the referral site or search engine:
Medium	The type of traffic: Organic = search engine Referral = from an external web link (none) = direct – i.e. the user has entered the URL of a GEBCO web page

Visits	The number of visits to the site
Pages/Visit	The average number of pages per visit
Avg. time on site (minutes)	The average amount of time spent on the site in minutes

Source/Medium	**Visits**	**Pages/Visit**	**Avg. time on site (minutes)**
google / organic	14699	3.7	3.7
ngdc.noaa.gov / referral	6945	4.2	4.2
images.google.com / referral	6621	1.6	1.2
(direct) / (none)	6243	3.0	3.2
en.wikipedia.org / referral	1699	3.9	3.6
images.google.co.uk / referral	1302	1.6	1.0
bodc.ac.uk / referral	1300	4.3	4.1
images.google.co.in / referral	749	1.4	1.0
yahoo / organic	693	3.7	4.3
images.google.de / referral	669	1.9	1.4
iho-ohi.net / referral	625	4.2	5.0
images.google.fr / referral	502	2.0	1.4
images.google.ca / referral	496	1.7	1.0
clasticdetritus.com / referral	392	3.2	2.9
iho.shom.fr / referral	383	3.8	4.1
images.google.com.au / referral	324	1.5	1.0
images.google.nl / referral	301	1.8	1.4
de.wikipedia.org / referral	298	3.9	2.7
images.google.com.br / referral	292	1.6	3.6
images.google.pl / referral	290	1.6	0.7
google.com / referral	253	1.9	1.3
images.google.es / referral	251	1.6	1.0
images.google.it / referral	229	1.7	1.0
images.google.ro / referral	228	1.9	1.1
images.google.se / referral	218	1.6	0.8
images.google.co.id / referral	217	1.4	0.9
images.google.com.my / referral	217	1.5	1.2
images.google.com.tr / referral	191	1.5	0.8
vterrain.org / referral	186	3.6	2.9
oceanworld.tamu.edu / referral	172	4.0	3.6
images.google.com.ph / referral	171	1.4	1.0
images.google.co.th / referral	160	1.6	1.4
scienceblogs.com / referral	158	2.2	3.4
images.google.hu / referral	153	1.6	0.7
images.google.cz / referral	152	1.8	0.9
images.google.com.pk / referral	141	1.6	0.7
ibcso.org / referral	139	4.0	4.4

images.google.ch / referral	130	1.9	1.5
stumbleupon.com / referral	128	1.9	1.2
live / organic	119	3.1	4.1
bing / organic	117	3.0	2.5
gearthblog.com / referral	116	2.8	5.3
search / organic	116	2.8	3.5
images.google.be / referral	110	2.1	1.0
images.google.com.sg / referral	107	1.2	0.4
fao.org / referral	105	3.4	3.8
images.google.ru / referral	104	1.5	1.4
images.google.fi / referral	100	1.6	0.7
forums.futura-sciences.com / referral	99	1.7	0.9
images.google.co.nz / referral	95	1.3	0.6

5. The most popular keyword search terms

The following lists the top 50 keywords used in search engines to find pages on GEBCO's web site.

Explanation of terms used:

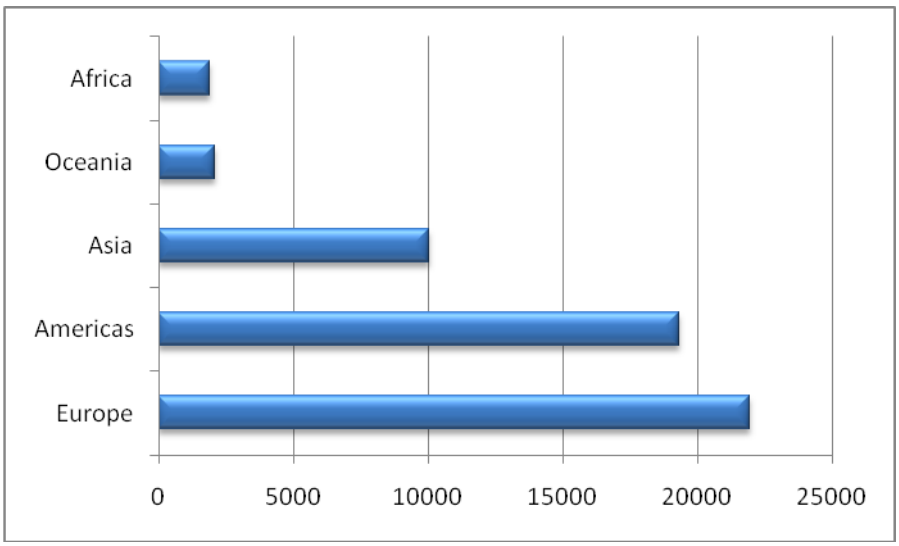
Keyword	The term or phrase used in the search engine to find GEBCO's web site
Visits	The total number of visits to the site using this keyword
Pages/Visit	The number of pages viewed per visit
Average time on site	The average amount of time that visitors spent on the site

Keyword	**Visits**	**Pages/Visit**	**Average time on site (minutes)**
Gebco	8416	4.2	4.3
gebco bathymetry	408	4.1	5.0
bathymetric	203	2.9	1.8
world map	161	1.7	0.9
bathymetric charts	155	4.2	3.6
general bathymetric chart of the oceans	146	5.5	5.8
bathymetric chart	116	3.6	2.1
gebco.net	96	3.3	3.1
gebco_08	92	4.8	5.4
gebco data	81	3.0	2.9
ocean bathymetry	67	4.3	2.6
gebco bathymetrie	66	1.3	0.5
gebco map	66	3.8	4.1
bathymetry	58	2.9	4.9
copy of world map	56	1.3	0.8
bathymetry data	52	3.6	3.2
gebco gazetteer	52	2.9	4.9
bathymetry chart	49	2.6	2.4
chart of ocean depth	47	3.5	1.2
www.gebco.net	47	4.1	5.9
gebco digital atlas	45	3.6	2.6
Scufn	45	3.1	3.6
gebco bathymetry data	39	4.6	6.0
gebco download	39	4.0	2.6
bathymetry charts	33	3.7	2.8
free mapping software	30	1.5	0.2
world map jpg	29	1.6	0.7
general bathymetric chart of the ocean	27	3.6	6.0

high resolution world map	27	1.6	1.0
gebcoce	26	1.7	0.3
undersea feature names	25	7.2	12.8
undersea features	25	2.6	5.0
gebco_08 grid	21	3.4	2.4
gebco centenary edition	20	1.8	1.6
bathymetric data	19	2.9	3.7
iho gazateer on undersea feature names	19	3.8	2.5
bathymetry data download	18	3.0	6.0
gebco grid	18	4.2	3.5
gebco training	18	2.3	6.5
gebco world map	18	4.4	2.2
general bathymetric chart of the oceans (gebco)	17	7.4	5.1
copy of the world map	16	2.8	1.2
gebco bathy	16	4.2	3.5
bathymetric chart of the oceans	15	6.9	5.2
ifremer bathymetry	15	3.9	3.5
world bathymetry data	15	3.5	3.2
world map jpeg	15	1.6	0.8
bathymetry gebco	14	3.7	8.0
gebco maps	14	3.6	4.2
gebco ocean	14	6.5	6.1

6. Geographic distribution of Internet Protocol (IP) addresses accessing GEBCO's web site

The diagram below outlines the geographic distribution by continent.



The table below details the geographic distribution by country (top 50 '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
Number of 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	The average amount of time that visitors spent on the site

Country/Territory	**Number of visits**	**Pages/Visit**	**Average time on site (minutes)**
United States	13451	2.9	2.5
United Kingdom	4626	3.1	2.5
Germany	2790	3.7	3.1
France	2779	3.5	3.0
Canada	1939	3.1	2.9
Japan	1837	3.5	3.2
India	1652	2.4	3.0
Spain	1553	3.7	3.3
Australia	1477	2.9	2.9
Italy	1342	4.0	3.6
Russia	1166	3.7	3.3
Brazil	1139	3.1	4.3
Netherlands	858	3.2	2.8
Indonesia	846	2.8	4.3
China	807	3.2	4.6
Norway	792	3.5	3.1
Mexico	768	3.4	4.2
Portugal	574	3.7	3.1
Poland	551	2.8	2.4
Malaysia	524	2.2	2.3
Sweden	520	2.6	2.1
Turkey	518	2.7	2.7
New Zealand	509	2.6	3.2
Argentina	482	2.9	3.0
Philippines	429	2.2	2.6
South Korea	410	3.1	3.8
Taiwan	407	2.6	2.7
Greece	394	3.5	3.3
Romania	383	2.2	1.5
Ireland	363	2.9	2.2
Chile	362	3.5	3.9
Belgium	358	3.0	2.4
Côte d'Ivoire	341	1.6	2.1
Thailand	339	2.5	2.3
Switzerland	334	3.1	2.7

South Africa	317	2.5	3.6
Denmark	284	2.8	2.6
Nigeria	273	1.6	2.5
Singapore	267	2.1	1.6
Colombia	266	3.2	3.9
Pakistan	256	2.1	1.9
Hungary	239	2.6	2.0
Ukraine	234	2.8	2.4
Sri Lanka	220	2.9	3.3
Czech Republic	218	2.3	1.5
Vietnam	210	2.6	4.0
Austria	209	2.8	1.8
Finland	203	2.3	1.8
Venezuela	202	3.6	4.1
Egypt	190	2.5	3.4

ANNEX 3

Bathymetric Editor's Report

Brest 2009

1. Action Items from 2008 General Meeting

Initiate an email discussion on attributes to data sets –

This was raised in early 2008 before we had decided how the source data were to be stored at BODC. It has mostly been overtaken by events.

There have been visits to Walter Smith's office and to Martin Jakobsson to see how they handle data.

The source data is to be (eventually) stored on an Oracle database at BODC, with parameters and attributes likely to follow the model used by IBCAO.

Investigate the cost and resources to prepare a 6th Edition for publication (at 1:10M scale) –

This was also superseded by events.

The GEBCO_08 grid was published which in reality made the GEBCO 6th series redundant.

It may be possible to investigate the costs of printing a 1:10M scale chart series of the GEBCO_08 grid but when will there be enough "fixes" for it to be "ready" to print – I suspect someone will always find something they are not happy with.

2. Updates to the GEBCO_08 grid

The grid has been updated with bathymetry provided by the Geological Survey of Ireland (GSI) and OLEX. At present the update work has been done by "patching" the existing GEBCO_08 grid, until the predictive bathymetry software is available for use

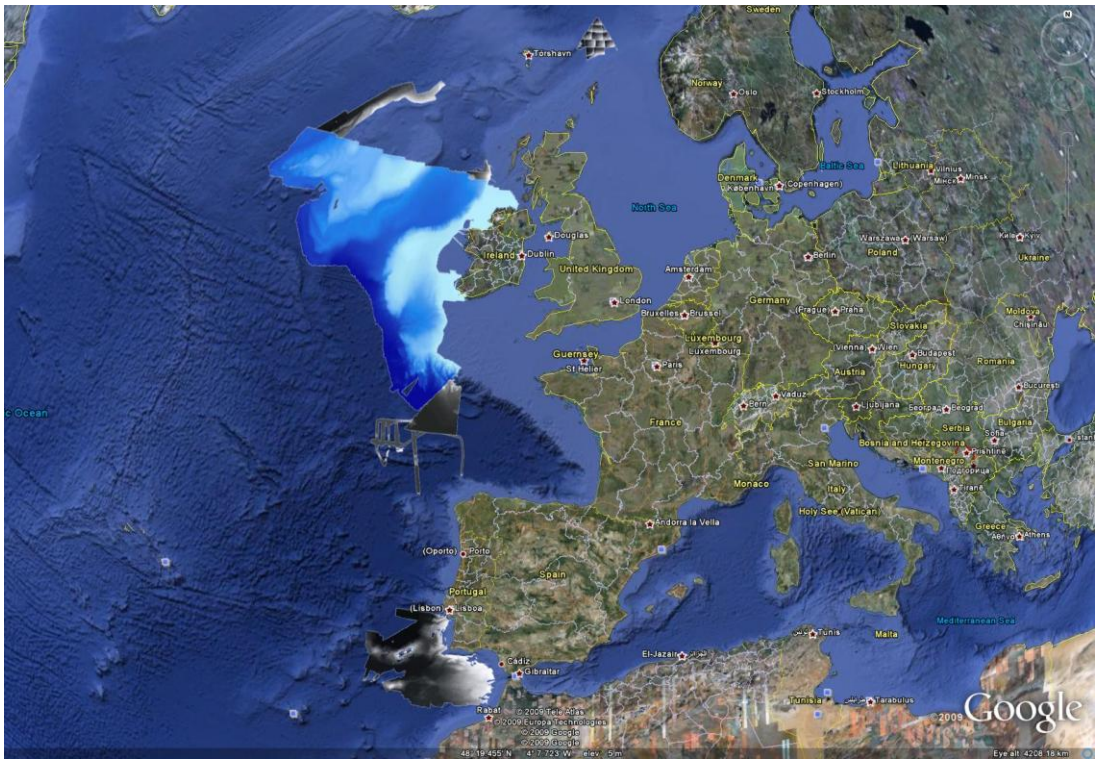
3. Data and Contacts

I have had data sets made available to GEBCO from a number of new sources and contacts, some of which has yet to be collected/delivered -

Dutch Hydrographic Office
UK habitat mapping programmes
UK UNCLOS mapping programmes

Some projects e.g. SWIM (an EU-funded multibeam mapping project) are reluctant to let data be used.

NOTE : For whatever reason, these data have been made available to GEBCO and **not** been given/submitted to the Data Centre for Digital Bathymetry so far as I am aware (except GSI).



Examples of additional data sets obtained EXCEPT the SWIM data which is located in the Gulf of Cadiz and off S W Portugal.

OLEX have currently suspended free distribution of their data as they are overwhelmed by requests form academia. They will at some point decide a company policy and may in fact provide an open-access portal for their data. During Science Day a presentation by Martin Jakobsson will show the huge value of this (largely shallow water) dataset.

I have contacted the International Cable Protection Committee to ask about obtaining survey data – awaiting a response after their Executive Committee has been consulted.

GEBCO scholars and Regional Study Groups

In mid 2008 I did try to contact the GEBCO scholars who said they wanted to be involved in the regional study groups; the response was very disappointing. I also contacted this group again a couple of weeks ago asking about progress in the regional mapping, and/or any difficulties the scholars may have had and asking if they would like the help and/or intervention of GEBCO members; again with no response.

Is the lack of response because I don't have the correct email addresses of the alumni?

Though only one "bounced"….

4. Personal Information

NERC is subject to budget restrictions, with an immediate detrimental impact on my time and resources for GEBCO work. To ensure future funding for GEBCO work, I need to demonstrate achievements, uses, plans etc.

I have spent over half my time since the last GEBCO meeting working on non-GEBCO science and applied science projects.

ANNEX 4

Release of bathymetric data collected under-ice by US Nuclear Submarines 1993-2000

George Newton

The United States Navy has been conducting nuclear submarine operations under the Arctic ice pack since 1957. Bathymetric data sets are often collected by those submarines at various geographic intervals, when on active patrols. Those soundings are routinely classified and released to the public domain at various intervals. Previous releases have been permitted for the years 1958-1972, 1973-1982 and 1983-1992. This data set contains data collected between 1993 and 2000.

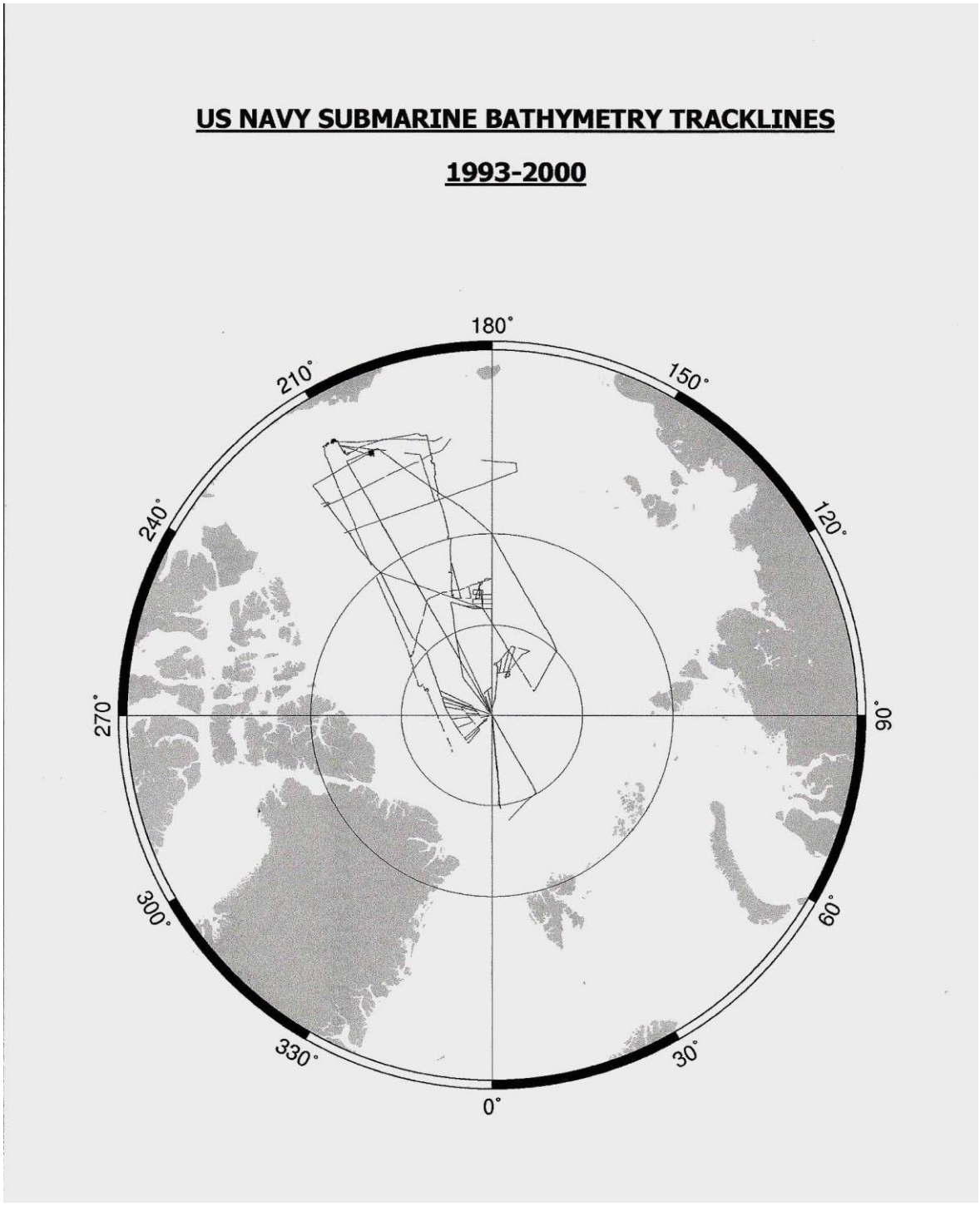
When the Gore-Chernomyrdin agreement on the exchange of Arctic Ocean data was announced in 1997, a "science zone was established in the Arctic Ocean, where bathymetry could be collected. That "Gore Box", as it is often referred to, established a line 200 nautical miles from any national shoreline. The US Navy may not collect bathymetry outside that box, except in its own territorial waters. This data release contains only data collected within the Gore Box, except where they fall within the United States zone. In the latter case, all data within the US zone is contained in the submission.

As in previous Arctic submarine bathymetry data releases, one additional condition for the declassification and release of the data into the public domain was required, i.e., ***no metadata was to be supplied, other than to state that modern navigation methods (a combination of GPS and inertial navigation systems in these cases) and modern single-beam echosounders were used in the collection of the data.***

When received, the data set contained 13,323 data points, in a longitude, latitude, depth value format. The navigational values are in decimal degrees and the soundings are in UNCORRECTED meters and tenths, with an average assumed sound velocity of 1500 meters per second.

The data were carefully examined and approximately 570 obvious errors in either navigation or depth were deleted. The tracks were then segmented to reflect major navigation or data breaks. There are 173 segments, each assigned a name, "***Line xxx***." A raw, unedited data file was archived but is not a part of this submission.

Editing was done by Norman Z Cherkis (Planning Systems, Inc. - Qinetiq-North America and a member of GEBCO), upon release by the US Navy. The US Arctic Research Commission and Planning Systems, Inc. were directly responsible for negotiations securing the release of the data and locating funding for the editing.


US NAVY SUBMARINE BATHYMETRY TRACKLINES
1993-2000
180°
210°
150°
240°
120°
270°
90°
300°
60°
330°
30°
0°

ANNEX 5

Acronyms

ACUF	Advisory Committee on Undersea Features (USA)
BODC	British Oceanographic Data Centre
DCDB	Data Center for Digital Bathymetry
DEM	Digital elevation model
DTM	Digital terrain model
EEZ	Exclusive Economic Zone
EMODNET	European Marine Observation and Data Network
ENC	Electronic Navigational Chart
ETOPO1	Earth topography digital 1 arc.minute grid
ETOPO2	Earth topography digital 2 arc.minute grid
EU	European Union
GDA	GEBCO Digital Atlas
GEO	Group on Earth Observations
GLORIA	Geological LOnge Range Inclined Asdic
IBCAO	International Bathymetric Chart of the Arctic Ocean
IHO	International Hydrographic Organization
IOC	Intergovernmental Oceanographic Commission
LDEO	Lamont-Doherty Earth Observatory
NGA	National Geospatial-Intelligence Agency
NGDC	National Geophysical Data Center, Boulder (USA)
NGO	Non-governmental organisation
RHC	Regional Hydrographic Commission
SCICEX	Science under Ice Expeditions
SCUFN	Sub-Committee on Undersea Feature Names (GEBCO)
SHOM	Service Hydrographique et Océanographique de la Marine
TSCOM	Technical Sub-Committee on Ocean Mapping (GEBCO)
UNEP	United Nations Environment Programme
USGS	United States Geological Survey