TABLE OF CONTENTS

ANNEXES

1. OPENING OF THE MEETING AND WELCOME BY INEGI HOSTS

1. The Twenty-first Meeting of the joint IOC-IHO General Bathymetric Chart of the Oceans Sub-Committee on Digital Bathymetry (SCDB XXI) was held at the Instituto Nacional de Estadística, Geografía e Informática**,** Aguascalientes, Mexico on 7th and 8th July 2005.

2. Those present, in addition to the Chairman, were Etienne Cailliau, Mike Carron, Norman Cherkis, Robin Falconer, Chris Fox, José Frias, Andrew Goodwillie, John Hall, Mike Loughridge, Paolo Lusiani, Ron Macnab, Dave Monahan, Tony Pharaoh, John von Rosenberg, Hans-Werner Schenke, George Sharman, Steve Shipman, Shin Tani, Pauline Weatherall and Bob Whitmarsh. In addition the first session was attended by Gilberto Calvillo, President of INEGI, Mario A. Reyes, General Director of Geography, INEGI and Francisco Jiménez Nava, INEGI. On Day 2 the Committee was joined by Francisco Takaki T., INEGI, Jorge L. Heredia (Mexican Navy and Hydrographic Office and one of the 2005 intake to the NF/GEBCO Training Project) and Francisco Hansen Albites, INEGI.

3. Dr Jiménez briefly welcomed all the GEBCO participants. Short responses were made by Mr Monahan, Dr Falconer and Cdr Shipman on behalf of GEBCO, the IOC and the IHO, respectively. Finally, Dr Calvillo formally welcomed GEBCO to Aguascalientes and INEGI and emphasised INEGI's commitment to ocean bathymetry. He declared the meeting open.

4. The Chairman, Dr Walter Smith, began the meeting at 1010.

2. CONDUCT OF THE MEETING

2.1 Adoption of the Agenda

5. The Chairman presented an Agenda which was adopted (Annex 1).

3. REVIEW OF ON-GOING ACTIVITIES AND CURRENT PRODUCTS

3.1 Report of the GEBCO Bathymetric Editor

6. In the absence of the Bathymetric Editor it was decided to postpone presentation of his report, which had only just been received by email, until it could be considered by the Guiding Committee.

3.2 Report of the GDA Manager

7. The GDA Manager, Ms Weatherall, presented a report describing the work that she and Dr Cramer had accomplished during the year (Annex 2). They had, among other things, received and implemented updates to the GEBCO 1 minute grid, developed the GDA-CE software interface, developed and maintained the GDA web pages hosted by BODC, authored an article about the GDA in NERC's magazine 'Planet Earth', provided user support for the GDA and carried out work on the development of global data sets from the GDA for use with GIS Sample shape files. In answer to questions Ms Weatherall explained that it was proposed that users would obtain updates to the grid by downloading software over the internet and that users would be told about updates by email because BODC had a database of all the people who owned copies of the GDA-CE.

3.3 Report of the IHO Data Centre for Digital Bathymetry (DCDB) including a Report of the WDC for Marine Geology & Geophysics Boulder and a Report on NGDC activities in support of IOC/GEBCO.

8. Dr Sharman presented the report of the DCDB (Annexes 3a, 3b). He emphasised several key points in addition to the constantly increasing amount of data held and the number of users accessing the data. The first point was the efforts of the DCDB to expand access to data holdings via the internet; this made it easier for users to access data but the DCDB had no way of knowing who was downloading the data. A new development was the creation of the Historic National Ocean Service Hydrographic Survey database which contains Descriptive Report documents plus images of 'smooth sheets'. Second, the USA Coastal Relief Model was almost complete. Third, regarding new products and systems, Dr Sharman noted that NGDC was no longer pressing CDs; he said it would deliver DVDs on demand but preferred to deliver data via the internet as part of a move to web-based interactive maps. In response to an action from the last meeting Dr Sharman also reported that NGDC provided GEBCO with in-kind support to the tune of ca. US$46k per annum.

9. Dr Fox commented that many more multibeam bathymetry systems were being installed which was leading to a great increase in data input to NGDC which might adversely affect the support available to GEBCO. He said that he hoped that in future academic multibeam bathymetry might be processed by the group at LDEO while NGDC could concentrate on NOAA data. He added that NGDC was looking beyond clients downloading data and was planning machine to machine contacts to enable free downloading.

10. Mr Tani noted that scanning smooth sheets was a good way to mine data and was pleased to know that this was being done together with the creation of metadata well in excess of the basic MGD77 format.

3.4 Reports of liaisons with IBCs, regional data centres, and SCUFN

11. International Bathymetric Chart of the Southern Ocean (IBCSO). Dr. Schenke reported that the inaugural meeting of the IBCSO, defined as covering the Earth south of 60ºS, had taken place on 30th July 2004 under the auspices of the IHO/IOC/SCAR in Bremen, Germany (Annex 4). The meeting was well attended and there was extensive discussion including the acquisition of data from under the ice shelves. A lot of data had been promised and connections with the IPY and the SSPARR program had been established. An initial working group of 8-9 people had been established. The IBCSO had been accepted as an Expert Group within the SCAR Geoscience Standing Scientific Group.

12. Dr Falconer noted that two sheets of the Ross Sea up to 60ºS had been prepared in New Zealand as a contribution to the IBCSO which would be updated to a 1' grid in 2005-2006.

13. Dr. Schenke continued by describing multibeam surveys collected during recent legs of the F.S. *Polarstern* to the Antarctic and Arctic Oceans (Annex 5). He said that he hoped that Spanish and UK scientists would add to the surveys conducted in the Scotia Sea.

14. Dr Falconer added that a new fisheries commission had been set up between New Zealand, Chile and Australia to cover the area between New Zealand and Antarctica. This would likely lead to more bathymetric surveys by fishing vessels and research ships.

15. International Bathymetric Chart of the Southeast Pacific (IBCSEP). Mr Macnab showed a map of the area to be covered by the IBCSEP (Annex 6). The area for which Chile was responsible

extended east of Easter Island to the Chilean coast. Dr. Schenke also noted that a large area within the IBCSEP region had already been surveyed by the F.S. *Sonne*.

16. Dr Falconer added that two months ago he had visited the Hydrographic Office in Valparaiso, Chile and had met Cristian Rodrigo who was working on a bathymetric compilation for the IBCSEP. Dr Smith enquired about the fate of the request from the Chilean HO to publish the GDA-CE on their web site; Ms Weatherall replied that a license was being prepared.

17. International Bathymetric Chart of the Western Pacific (IBCWP). Dr Sharman noted that David Divins had attended the April 2004 meting of the IBCWP Editorial Board. At this meeting it had been agreed to compile only those sheets in which a single country had an interest. Dr Falconer reported that there had been no activity in either New Zealand or Australia in support of the IBCWP.

18. International Bathymetric Chart of the Western Indian Ocean (IBCWIO). Dr. Schenke noted that F.S. *Sonne* was currently working off SE Africa and Madagascar and had also been south of South Africa. He said that he had been in contact with the Chief Editor of the IBCWIO. Mr Pharaoh noted that a survey was also planned off SE Africa which had been funded by the World Bank. Dr Hall proposed that the northwest corner of the IBCWIO map should include the Persian Gulf and the Red Sea and he offered to provide a 0.1 arc minute gridded data set for these areas.

19. Dr Fisher's Indian Ocean sounding sheets. The discussion then moved on to the topic of digitising Dr Fisher's sheets in the Indian Ocean region. Dr Hall reported that all of Dr Fisher's hand drawn echo-sounding sheets had now been sent to CCOM and scanned (Annex 7). Dr Hall continued that some soundings had been written 'upside down' so that there might be a problem for optical character recognition software. He stated that Dr Fisher had apparently used more tracks, for example off Sumatra, than appear in the GDA-CE or are held by NGDC. Dr Sharman noted that, through his contacts, Dr Fisher had used proprietary data not available to others. Some of these original data were in digital form so there was a danger of re-digitising them. Mr Macnab stated that Dr Fisher would help with identifying his sources of data. Dr Goodwillie noted that the proprietary data did not appear on the sheets so that the sheets could be digitised without breaking any promise of confidentiality. In the following discussion Dr Goodwillie confirmed that the track lines on the GDA-CE did include proprietary data.

20. Dr Loughridge expressed his confusion about the status of the proprietary data used by Dr Fisher. He said that it appeared that the sources of such data would still need to be asked for permission for their data to be digitised. Dr. Goodwillie replied that the proprietary soundings used by Dr. Fisher were from a number of academic - primarily French - and agency cruises which date from the mid- to late-90s and which were already in a digital format. Many of these data from academic cruises may already be available from database archives such as NGDC or directly from Roland Schlich's former group at Strasbourg. The remainder of these proprietary data from late-1990s cruises are from agencies such as the South African Hydrographic Office and the Australian Antarctic Division, and Dr. Goodwillie considered that these cruise files will probably be harder to obtain. However, he continued, Dr. Fisher had offered to open his correspondence for any interested person wishing to visit Scripps to readily ascertain the cruise IDs and the names of contacts for these agency cruises, and had offered to act as a knowledgeable advisor in pursuit of these data. Dr Goodwillie said that he was not sure how GEBCO would succeed in getting permission to use these latter data. Dr Loughridge responded by saying that the IHO might be able to help to release such government-held data. The intention should be to get all Dr Fisher's data into the public domain or into NGDC.

21. Mr Macnab said that he was well aware of all these issues. The key point was that mechanisms exist to resolve them but some group has to take responsibility for the problem. He had found that

some of Dr Fisher's tracks were not on the GDA-CE. He informed the Committee that he had conducted some experiments with automatic digitising of Dr Fisher's sheets, using a company based in Norway, and obtained 99% accuracy. The problem was that the soundings had been written at all azimuths. He continued that in his opinion getting access to other data sets such as from the NGDC, US Navy (who hold a lot of data), mapping agencies and research institutes was best done by personal approach and not through the IHO. Some public domain data had still not been submitted to NGDC. He concluded that the best approach was to follow the successful processes and protocols used in creating the IBCAO.

22. The Chairman noted that in Dr Fisher's database held at Scripps Institution of Oceanography there were data from many French cruises with good metadata. He considered that it should be simple to write to the PIs of these cruises requesting that the data be submitted to NGDC if that had not already happened. Ing. Gen. Cailliau said that getting access to such data was not a new problem in France but he would try to help **[Action Chairman, Ing. Gen. Cailliau].**

23. International Bathymetric Chart of the Mediterranean (IBCM). Dr Hall reported that work continued on the IBCM bathymetry. Multiple surveys had been conducted off Israel, Lebanon and Syria and in the Gulf of Aqaba. Further, all IBCM working sheets had been scanned at CCOM, Durham, New Hampshire using a new scanner donated by him (Annex 7).

24. International Bathymetric Chart of the Eastern Atlantic (IBCEA). No report was received from any member of the IBCEA Editorial Board.

25. International Bathymetric Chart of the Arctic Ocean (IBCAO). See Annex 8. Mr Macnab reported on recent exchanges with Russian scientists about apparent discrepancies that existed between the IBCAO and the HDNO maps of the Arctic Ocean. These discrepancies had now been resolved except in the area of the Gakkel Ridge. In future Mr Macnab said he looked forward to the release of AMORE data and its merging with Russian observations; the two had yet to be compared.

26. The Chairman asked whether there would be a problem with including confidential data in an updated version of the IBCAO and whether at least the data density and source could be indicated. Mr Macnab concurred that this would be a problem.

27. International Bathymetric Chart of the Caribbean (IBCCA). Geog. Frias, Vice-Chairman of the IBCCA, reported that the IBCCA, sponsored by the IOC, includes 16 sheets (since sheet 1-17 was transferred to the IBCSEP project) at 1:1 million scale covering the Caribbean, east Pacific Ocean and Gulf of Mexico. The project involves Columbia, Costa Rica, Mexico, USA, Venezuela and Cuba as well as IOC and IHB. France had declined to continue as a member. INEGI provided the coordination, editing, digitisation and distribution of information. Eight meetings had been held, the last at NGDC in 2003. Progress had been hampered by the frequent job changes of the participants.

28. The compilation of data for most sheets, at 1:250,000 or 1:500,000 scale, was nearing completion. By the end of 2004 fourteen sheets had been completed and the sheet off Costa Rica (1-12), was under review. One sheet had been transferred to the area of the IBCSEP. Names from the GEBCO Gazetteer were being used. The Editorial Board was now considering adding overlay sheets of gravity, magnetics, seismicity and geology, like the IBCM. The eventual products were going to be printed sheets (with copies of vector data available on CD), .eps files of the sheets, 'home-made' coloured image files, a digital terrain model display and access via the NGDC web site.

29. In answer to a question Dr Frias confirmed that work had started on producing a gridded data set of the IBCCA, which hopefully would be freely available via the internet but this had not been decided yet. The grid interval had not been fixed.

3.5 Review of bathymetric mapping worldwide

30. A new chart of the North Atlantic. Mr Macnab informed the Committee that he and others were planning a new chart of the North Atlantic Ocean (Annex 9), defined as the Atlantic between the Equator and the Arctic Circle (66.5ºN), which might be called the International Bathymetric Chart of the North Atlantic (IBCNA). There was a strong need for such a chart for studies of ocean circulation, societal needs etc. 55 countries bordered the area. General agreement for this new chart had already been obtained from the GEBCO community and Dr Jakobsson had agreed to be in charge of the project. The process of generating the chart would follow the successful model of the IBCAO. In answer to a question from Dr Goodwillie, Mr Macnab confirmed that depths derived from satellite altimetry would only be used to fill significant gaps or deficiencies in the soundings. Mr Macnab concluded by saying that a prospectus for the new chart would be posted on the University of Stockholm web site http://www.sgvl.geo.su.se/ **[Action Mr Macnab].**

31. A new chart of the Indian Ocean. Mr Macnab described the progress made to date and the impact that the December 2004 tsunami had had on the interest of the IOC in this project. He presented an outline plan to produce a new chart of the Indian Ocean which included a plan to preserve the legacy of the soundings collated by Dr Fisher (Annex 10; also see para. 19).

32. SSPARR project. Dr Hall reported that, although he had not been in contact with Dr Anderson recently, he believed that the transducers for the first SSPARR buoys had been calibrated at CCOM. He was developing a plan to distribute SSPARR buoys in the Arctic using hovercraft to drill ca. 6 inch diameter holes in the ice from which transducers would be suspended. The logistics, particularly for hovercraft fuel, had still to be worked out.

33. Other matters. Dr Hall reported that over 30 CDs containing the Shuttle Radar Topography Mission (SRTM) topography and bathymetry, using Global Mapper software, had been distributed. Similarly, a grant of US$ 40k from the Margaret K. Blodgett Foundation had been made to the GAPA Atlas. He reiterated his dream of all multibeam data being stored in 0.1 arc minute grid file. In shallow water he said that ideally the WGS-84 coastline should be merged with 90m SRTM data. Mr von Rosenberg noted that pre-release samples of the latest coastline being prepared by the National Geospatial-Intelligence Agency might be available in late 2005 although some places with ice and cloud cover remained problematical.

34. The Chairman asked whether any discussion was needed on collaboration between SCUFN and SCDB. Dr. Schenke responded that a lot of co-operation was possible and even necessary; for example, about the DCDB web-based map interface and the GEBCO Gazetteer. He proposed the setting up of a small group to discuss collaboration **[Action Dr. Schenke, Chairman].**

35. Dr Sharman reported that a web-based map interface, to enable the on-line submission of new feature names, was still being developed.

36. Dr Goodwillie asked whether in general the flow of data from the IBCs into GEBCO was smooth and seamless. The Chairman replied that as far as the IBCCA was concerned the intention existed to pass on the data via INEGI.

37. Dr Goodwillie noted that the discussion of Indian Ocean bathymetry had resulted in only one action item. The Chairman replied that although the SCDB encouraged the work in the Indian Ocean it was interested in many areas and because the IBCWIO actually exists maybe other areas deserved a higher priority. He reminded the Committee that the SCDB, which does not control any resources, is a forum to encourage ongoing efforts and not to direct work or to set priorities.

3.6 Review of known problems and planned updates in the GDA-CE contours, grid, or other features

38. Ms Weatherall summarised the bugs that had been found in the GDA-CE and the fixes that had been developed for them (see Annex 11). In answer to a variety of questions she confirmed that original contributors had been told of the problems in their data, that this information was available via the BODC web site (which was updated when a bug was reported) and that bugs were fixed as soon as resources allowed. Dr Goodwillie considered that GEBCO was in danger of 'shooting itself in the foot' in that the bugs were being fixed relatively slowly and with the hope that users would visit the BODC web site to learn about the fixes. Ms Weatherall responded that it was the intention to email users with this information every 6 months but first the software to enable users to update their copies of the GDA needed to be tested, preferably by the SCDB before the end of August 2005 **[Action All].** The software would be based on either GMT or the Windows-based interface in the GDA.

39. The Chairman concluded that the bugs definitely needed to be fixed but he reminded the Committee that in 2004 GEBCO had decided to develop a new grid in parallel with maintaining the GDA and this doubled the workload. What was happening to the new grid? Dr Sharman responded that GEBCO needed to be pragmatic; it should make the fixes and Windows software available via the NGDC and BODC web sites as soon as the software was working. Then software for Unix boxes should be developed too as a move towards platform independence. Ms Weatherall replied that the software would be installed on an ftp site and that new purchasers of the GDA-CE would be informed. Mr Tani urged that all owners of the GDA should be emailed about the bugs and fixes as soon as possible to avoid damaging GEBCO. Dr Goodwillie noted that this was an example of better communications being required within GEBCO because he had been unaware of the bugs until the previous day.

3.7 Report on new World Chart from GDA-CE

40. A report from Dr Jakobsson on the World Map Project was tabled (Annex 12). A draft map at 1:35 million scale based on the GDA grid had been produced in Stockholm in two weeks with the assistance of two Nippon Foundation/GEBCO students. Once an Editorial Board had been established it was anticipated that printing could begin in Fall 2005.

3.8 Report on connections to the Nippon Foundation/GEBCO Training Project

41. Mr Monahan, the NF/GEBCO Training Project Manager, reported on assistance given to the NF/GEBCO Training Project students by members of the GEBCO community. He said that some people had visited and lectured to the students, some had offered data and others were about to receive students in their labs or on their research cruises. Although in Year 1 of the project funds had been available for both lab visits and cruise participation, in Year 2 it would be possible for a student to take only one of these options. Mr Monahan invited those present to offer places in the coming months **[Action All].** He continued that the arrangements in Year 3 promised to be different yet again. The President of the Nippon Foundation had indicated to him that in future he wanted the choice of students not to be constrained by their country of origin so that, for example, the students might all come from a single geographical area and could work together on the bathymetry of a single region, possibly with the help of members of the GEBCO community.

42. The Chairman enquired whether the concept of Work Packages had been abandoned and whether projects to be discussed under Agenda Item 4 might be suitable for such work. The Project Manager replied that at present the severe budget curtailment by the Nippon Foundation precluded not only Work Packages but also Project Fellowships. He added that the students are

very busy during the year and that their projects were best addressed during lab visits in the summer which, subject to funding of US$2500 per student, could last up to two months. Dr Fox said that NGDC could make use of the students and would welcome them to carry out summer projects. Mr Tani confirmed how useful such a visit had been to him personally some years ago. It was agreed that Dr Fox and the Project Manager would discuss the way forward **[Action Dr Fox, Project Manager].**

3.9 Status of the proposed new SCOR WG on critical bathymetry

43. The Permanent Secretary informed the Committee of the history and current status of the proposal, prepared largely by Dr Sharman, entitled 'Proposal for a Critical Bathymetric Studies Working Group'. He said that the proposal was going to be considered by the SCOR Executive Committee in early September. [Note. It was not funded. See GC Minutes, Annex 9.]

3.10 Review of the "straw-man" blend of the GEBCO and altimetry grids

44. The Chairman reminded the Committee that in 2004 GEBCO had decided to develop two grids in parallel, a grid based on 500m contours and a grid based on soundings alone. He had sent an email about this after the meeting in Porto Venere but, other than comments from Karen Marks, had had no feedback.

45. Dr Fox enquired whether GEBCO was anxious for the grid cell offset problem in ETOPO2 to be fixed and whether NGDC could implement the GDA-CE either in its original or updated form. The Chairman responded that he was in the process of merging the GEBCO grid and an improved version of the satellite altimetry grid using a rule-based system, but that it might take 1-2 years. Dr Sharman responded that NGDC did want to correct the ETOPO2 grid and some other bugs. He expected a new protocol for the correction to be available in 6 months with upgrades thereafter.

47. In conclusion the Chairman stated that he would email the Committee about the new grid with a plan of action **[Action Chairman].** Dr Carron requested that Ms Weatherall email all the grid builders to ensure they were aware of all the updates needed to their grids **[Action Ms Weatherall].** Dr Goodwillie added that maintenance - and updating - of the component grids of the GDA-CE (such as the Indian Ocean grid) needs to become centralised because the more GEBCO moves away from 2003, the less likely it is that the original gridder will be available or willing to continue working on his/her grid. He enquired whether BODC could take over the Indian Ocean grid and others like it. The Chairman agreed that there was a problem in archiving these valuable data sets and asked BODC to take on the job. Ms Weatherall replied that BODC was aware of the problem and that it would like to archive the definitive dataset and she invited the gridders to submit their sub-grids to her **[Action All Gridders].** She added that she personally was unable to carry out updates to the grids but would depend on the grid builders to do so.

3.11 Other items

48. Activities at the Lamont-Doherty Earth Observatory. Dr Goodwillie reported on the Marine Geoscience Data Management System (mgDMS) at Lamont Doherty Earth Observatory (LDEO) where he now worked. He told the Committee that the mgDMS had been set up as a direct result of the recognition by the NSF that it was necessary to support the archiving of cruise data. The LDEO had made a successful bid to archive data collected in the RIDGE2000 and US MARGINS Programmes. Data from polar regions, e.g. R.V. *Nathaniel Palmer* cruises, and from the international RIDGE programme were being added but not data from other non-U.S. national ridge investigations. Dr Goodwillie gave an on-line demonstration of the mgDMS and GeoMapApp systems to show their power and versatility. He continued that a relational database was being constructed with metadata and links were being included to other databases such as the

University of Texas data bank of multichannel seismic data, petrological databases, IODP and ODP etc. The metadata can be interrogated and data can be freely downloaded. In response to a question Dr Goodwillie stated that he did not know whether the incorporated RIDGE multibeam data were in corrected or uncorrected metres [subsequently it was ascertained that some are corrected and some not]. He acknowledged that although such information should be in the metadata these were not always complete for cruises that had happened ten or more years ago.

49. Dr Goodwillie continued that the mgDMS web site also included a world map, based on the Smith and Sandwell (1997) satellite altimetry, which had been set up by Bill Haxby. It includes multibeam bathymetry and earthquake epicentres. The map contains fixed images which the user can zoom in to and the display parameters can also be varied. In principle it is possible to add other parameters; for example, the grid in the GEBCO GDA can be readily imported into GeoMapApp. Dr Goodwillie concluded by emphasising the current trend towards dynamic Web Map Services (WMS), a very specific but incredibly powerful map-based presentation function, as a way of presenting data over the internet.

50. Dr Fox added that NGDC was working closely with Scripps and LDEO. Dr Goodwillie explained that Bill Haxby at LDEO had been developing a global bathymetric DEM as part of GeoMapApp. This DEM included multibeam files from about 180 cruises. He announced that his group had received notification of NSF funding to reprocess all of the multibeam data holdings from the UNOLS fleet which are kept at NGDC. The Lamont group would obtain the files from NGDC and process them according to a standardised procedure. The freshly processed multibeam files would then (a) be included into Dr Haxby's DEM and (b) be sent to NGDC for long-term archiving.

51. Dr Goodwillie asked whether GEBCO had an interest in the GDA grid being included in the mgDMS system. Mr Monahan, Chairman of GEBCO, responded that this would be discussed by the Guiding Committee in the following days **[Action Guiding Committee].**

52. In answer to a question from Mr Pharaoh, who mentioned that IHO was developing its own standard, Dr Goodwillie explained that the metadata were created in NASA's standard DIF format; the format was driven by the needs of the US UNOLS fleet and the RIDGE2000 and US MARGINS communities. Dr Fox added that NGDC has to use a U.S. Federal Geographic Data Committee (FGDC) standard for its metadata. Dr Sharman added that Dale Chayes is piloting an effort to arrive at a metadata structure for marine geology and geophysics data.

53. Mr Tani enquired how long the mgDMS was funded and what would happen if it was closed down. Dr Goodwillie replied that he was very optimistic that mgDMS would continue because it was strongly supported by NSF but if it closed he thought that enforcement by NSF of its data policies should ensure that old data would remain available and that new data would become available.

4. SCIENTIFIC AND TECHNICAL OPPORTUNITIES AND CHALLENGES AHEAD

4.1 High-resolution coastlines and land elevation data

54. The Chairman introduced the item and noted that problems arise when the grid size changes because the coastline can change shape. Dr Sharman responded by saying he thought this was the wrong philosophical approach because the coastline was not a two-dimensional feature but a fractal with a dimension between one and two. He said that he wanted to separate the shoreline from the grid. The Chairman responded that inevitably a land/sea mask was needed. Dr Carron thought that this was just one example of the decisions that needed to be taken. He proposed that interested parties should meet over the weekend and decide on the way forward.

4.2 'Mining' shallow water soundings from DNCs and ENCs

55. The Chairman noted that several people had worked on the problem of mining shallow water data from digital navigational charts (DNCs; produced by NGA/NATO) and electronic navigational charts (ENCs) (Annex 13). This number included Mr Rankin who regrettably had been prevented by Tropical Storm Cindy and Hurricane Dennis from travelling to Aguascalientes. It was also a problem of interest to the IHB who might be able to offer help. Mr Pharaoh responded and summarized the present situation (Annex 14). He noted that GEBCO had realised 7 years ago that a lot of shallow water data was held by Hydrographic Offices and consequently the IHB had sent out a Circular Letter asking for data to be submitted as contours. The upshot had been that a single HO had offered data as a grid and some others had indicated they would treat requests on an *ad hoc* basis. Very little data had eventually been offered to the BODC mainly because of a reluctance to release data, much of which was analogue, but also because bathymetric charts were a low priority. The problem today was how to obtain digital data ready for use.

56. Mr Pharaoh concluded by saying that Navigational Purpose charts 2 and 3 were the most useful for GEBCO. He thought that the data would be easy to obtain, if an HO agreed, provided that the HO was given the software to extract the data from their files. Requests for ENC data could be made through the IHB. DNCs had copyright problems.

57. The Chairman remarked that how the data were to be used was a problem to be addressed by a breakout group. He asked whether requests should be for averaged data to increase the chance of success. Mr Pharaoh replied that that might be an option if there were copyright problems. He recommended that GEBCO should ask first, for soundings, and second, for averaged depths. It was important not to expect the HOs to commit much staff time to a request.

58. Mr Monahan confirmed that Mr Pharaoh's approach was sound. He said GEBCO needed to get one HO to contribute first as a model for others to follow.

59. In the ensuing discussion, Dr Falconer noted that the needs of tsunami modellers might be a big incentive for HO's to provide data for water depths of less than 500m. The Chairman commented that shoal bias was probably an unavoidable problem and suggested that working with such data might be a good project for the Nippon Foundation/GEBCO students. Mr Monahan concurred it would make a good project.

60. Mr Pharaoh offered to draft some suitable text to ask the IHB to initiate a general request for shallow water data. At this point Mr Tani sounded a note of caution. He said that permission would be needed if the extracted data were not to be used for navigation and that asking for shallow water soundings raised questions of national security; most countries want to keep their shallow water data to themselves. He continued that it does no harm to ask but he predicted that most countries would emphatically turn down any request for shallow water data. Mr Pharaoh concluded by saying that the idea could be dropped if those people present from Hydrographic Offices rejected the idea. In any case a very strong case would need to be made that giving shallow water data to GEBCO would be of benefit to the Member States. The Chairman concluded that a small group consisting of himself, Ms Weatherall and Dr Cramer should work with Mr Pharaoh **[Action Chairman, Mr Pharaoh, Ms Weatherall, Dr Cramer]**. The development of software to extract the data was regarded as relatively straight forward and such software might even already exist.

4.3 GDA track line and contour intersections

61. The Chairman enquired whether it was feasible or even useful to make a list of GDA track line and contour intersections. Two preliminary approaches are described in Annexes 15 and 16.

5. HOW SHALL WE WORK TOWARDS FUTURE GOALS AND PRODUCTS?

62. The Chairman suggested three areas that required action by the Committee. They were, 1) update the existing grid and the GDA; fix bugs; 2) pursue the vision of a smaller grid interval or a variably sized grid; 3) meet the need for moderate resolution global products that include all available data.

63. Although Dr Fox noted that there was already action in many of these areas Dr Goodwillie said he believed that there was a danger of GEBCO spreading its resources too thinly. He thought that GEBCO should concentrate or focus on limited problems. The Chairman agreed that there was a tension between GEBCO's dreams and its resources. Dr Falconer commented that he thought the first objective was straightforward, the second was a long-term goal and the third needed further discussion and clarification. Dr Loughridge warned that care was needed in defining what was meant by 'grid'. GEBCO's eventual aim should be to create a high-resolution, but partly populated, grid. Such a grid would need to include both shallow-water data and depths computed from satellite altimetry. Dr Loughridge asked who, in future, would hand-contour large areas of ocean because there was unlikely to be a successor to Dr Fisher. He ended by saying that a fresh approach was required.

64. Dr Goodwillie noted that the GeoMapApp DEM being developed at LDEO already had variable resolution (100m in areas covered with 12kHz multibeam) and that, crucially, it uses the Smith and Sandwell predicted bathymetry as its base layer. He emphasised that there would be, therefore, very little difference between this GeoMapApp DEM and any new GEBCO global grid. Dr Fox replied that GEBCO could contribute expertise in interpreting bathymetry but better internal electronic communication was essential to tap this expertise. Mr Tani said that GEBCO could work to encourage people to fill the many gaps in the distribution of soundings (only 10% of the sea floor was covered by multibeam bathymetry); Mr Macnab reminded the Committee that exactly that had been proposed in Porto Venere in 2004.

65. The discussion continued with Dr Loughridge stressing that only 'doable' tasks should be considered to attain the three objectives such as fixing bugs, reducing errors, obtaining shallow-water data and gathering more data.

66. Dr Sharman suggested that the Committee should consider who the 'customers' would be for GEBCO's products. For example, the recent tsunami had revealed that the GDA does not provide the most accurate bathymetry because it contains fewer seamounts than are known from bathymetry computed from satellite bathymetry. Consequently, NGDC was developing grids for the Pacific Marine Environmental Laboratory (PMEL) with 1'-2' grids in deep water, 3"-18" nearer the coast and 1"-2" in the inundation zone. The Chairman concurred and said that NOAA had already recognised that the distribution and shape of seamounts were very important for modelling the propagation and amplitude of tsunamis.

67. Dr Falconer returned to the Chairman's third point. He did not think that it had been answered at the scale of a 1'grid. Not only did the existing grid need 'patching up' but there was a also need for a revised version of the GDA. The Chairman responded that real data and computed depths

from satellite altimetry could be combined in many ways to create a version 2. For example, only nodes far from a ship track would be filled with computed depths and in areas where research ships had used astronomical navigation the soundings could at least be used to calibrate the function relating satellite gravity to bathymetry.

68. Dr Goodwillie stated that, with help from Nippon Foundation/GEBCO students, he would like to see the creation of a 0.1' grid for the Pacific Ocean that would include all available data soundings, multibeam surveys and depths computed from satellite altimetry. In his opinion it was too ambitious of GEBCO, with its limited resources, to consider gridding the whole world. Mr Macnab agreed; he said that the Regional Mapping Working Group, which he chaired, had come to the conclusion that it was better to divide the world into manageable areas each of which could become the responsibility of a small group. Dr Fox added that he thought a better approach, given current technology, was to create a variable density grid to avoid a multitude of empty nodes. Dr Carron noted that it was meaningless to speak of populating a grid with satellite derived depths at a grid scale (say 0.1') much smaller than the resolution of current altimetry. Dr Sharman concurred with the previous two speakers and said that even if a variable grid was used it would mostly be a 1'-2' grid.

69. Dr Fox mentioned that NOAA and PMEL were the lead US institutions for tsunami prediction and modelling. They had already received requests to model tsunamis for other Pacific and Caribbean countries. He enquired whether GEBCO wished to support this work and to connect with the modellers and bathymetrists involved. The Chairman noted that inundation and run-up were local problems, and asked whether GEBCO, historically having had a global and regional focus, could help with local problems.

70. Dr. Schenke said he thought that the discussion had been very valuable and he would like to see a small group work up such ideas, perhaps in collaboration with the Nippon Foundation/GEBCO students, for the Committee.

71. After a break the Chairman summarised he discussion so far as,

a) agreeing to update existing products
b) supporting a vision of higher resolution, but variable, grids
c) noting Dr Goodwillie's proposal to concentrate on the Pacific Ocean,

and as defining two tasks,

d) improving the existing grid and
e) developing, in parallel with d), a new non-contour based grid that would include depths mined from shallow water.

72. The Chairman then returned to the subject of tsunamis and stressed the importance of seamount altitude on tsunami propagation. Consequently, he continued, there was an immediate need for intermediate resolution global bathymetry and, if GEBCO did not provide it, others would. Dr Carron noted that many good shallow-water grids already existed in the GDA and could be updated. He feared that relying on data from ENCs would take too long. Dr Sharman expressed the view that it was essential for the health of GEBCO that it was involved; the NGDC could provide support by quality controlling the data, for example. Dr Goodwillie expressed his concern at the lack of manpower resources within GEBCO. The Chairman stated that it was time to improve the satellite bathymetry produced in 2000, for example by the addition of a better coastline and shallow water data, and such a dataset could be fed into GEBCO's next grid. He saw the main problem to be the creation of the database of ship-acquired data which was required to calibrate depths based on satellite observations. Who would create such a database?

73. Mr Monahan interjected that it was important to separate technical and policy issues in this discussion. One alternative, among many, was simply to do nothing! In any event, he continued,

GEBCO cannot compete with the coverage of the Smith & Sandwell maps and it had to find its niche. If GEBCO could play a part in the creation of a new Smith & Sandwell map it would benefit.

74. Dr Loughridge said he backed the idea of working on the Pacific Ocean; there was an identified 'customer', a clear need and it could be done quite quickly with Guiding Committee support. The Chairman noted that there was a groundswell of opinion in the USA for a new product that included depths from satellite altimetry. If GEBCO wanted to give this product an international dimension it could do so given the wide range of contacts accessible through the Committee and GEBCO as a whole. The Chairman noted that GEBCO could postpone a decision until the new map was ready. In answer to a question from Dr Modesto the Chairman confirmed that the Smith & Sandwell map worked better than the GDA for tsunami propagation studies because it contained a more realistic bottom roughness at wavelengths of <100 km.

75. It appeared at this point that a large majority of the SCDB wanted to build something global and better than what currently existed in the GDA-CE. Some of that majority would also argue that GEBCO should start building the data base upon which that product will rely, such as Dr Hall's suggestion that GEBCO should build a mostly empty 0.1 minute grid and hope to slowly populate it with multibeam surveys. Some in that group would also say that global progress will inevitably occur regionally and would try to set priorities for the sequence of efforts, such as starting with the South Pacific. A small minority would propose that GEBCO focuses on specific regional efforts only, and give up, for now, on a global product. Nevertheless there was confidence that the SCDB and others will work together in spite of some inevitable differences about the best ways to proceed.

76. Returning to the Agenda the Chairman summarised the following three items as follows.

5.1 Two grids in parallel, or one grid only?

77. The 'gridders' do not wish to work on two grids at once. Dr Sharman stated that there was an order of magnitude difference between maintaining the old grid and developing a new grid. In his opinion GEBCO should aim at maintenance and development and not at developing both grids in parallel. The Chairman noted that this was different from the decision in Porto Venere (April 2004) to allow both grids to be updated and to grow with time. Dr Goodwillie responded that very few people wanted to work on the new grid; thus, the only other resource available was the Nippon Foundation/GEBCO students. Dr Loughridge asked when the old grid should be abandoned. He thought that once the new grid existed the old one should be abandoned. The Chairman concurred. He concluded that only bugs should be corrected in the old (GDA-CE, 2003) grid and that all maintenance should stop at some point (perhaps mid-2006) after which all efforts would be put into the new grid.

5.2 Moving from contour-driven grids to grid-driven contours in the GDA

78. If GEBCO uses original observations (soundings etc.) it was inevitable that this would lead to grid-driven contours.

5.3 Procedures for product update and distribution

79. The Chairman noted that LDEO has been unable to include the GDA among its web-based maps simply because the grid had to be protected from free distribution. He noted that the Committee members wished to remind the Guiding Committee that the decision to make the grid freely

available had already been taken in Porto Venere in 2004 and urged the GC to make it so **[Action Chairman].**

80. Ms Weatherall confirmed that BODC was prepared to take over the task of updating the GDA grid subject to discussions with the gridding group **[Action Ms Weatherall].**

81. Dr Loughridge noted that nothing had been heard so far about peer review. He asked what the SCDB policy was on this issue. The Chairman replied that peer review could work at two levels depending on the source of a submitted grid. Existing gridders were well aware of the inherent problems and their work should be easy to review. Grids submitted by others might need more review. Dr Sharman noted that the Regional Mapping Projects operate a peer review system and suggested that the Bathymetric Editor was tasked with seeking out reviewers.

5.4 Update of GEBCO Guidelines and Terms of Reference

82. GEBCO Bathymetric Editor. The Committee reviewed the Terms of Reference of the Bathymetric Editor. The Chairman expressed the view that it was now too much to expect one individual to keep in touch with the acquisition of all new data worldwide. It was agreed that the Mr Hunter should be asked to comment on revising the existing Terms of Reference first **[Action Chairman].** Dr Goodwillie pointed out that the Terms of Reference were 14 years old. [Since this meeting Mr Colin Jacobs has taken over from Mr Hunter].

83. GEBCO Digital Atlas Manager. The Committee reviewed draft Terms of Reference submitted by the Atlas Manager (Annex 17). After a short discussion, including some suggested changes, the Chairman proposed that the revised Terms of Reference should be referred to the Guiding Committee **[Action Chairman].** Ms Weatherall confirmed that her line manager was very supportive of the work that she and Dr Cramer did for GEBCO.

84. Sub-Committee on Digital Bathymetry (SCDB). The Chairman expressed the view that the Committee should redraft its own Terms of Reference; the published Guidelines did not help to guide the Committee in its work **[Action All].** Cdr. Shipman noted that from the point of view of the IHO it was vital from time to time to reconsider the Terms of Reference of the SCDB. Suggested changes should be passed to the Guiding Committee in the first instance but the Terms of Reference should not be over prescriptive.

6. PRESENTATIONS BY MEXICAN SCIENTISTS

85. Several presentations were made by Mexican scientists about their work some of which appear as Annexes 18 and 19 at the end of this report.

6.1 Dr Carlos Mortera. 'Visiting the Pacific seafloor in the Mexican sector with multibeam surveys'.

6.2 Dr Modesto Ortiz. 'On the search for the sea-level datum 1983-2001 along the coast of Mexico'. (Annex 18)

6.3 Dr Pilar Luna. '1630-1631 New Spain's Fleet Research Project' (Annex 19)

6.4 José Luis Ornelas (INEGI). 'Interoperability to access distributed spatial data'

6.5 Cesar Navarro, PEMEX. 'Bathymetry in petroleum exploration'
Mr Navarro said that PEMEX data were available to GEBCO **[Action Dr Frias].**

7. ANY OTHER BUSINESS

86. Dr Goodwillie asked that a draft version of the Minutes be circulated to all those present. This was considered to be a topic for the Guiding Committee to discuss.

8. CLOSURE OF THE MEETING

87. The Chairman thanked the Mexican hosts of the meeting for their very good logistical arrangements and for arranging such excellent presentations by scientists. There being no other business the Chairman closed the meeting at 1752.

ANNEX 1

Twenty-first Meeting of the GEBCO Sub-Committee on Digital Bathymetry in the Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes, Mexico
7th – 8th July, 2005

AGENDA

1. OPENING OF THE MEETING AND WELCOME FROM INEGI HOSTS

2. CONDUCT OF THE MEETING

2.1 Adoption of the Agenda

2.2 Tabling of Documents

2.3 Scheduling of oral and poster scientific and technical presentations

3. REVIEW OF ON-GOING ACTIVITIES AND CURRENT PRODUCTS

3.1 Report of the GEBCO Bathymetric Editor

3.2 Report of the GDA Manager

3.3 Report of the IHO DCDB

3.4 Reports of liaisons with IBCs, regional data centers, and SCUFN

3.5 Review of bathymetric mapping worldwide

3.6 Review of known problems and planned updates in the GDA-CE contours, grid, or other features.(Note product update and distribution is under Agenda item 5.3)

3.7 Report on new World Chart from GDA-CE.

3.8 Report on connections to NF/GEBCO Training Project

3.9 Status of the proposed new SCOR WG on critical bathymetry

3.10 Review of the "straw-man" blend of the GEBCO and altimetry grids

3.11 Other items

4. SCIENTIFIC AND TECHNICAL OPPORTUNITIES AND CHALLENGES AHEAD

4.1 High-resolution coastlines and land elevation data

4.2 Mining shallow water soundings from DNCs and ENCs

4.3 GDA track line and contour intersections

4.4 Other new sources or contributions of data

4.5 Data required to support tsunami propagation and run-up models

4.6 Characterizing quality or confidence limits in the grid

4.7 New opportunity for digitizing analog sounding sheets at UNH

4.8 Other opportunities, challenges, and projects we want to work on

5. HOW SHALL WE WORK TOWARD FUTURE GOALS AND PRODUCTS?

5.1 Two grids in parallel, or one grid only?

5.2 Moving from contour-driven grids to grid-driven contours in the GDA

5.3 Procedures for product update and distribution

5.4 Update of GEBCO Guidelines and Terms of Reference

6. ANY OTHER BUSINESS

7. CLOSURE OF THE MEETING

ANNEX 2
Report of the GEBCO Digital Atlas Manager

April 2004 – June 2005
by Pauline Weatherall

This report includes the work carried out by staff at the British Oceanographic Data Centre (BODC) for the GEBCO project between April 2004 and June 2005.

Receipt of updates to the GEBCO One Minute Grid

Updates to the GEBCO One Minute Grid have been received from Bill Rankin of the United States Naval Oceanographic Office. These sections of grid were created to fix bugs in the original grid.

The updates are for:

1. The Hudson Bay area, to fix lines of discontinuity in the grid between 90°W and 77°W at 60°N and between 60°N and 51°N at 80°W.

2. An area off the west coast of Africa, to fix a line of discontinuity in the grid between 13°E and 13° 30'E at 10°S.

These bugs have been reported in the 'Hints, Bugs and Fixes' list hosted on BODC's web site (http://www.bodc.ac.uk/gebco).

The updates were supplied in the form of thirty degree square tiles.

Some quality control checks have been carried out on the data files.

Software development

Further development of the GEBCO Digital Atlas (GDA) Software Interface

Enhancements and fixes to the GDA Software Interface are being developed by Ray Cramer at BODC.

The two bugs reported on the BODC web site have been fixed.

New software features include the options to:

- **plot your own file of data points** using the GDA software interface. Up to 10 data files can be plotted at any one time (up to an arbitrary 5000 points each). The user can select the symbol style, colour and size used to display the data points. Attribute information can be stored with the position information and can be

queried in a similar manner to the undersea feature names data set currently available for display within the GDA.

- **select to display the position of undersea features by feature type**, e.g. select to display only seamounts and ridges.
- **use a 'magnifier'** to view specific regions of the displayed area in larger format.
- **label** simple point and line undersea features.
- **display a supplementary data toolbar,** allowing the user an easy mechanism to change the symbol style and colour used for displaying vector features such as contours and track lines.

Patch update software for the GEBCO One Minute Grid

Software has been developed to allow sections of grid to be 'patched' into the existing GEBCO One Minute Grid thus allowing users to update their copy of the data set. The software also increments the version number of the gridded data set.

Track line and contour intersection software

Software has been created to run against the GDA track lines and contour files to create a file of 'virtual sounding nodes', i.e. points where the bathymetric contour lines and track lines cross. A brief attempt to run this across a network as a distributed application proved slower than running on a dedicated high powered PC. The technique is more brute force than clever, and took 5 days of computer time.

Development and maintenance of the GEBCO Digital Atlas web pages hosted by BODC

As part of BODC's web site re-design project the GEBCO Digital Atlas web pages hosted by BODC have been updated and enhanced. In addition to the existing pages giving details about the GDA and its contents, new pages have been created giving information about the development of the GDA and the data sets included in it.

It is hoped to launch the new web site at the end of July 2005. A test version of the new GEBCO Digital Atlas web pages can be accessed from the following URL: http://wwwtest.bodc.ac.uk/projects/international/gebco/index.html.

GEBCO Digital Atlas promotion

An article about the GEBCO Digital Atlas and the GEBCO project was included in the summer 2004 edition of NERC's Planet Earth magazine.

GEBCO Digital Atlas user support

During the year we have dealt with over 60 enquiries relating to the GDA and its data sets. The enquiries include:

- requests for information on the availability of bathymetric data sets for particular areas
- requests for further information on the source of the data sets included in the GDA
- reports of potential bugs in the GDA data sets
- technical enquiries regarding the use of the software interface
- requests for information on data export formats and advice on importing the data into software systems
- requests for information relating to copyright and the use of the data outside normal copyright boundaries

In addition, over 220 CD-ROMs have been distributed during the year. Further details can be found in the GDA sales and distribution document at the end of this Annex.

In March 2005 GEBCO received £9,053 pounds in royalties from sales of the GDA during 2004.

Since January 2004 there have been over 3000 downloads from BODC's web site of the 20 degree square samples of the GEBCO One Grid and/or images produced from the grid for these 20 degree tiles.

Geographic Information System (GIS) data set development

Work has been done on the development of data sets from the GDA for use with GIS. Sample shape files of the undersea feature names, place names and island names files have been produced.

Some development work has also been done on the production of polygon shape files from the GEBCO bathymetric contours.

DISTRIBUTION/SALES OF THE CENTENARY EDITION OF THE GEBCO DIGITAL ATLAS (March 2003 – June 2005)

	SECTOR					
Country	**Gov**	**Univ**	**Comm**	**Other**	**Total**	
Algeria	1	-	-	-	1	(0)
Angola	1	-	-	-	1	(0)
Argentina	3	1	-	-	4	(1)
Australia	9	8	7	2	26	(23)
Austria	-	1	-	-	1	(1)
Bangladesh	1	-	-	-	1	(0)
Belgium	5	1	-	3	9	(2)
Benin	1	-	-	-	1	(0)
Brazil	1	-	-	-	1	(1)
Cameroon	1	1	-	1	3	(0)
Canada	10	6	6	2	24	(15)
Chile	3	-	-	3	6	(0)
China	3	2	-	2	7	(2)
Colombia	2	-	-	-	2	(0)
Comoros	1	-	-	-	1	(0)
Congo	1	-	-	-	1	(0)
Cote d'Ivoire	2	-	-	-	2	(0)
Croatia	1	-	-	-	1	(0)
Denmark	3	2	1	1	7	(6)
Dominica	1	-	-	-	1	(0)
Ecuador	1	-	-	-	1	(0)
Egypt	1	-	-	-	1	(0)
Estonia	2	-	-	2	4	(0)
Faeroes	2	-	-	-	2	(0)
Finland	2	1	1	-	4	(2)
France	16	3	6	9	34	(17)
Gabon	1	-	-	-	1	(0)
Germany	13	12	4	9	38	(31)
Ghana	1	-	-	1	2	(0)
Greece	-	-	-	1	1	(1)
Guinea	2	-	-	-	2	(0)
Hong Kong	-	1	1	-	2	(2)
Iceland	1	-	-	-	1	(0)
India	4	-	-	1	5	(2)
Indonesia	-	-	1	2	3	(1)
Ireland	1	3	-	4	8	(7)
Israel	1	-	-	-	1	(0)
Italy	7	1	1	9	18	(6)
Jamaica	1	-	-	-	1	(0)

	SECTOR					
Country	**Gov**	**Univ**	**Comm**	**Other**	**Total**	**(sold)**
Japan	4	11	5	3	23	(16)
Kenya	1	-	-	1	2	(0)
Korea	2	2	-	-	4	(4)
Madagascar	1	-	-	-	1	(0)
Mauritania	1	-	-	-	1	(0)
Mauritius	3	-	-	-	3	(0)
Mexico	5	-	-	-	5	(0)
Monaco	-	-	-	6	6	(0)
Morocco	2	-	-	-	2	(0)
Mozambique	2	-	-	-	2	(0)
Namibia	2	-	-	-	2	(1)
Netherlands	5	2	2	5	14	(8)
New Zealand	3	-	2	1	6	(3)
Nigeria	1	-	-	-	1	(0)
Norway	10	2	8	3	23	(15)
Oman	-	1	-	-	1	(1)
Pakistan	1	-	-	1	2	(0)
Panama	1	-	-	-	1	(0)
Peru	3	-	-	2	5	(0)
Philippines	-	1	-	2	3	(1)
Poland	3	-	-	1	4	(0)
Portugal	5	3	-	3	11	(5)
Russia	4	-	-	5	9	(1)
Senegal	1	-	-	-	1	(0)
Seychelles	4	-	-	-	4	(1)
South Africa	2	-	2	2	6	(3)
Spain	12	8	8	4	32	(30)
Sudan	-	-	-	1	1	(0)
Sweden	4	-	-	-	4	(2)
Switzerland	1	1	-	1	3	(3)
Tanzania	1	-	-	-	1	(0)
Togo	2	-	-	-	2	(0)
Tunisia	1	-	-	-	1	(0)
Ukraine	1	-	-	1	2	(0)
UK	43	34	43	33	153	(80)
USA	27	50	38	44	159	(98)
Vietnam	-	-	-	1	1	(0)
TOTAL	264	158	136	172	730	(392)

Figures above refer to total number of copies sold or distributed up to 30 June 2005. GOV = Government/Public funded organisation; UNIV = University; COMM = Commercial organisation. Number in parenthesis refers to total number of copies sold as opposed to complimentary copies.

DISTRIBUTION/SALES OF GEBCO DIGITAL ATLAS – SUMMARY STATISTICS (up to 30 June 2005)

a) Total number sold/distributed = 730 copies
Total number sold = 392 copies
Number of complimentary copies = 338 copies

b) Copies sold/distributed to 76 countries

c) Breakdown of copies sold/distributed by sector:

Government bodies	264 copies
University groups	158 copies
Commercial bodies	136 copies
Other organisations	172 copies

d) Distribution of 338 complimentary copies:

GEBCO Centenary Conference:	104 copies
Distributed by IHB on request from IHO member states:	24 copies
Distributed to UNCLOS Commissioners on request:	10 copies
Customers purchasing GEBCO-97 from 1 January 2002:	21 copies
International and UK national exchange:	179 copies

e) Sales/distribution by month:

2003	Sold	Gratis	T
Jan	-	-	-
Feb	-	-	-
Mar	-	4	4
Apr	25	114	139
May	44	46	90
Jun	34	9	43
Jul	23	28	51
Aug	14	1	15
Sep	22	39	61
Oct	14	16	30
Nov	10	1	11
Dec	11	1	12
Total	197	259	456

2004	Sold	Gratis	T
Jan	22	1	23
Feb	11	2	13
Mar	7	2	9
Apr	7	9	16
May	13	-	13
Jun	19	5	24
Jul	11	23	34
Aug	10	2	12
Sep	7	2	9
Oct	3	10	13
Nov	14	4	18
Dec	8	1	9
Total	133	61	193

2005	Sold	Gratis	Total
Jan	19	-	19
Feb	11	-	11
Mar	12	2	14
Apr	11	13	24
May	7	-	7
Jun	6	-	6
Jul	x	x	x
Aug	x	x	x
Sep	x	x	x
Oct	x	x	x
Nov	x	x	x
Dec	x	x	x
Total	66	15	81

T = total

ANNEX 3A

Reports to GEBCO

George Sharman, NGDC, Boulder, USA

July 2005

Aguascalientes, Mexico

I. REPORT OF THE INTERNATIONAL HYDROGRAPHIC ORGANIZATION DATA CENTER FOR DIGITAL BATHYMETRY (IHO DCDB)

I-A. Bathymetric Data Holdings and Global Database Management

Since the April 2004 Meeting of the GEBCO Sub-Committee on Digital Bathymetry, the National Geophysical Data Center (NGDC) has responded to 107 international requests for marine geology and geophysics data from 30 countries of which 27 are IHO Member States. This contrasts with over 522 total sales requests within this category from the U.S. over the same time. NOAA is currently transitioning to a new database for tracking orders and not all order information is accessible at this time. Hence, these numbers are lower than actual counts. Nevertheless, the overall number of requests is dropping, as is expected due to NGDC placing more data online for direct download.

Version 4.1.22 of the global Marine Track line Geophysics data set became available in June 2004 on a single DVD-ROM, which may be ordered online at http://www.ngdc.noaa.gov/mgg/fliers/03mgg02.html. The new release contains an additional 274,000 nautical miles of bathymetry, magnetics and gravity from 89 surveys, added since Version 4.1.18. Also provided on the DVD is GEODAS search and retrieval software, which runs under MS Windows®, UNIX Xwindows, and now Macintosh OS-X. NGDC's global Marine Track line Geophysics database continues to grow and now includes 43.6 million soundings from over 4,600 cruises. During this reporting period, 946,000 soundings were assimilated, originating from 87 cruises covering over 190,000 nautical miles.

NGDC's U.S. coastal database contains data collected during National Ocean Service (NOS) hydrographic survey operations. Over the reporting period, the database grew by 89 surveys and 417,474 soundings. The database now contains over 77 million soundings from 6532 surveys, providing valuable input to bathymetric base maps, Geographic Information Systems, geophysical exploration, coastal engineering studies, and seafloor habitat mapping. This database is the primary data source for NGDC's Coastal Relief Model efforts.

NGDC continues to archive digital side scan sonar data and imagery collected as part of NOS survey operations. These data contain digital files of track line side scan sonar data and cleaned, mosaiced imagery of the seafloor. NGDC is offering these large images for download over the internet, and is working to develop products derived from these data. Over 4 terabytes of side scan sonar data have been archived. The shear volume of the data is providing IT challenges in the areas of data archive, access, and product generation.

In an effort to make NOS hydrographic survey data more accessible and searchable, a new interactive map service has been constructed at NGDC. The NOS Hydrographic Survey Data Map Service at http://map.ngdc.noaa.gov/website/mgg/nos_hydro/viewer.htm is a data discovery and download tool that allows the user to quickly and easily make spatial or textual searches for surveys of interest, then download survey-related data products. NGDC is now archiving numerous digital data files of survey data, including metadata documents, survey plots, sounding data in XYZ and HYD93 formats, side scan sonar mosaics, shaded-relief images, and gridded data in text form. Over 8,600 NOS Descriptive Reports containing detailed survey metadata are currently available, in addition to over 23,000 final smooth sheet images scanned from original plots of the survey area using corrected hydrographic data. The map service enables NGDC to deliver these products, including high resolution multibeam and side scan sonar data, over one interactive, web-based system. In May 2005 the site recorded over 8,000 hits.

During the period April 1, 2004 through May 31, 2005, NGDC received a total of 190 gigabytes of deep-water multibeam bathymetric data comprising 63 surveys. The U.S. National Marine Fisheries sent a majority of this data (123 gigabytes). Also of significance was the 38 gigabytes downloaded from the Scripps Institution of Oceanography and 23 gigabytes from an NSF-LDEO joint effort for the U.S. Antarctic Program.

NGDC has developed an online access to its multibeam bathymetric data holdings using an interactive mapping tool with query capabilities at: http://map.ngdc.noaa.gov/website/mgg/multibeam/viewer.htm. The queries can be conducted using several parameters including ship, source (institution), and survey name. In addition, NGDC has provided an interactive website, which allows the user to generate color relief maps (with contours, if desired) and grids of the data using NOAA/PMEL's AutoChart, Generic Mapping Tools (GMT), and MBSystem software. The maps and grids are provided in Postscript and GMT formats, respectively, and users have the option to download the source data. Over this reporting period, the map received an average of 7,416 hits/month.

I-B. GEODAS Software Development

NGDC continues to enhance the GEODAS software management system. Originally developed to manage marine geophysical track line data, GEODAS has evolved into a universal software management tool, which can handle a variety of data formats and types including single-beam/multibeam, track line/survey, and gridded bathymetric/topographic data. The software serves users both as a desktop application on various NGDC CD and DVD products, and as an online search, display, and retrieval system.

The latest development is a prototype online utility that produces output in the form of the IHO B-4, Information Concerning Recent Bathymetric Data publication. This utility allows the user to search NGDC's worldwide bathymetry database and produce standardized individual and composite plots of survey track lines. Survey data and metadata for the area of interest is also available for download.

GEODAS Software runs under Microsoft® Windows™ for PCs, Xwindows for UNIX™, and Mac OS-X for Macintosh platforms. The window driven interfaces simplify data searches, guide users with a context-sensitive help system, and support color postscript and screen plotting capabilities.

I-C. Response to Request for Track line Bathymetry in the Indian Ocean

The IHO made an extraordinary request to the DCDB for track line bathymetry in the Indian Ocean following the 2004 tsunami. In response, the DCDB prepared and delivered six track line plots for possible presentation by Vice Admiral Alexandros Maratos, President of the IHO, at the conference of the North Indian Ocean Hydrographic Commission (NIOHC) taking place from 28 Feb to 1 March 05 in Jiddah, Saudi Arabia. The plots distinguish between multibeam data, single beam data with GPS, other single beam digital data, and analog data.

II. REPORT OF THE WDC FOR MARINE GEOLOGY &

GEOPHYSICS, BOULDER

NGDC, in its capacity as the World Data Center for Marine Geology and Geophysics (WDC MGG), Boulder, promotes excellence in archiving, managing, and exchanging data obtained from measurements of the seafloor, and works with national and international groups on many projects outside the scope of the IHO DCDB, GEBCO, and the IOC Regional Mapping Projects.

Although the WDC MGG, Boulder manages all types of data from the ocean floor including descriptions and analyses of seafloor samples, deep drilling data, underway geophysical measurements, and derived gridded data sets, only those areas dealing with bathymetry will be mentioned in this report.

II-A. U. S. – Canada Cooperation on New Bathymetry for the Great Lakes

New bathymetry for the Great Lakes has resulted from a long-term international cooperative effort between NOAA/ NGDC, NOAA/ Great Lakes Environmental Research Laboratory (GLERL), and the Canadian Hydrographic Service. Bathymetry is complete for Lakes Erie, St. Clair, Michigan, Ontario, and Huron, and is progressing steadily for Lake Superior.

NGDC maintains web pages for Great Lakes bathymetry at http://www.ngdc.noaa.gov/mgg/greatlakes/greatlakes.html. These pages provide direct links to the web of related external organizations including NOAA/GLERL, the Canadian Hydrographic Survey, and the Great Lakes Information Network. During the period from April 2004 to May 2005, an average of 27,816 hits per month was recorded for the Great Lakes web pages at NGDC. An interactive map has recently been developed for the Great Lakes, and is accessible from the Great Lakes web page. The map includes a coastline for the entire Great Lakes as well as bathymetric contours for Lakes Ontario, Michigan, Erie, St. Claire, and Huron. Lake Huron is the newest addition to the list. The web-based map service received 3,067 hits in its first month of production. Grids of Great Lakes data can be downloaded from the Great Lakes web page using GEODAS software for Lakes Michigan, Erie, and St Claire by clicking on the lake of interest and then clicking on the 'Create and download a custom grid of …' link.

II-B. U. S. – Japan Cooperative Program in Natural Resources (UJNR)

A UJNR Sea-Bottom Surveys Panel Meeting of the U.S.-Japan Cooperative Program in Natural Resources has not taken place since the 32nd Meeting held in February 2004. This panel continues as one of the principal mechanisms by which Japan and NGDC exchange technologies and marine geophysical data, including bathymetry.

II-C. WDC MGG, Boulder, On-Line Activities

The web pages of the WDC MGG, Boulder, collocated with those of the NGDC's Marine Geology and Geophysics Division, averaged 2,013,684 hits per month during the period from April 2004 through May 2005, compared with 2,840,968 hits per month over the last reporting period. Over this reporting period, users downloaded an average of 357

gigabytes of data from the MGG website each month, compared with 96 gigabytes per month during 2004. NGDC's web software no longer reports unique users or countries at the MGG divisional level, as identified in some previous reports. The WDC MGG website can be found at http://www.ngdc.noaa.gov/mgg/aboutmgg/aboutwdcmgg.html.

II-D. ETOPO2

In September 2001, NGDC published a high-resolution global topography and bathymetry database, ETOPO2. The database was a 2 arc-minute latitude-longitude grid of elevations and depths, compiled from a variety of sources, primarily the work of Smith and Sandwell's measured and estimated ocean depths between the 72° parallels, north and south, the GLOBE elevations for the land masses, and the IBCAO bathymetry and Greenland topography. After several years of exposure, a number of discrepancies have been detected by users. NGDC is currently working with colleagues to revise the database, correcting those and other discrepancies uncovered during quality assessment investigations. The GLOBE data will be resampled to account for differing grid registrations, and in particular, to eliminate the one-cell westward positional bias introduced in the original ETOPO2 compilation. The Smith and Sandwell database will be recalculated to remove some small north-south errors and NGDC will correctly position it in the east-west direction. The revised ETOPO2 database will have its new and consistent protocol documented and made available with the data. NGDC is considering the inclusion of a 1-minute version of the global topography and bathymetry.

II-E. New Educational Visualizations of Global Relief

Additional posters and animations of global imagery have been posted on http://www.ngdc.noaa.gov/mgg/image/globalimages.html, along with new videos of Coastal Relief Model and Marianas Trench animations, all accessible via the general images links at http://www.ngdc.noaa.gov/mgg/image/images.html.

II-F. NOS Bathymetric Fishing Maps

The interface for ordering scanned NOS Bathymetric and Fishing Maps continues to be an ArcIMS online map service with links to preview map images. Map layers include state boundaries, shaded relief, all maps or map types individually as bathymetry, fishing, preliminary, and topo/bathy. The existing TIFF and MrSid images on the CD-ROM set were converted to PDF form and placed online. The black and white preliminary maps are at their full resolution in PDF form, and directly downloadable to meet customer needs. Color bathymetry and color fishing maps were slightly degraded in resolution to speed up image loading times. Customer orders remain popular for paper copies of the maps and the scanned images on CD-ROM. For more information and a link to the ArcIMS map interface, please see: http://www.ngdc.noaa.gov/mgg/bathymetry/maps/nos_intro.html

III. REPORT OF NGDC ACTIVITIES IN SUPPORT OF IOC / GEBCO

III-A. IOC Regional Mapping Projects

In addition to participation in GEBCO, NGDC staff continues to take an active role in the IOC regional bathymetric mapping projects. Dr. Troy Holcombe serves on the Editorial Board of IBCCA, IBCEA, and IBCWIO; Dr. George Sharman continues as an active member of the Editorial Board of the IBCWP; and Dr. David Divins serves on the Editorial Board of the IBCAO and as a technical advisor to the IBCSEP. NGDC has also been involved in the development of a proposal for Building Capacity for Coastal Bathymetry in the northern Indian Ocean, especially those areas affected by the 26 December Tsunami.

1. Gulf of Mexico and Caribbean (IBCCA)

A CD-ROM containing vector contours and DEM data with color imagery for the completed IBCCA areas was released at the IOC General Assembly by the Instituto Nacionale de Estadistica, Geografia, y Informatica (INEGI) of Mexico. Additional data in the series is planned for later release. NGDC is using the IBCCA contours and other bathymetric data to construct a topographic/bathymetric grid for use in tsunami modeling at the US NOAA Center for Tsunami Inundation Mapping Efforts (TIME). The next IBCCA Editorial Board Meeting, originally scheduled for this year, has been postponed.

2. Mediterranean Sea (IBCM)

There was no reportable NGDC activity during the past year.

3. Arctic Ocean (IBCAO)

NGDC published the poster for the International Bathymetric Chart of the Arctic Ocean (IBCAO) in August 2004. The poster is part of NGDC's Research Publication series. To date, over 500 copies of the poster have been distributed. The color shaded relief poster portrays the bathymetry and topography of the Arctic region in a Polar Stereographic projection at a scale of 1:6,000,000 at 75º North. The poster was designed to replace or augment GEBCO Sheet 5-17.

4. Western Indian Ocean (IBCWIO)

There was no reportable NGDC activity during the past year..

5. Eastern Atlantic (IBCEA)

There was no reportable NGDC activity during the past year.

6. Eastern South Pacific (IBCSEP)

NGDC is currently working with the Hydrographic and Oceanographic Service of the

Chilean Navy (SHOA) to produce a bilingual web site for the IBCSEP.

7. Western Pacific (IBCWP)

Dr. David Divins attended the fourth meeting of the Editorial Board of the Western Pacific (IBCWP) in Hangzhou, China from 20 to 23 April 2004. The meeting was held in conjunction with the 6th IOC/WESTPAC International Scientific Symposium. It was agreed at the meeting that work should proceed for sheets where there was no mutual interest in the compiling of the sheet. For those sheets where two or more countries have expressed an interest in compiling and publishing the sheets, a method for the procedure would be worked so that it is agreeable to all parties.

8. Southern Ocean (IBCSO)

The first meeting of the IBCSO was held in Bremen, Germany, hosted by Hans Werner Schenke, in July 2004. NGDC did not attend.

III-B. GEBCO Reviewers Report:

1. North-East Pacific Ocean

While there are no major mapping programs in the Northeast Pacific, there are numerous small-scale studies and a host of ship activity. All of the major Universities and NOAA have ship's working in the northeast Pacific, including Lamont Doherty Earth Observatory's MAURICE EWING, NOAA's KA'IMIMOANA and RONALD H. BROWN, the University of Washington's THOMAS G. THOMPSON, Woods Hole Oceanographic Institution's ATLANTIS, Scripps's MELVILLE and ROGER REVELLE, and Oregon State University's WECOMA.

2. Caribbean Sea and Gulf of Mexico

While there are no major mapping programs in the Caribbean, there is significant ship activity. U.S. institutions, Universities, and NOAA all have vessels that periodically work in the area, and as this data becomes available, it may be incorporated into the bathymetric databases of the region.

III-C. Related Activities Supporting IOC / GEBCO Programs and Projects:

1. GEBCO On-Line Activities

1A. GEBCO Web Pages

The GEBCO web pages continue to be updated on a regular basis. Several new reviews of "The History of GEBCO, 1903-2003" were added to the web pages over the reporting period. Updated information/applications for the 2005-2006 round of postgraduate certificates in ocean bathymetry at the University of New Hampshire were added to the

web site in January of 2005, at the request of Dave Monahan. Contact information for the purchase of hard copy charts from Geopubs Ltd was updated, as well as prices for the maps on the web site. The GEBCO alphabetical contact list was updated continuously, as were committee/working group membership lists on the web site. Email addresses on the web pages continue to be protected by a scripting mechanism to prevent them from being harvested. Access to the GEBCO web pages at http://www.ngdc.noaa.gov/mgg/gebco/gebco.html has increased over the last year, averaging 18,242 hits per month.

1B. IBC Web Pages

Table I shows the web activity over this reporting period for the International Bathymetric Chart web sites hosted by NGDC.

Table I: Web Activity for Regional Mapping Project Sites

IBC	Updates	Average Hits/Month
IBCWIO	None	1,431
IBCAO	No update, poster published	13,027
IBCM	None	2,188
IBCCA	None	9,753
IBCEA	None	2,968

1C. GEBCO List Servers

NGDC continues to maintain the GEBCO Folk List Server to facilitate communication between members of the GEBCO personality list. The GEBCO list server, gebco_folk@mailman.ngdc.noaa.gov, was completely cleaned to match the GEBCO alphabetical web pages. List servers for the IBCAO, IBCCA, IBCEA, IBCSO, and GEBCO Gridders are also maintained by NGDC. During the past year, there has been virtually no traffic on the gebco_gridders list server. At the request of Prof. Bob Whitmarsh, Permanent Secretary of GEBCO, a new list was created, "gebco_guiding", for the Guiding Committee. The gebco_guiding, SCDB, and SCUFN list information pages were also linked to the corresponding committee web pages to facilitate their use by committee members. NGDC welcomes comments from the GEBCO community on how we can improve or enhance these services. A new list, scdb@mailman.ngdc.noaa.gov, was created and populated at the request of Walter Smith.

2. Coastal Relief Model Development

The Coastal Relief Model (CRM) for Puerto Rico (Volume 9) and Hawaii (Volume 10) were completed. All CRM data are now available online at http://www.ngdc.noaa.gov/mgg/coastal/coastal.html and are available on a single DVD-ROM, or 10 CD-ROM volumes. All NOS data were converted to a common horizontal datum, NAD83, while the vertical datum for individual surveys was retained. The development of the CRM for Alaska is underway with data quality control activities currently being performed.

3. Online IHO B-4 Development

The IHODCDB has historically been responsible for providing content for the IHO B-4, Information Concerning Recent Bathymetric Data. The bathymetric track line plots that the IHODCDB has assembled for the B-4 were a special product that utilized GEODAS to create small plots and manipulate data stored in MGD77 format. In order to increase the functionality of GEODAS for IHO users, the IHODCDB now offers the capability to search and select bathymetric track line data using 5th edition GEBCO, IBC, and INT chart limits as a spatial reference. These data may then be displayed and downloaded free of charge over the internet. Metadata for the area of interest is also available from GEODAS. Contrasted with prefabricated and static PDF forms, GEODAS allows the user to perform custom queries, and ensures that the most recent data are available. This specialized version of GEODAS could potentially be made available through the IHO web site.

4. Online Gazetteer of Undersea Feature Names

An online Gazetteer of undersea feature names interface is currently available as a developmental interactive map using ArcIMS, with access to underlying feature data from an Oracle database. The Gazetteer interface was presented at the SCUFN meeting last year in Moscow with a demonstration of its search and display capabilities. It allows the user to conduct spatial and textual searches for undersea features, enhanced by overlays of chart boundaries and GEBCO bathymetric contours. The interface will allow for the on-line submittal of new feature names, and can be used as a secure tool for the Gazetteer data manager to insert and update information in the database. The developmental map service is located at http://mapdevel.ngdc.noaa.gov/website/mgg/undersea_1.0/viewer.htm.

5. Bathymetric Modeling for the NOAA Tsunami Forecasting and Warning System

NGDC is developing a system of overlapping, basin-wide (1-2 arc-minutes) and intermediate grids (3-18 arc-seconds) for the Atlantic, Caribbean, and Gulf of Mexico in support of the U.S. National Tsunami Hazard Mitigation Program. NOAA has primary responsibility for providing tsunami warnings to the Nation, and a worldwide leadership role in tsunami observations and research. Detailed bathymetry is crucial to forecasting the potential effects of a tsunami and for the protection of life and property. A major thrust of this effort will be the identification of data sources and the acquisition of new data. Contacts are being established with federal, state, and local agencies for the coastal areas of the U.S. and Caribbean.

NGDC is assuming the role of bathymetric modelers for the NOAA Tsunami Forecasting and Warning System. NGDC will be building detailed bathymetry/topography grids for several small areas of the U.S. coastal zone each year. These inundation grids will be referenced to Mean High Water and will be made available to the public. The areas will be chosen by the tsunami modelers based on the perceived danger, data availability, population, and other factors. Planning is currently underway to make this activity international in scope in connection with the expanded network of DART (Deep-ocean Assessment and Reporting of Tsunamis) buoys used for tsunami warning purposes.

Appendix I

Sources of bathymetric data contributed to the NGDC during this reporting period:

Australia – Geoscience Australia
Japan – Japan Oceanographic Data Center
U.S. Antarctic Research Commission
Integrated Ocean Drilling Program
Scripps Institution of Oceanography
U.S. National Marine Fisheries Service
Lamont-Doherty Earth Observatory
NOAA Office of Ocean Exploration

Appendix II

Number of NGDC Marine Geology and Geophysics data requests fulfilled, by country during this reporting period:

Requests	Country
4	Australia
1	Belgium
4	Brazil
31	Canada
1	Chile
1	Costa Rica
1	Denmark
2	Finland
3	France
5	Germany
1	Great Britain
2	Iceland
1	Ireland
6	Italy
2	Jamaica
7	Japan
1	Monaco
1	Netherlands
2	New Zealand
3	Norway
1	Portugal
2	Republic of Korea
4	Russia
2	Saudi Arabia
1	Singapore
1	South Africa
3	Spain
4	Sweden
2	Switzerland
1	Trinidad and Tobago
8	United Kingdom
1	Virgin Islands U.S.

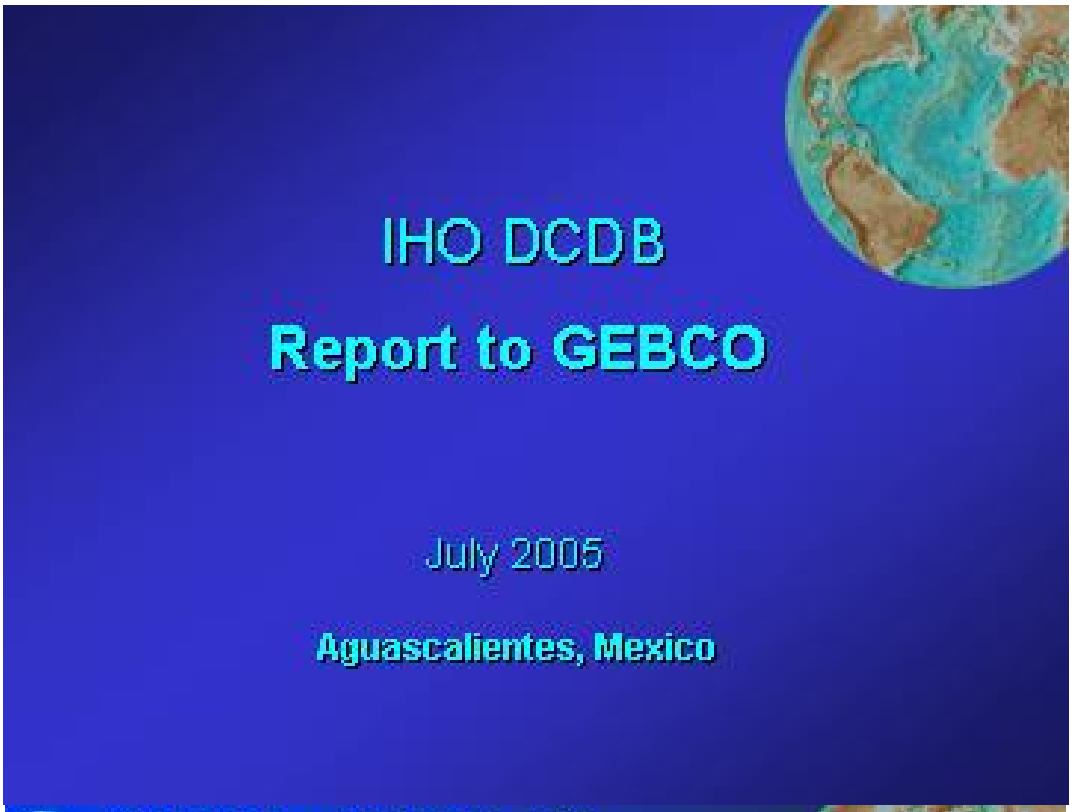
Appendix III

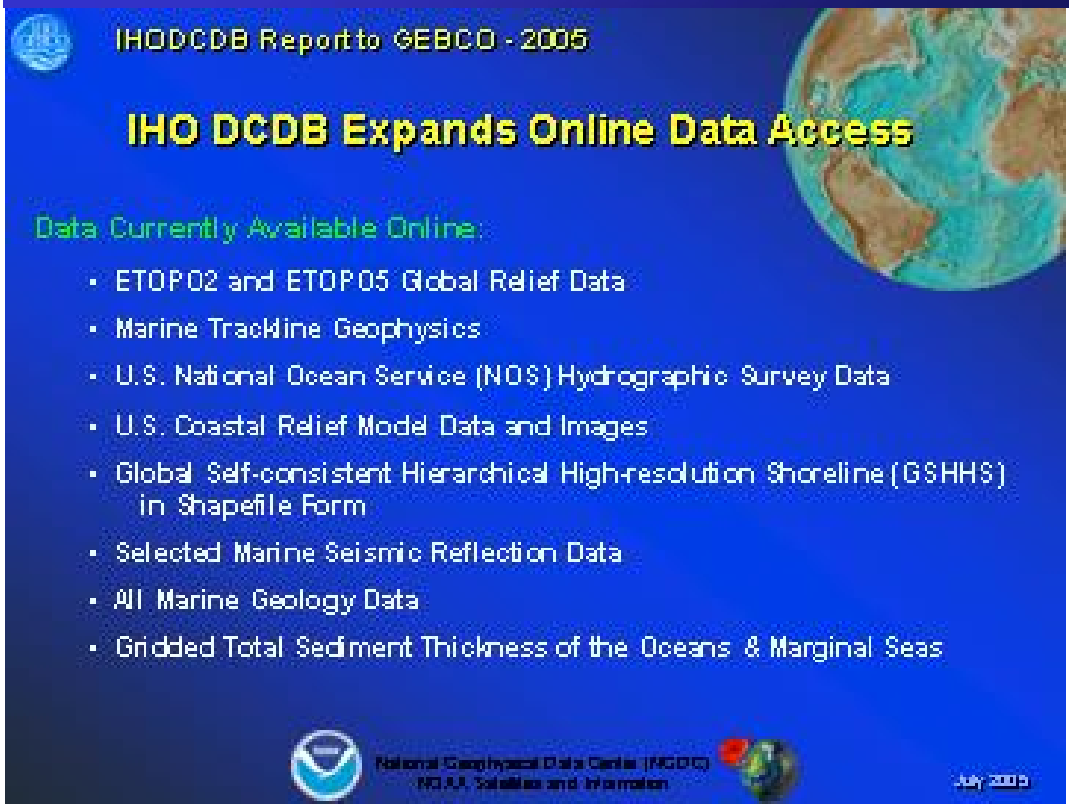
Number of cruises with bathymetry added to the Marine Track line Geophysics database, this reporting period:

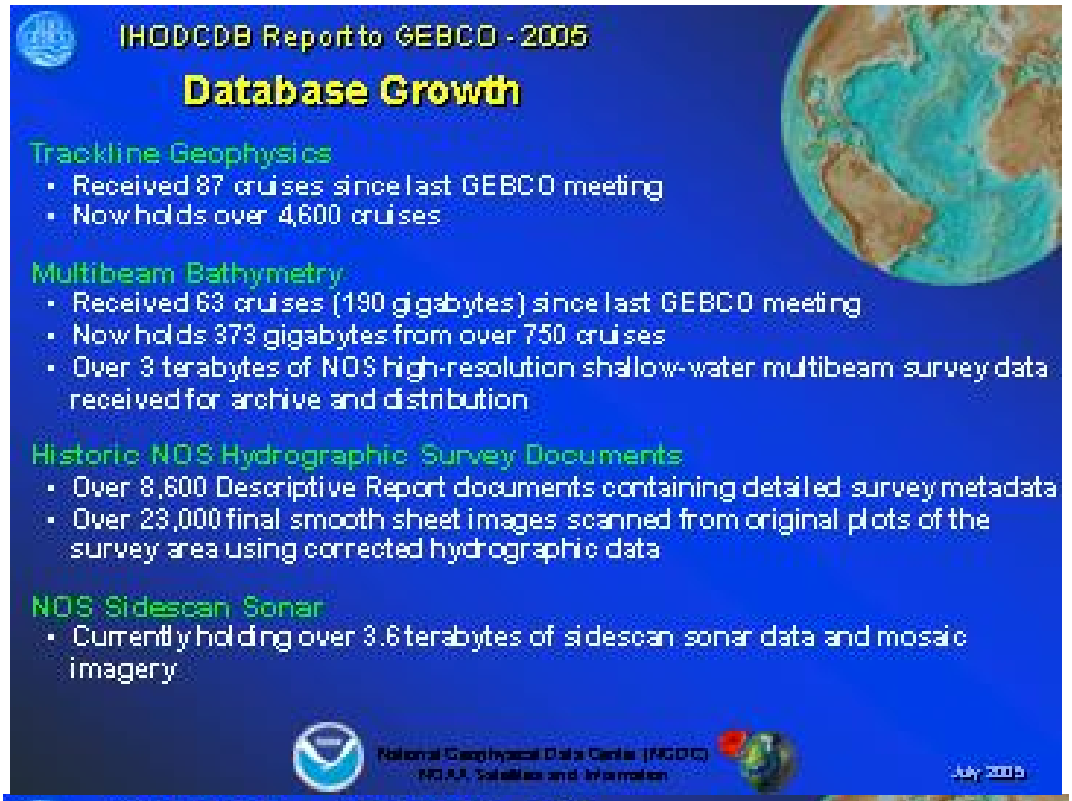
University of Texas	1
Scripps Institute of Oceanography	66
Integrated Ocean Drilling Program	20
Grand Total	87

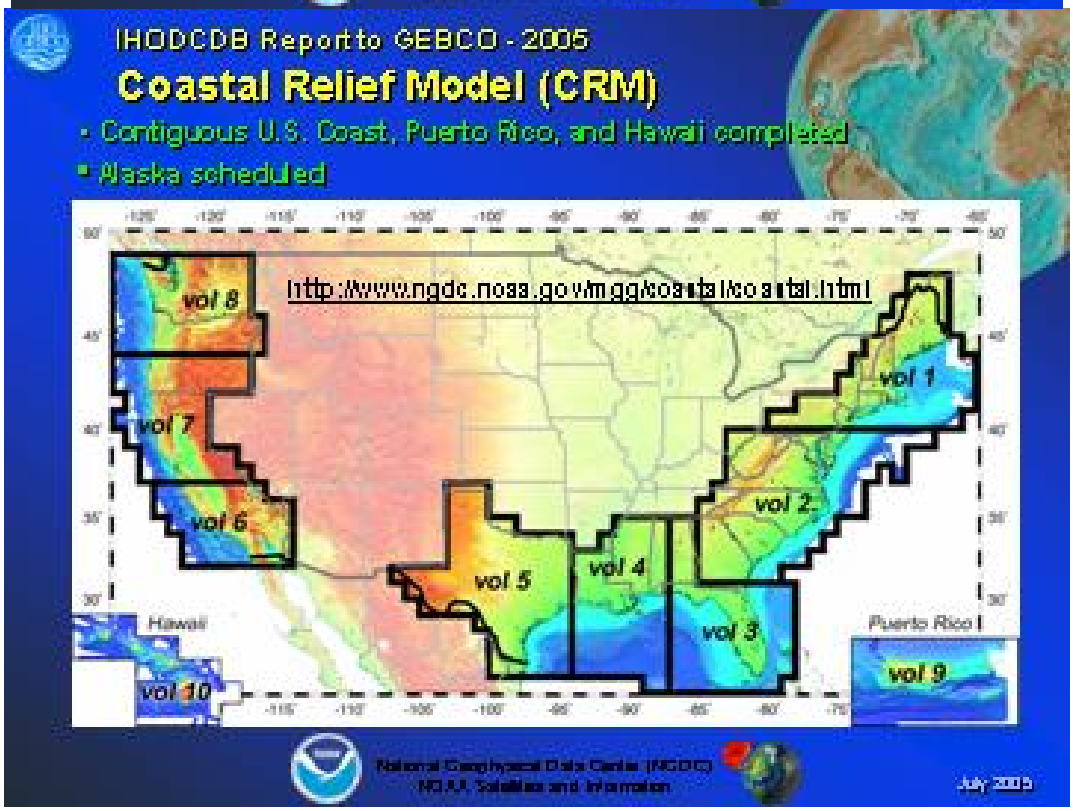
Number of cruises with bathymetry received during this reporting period:

Australia	78
USA	22
Japan	1
Grand Total	101


IHO DCDB
Report to GEBCO
July 2005
Aguascalientes, Mexico


IHODCDB Report to GEBCO - 2005
IHO DCDB Expands Online Data Access
Data Currently Available Online:
• ETOPO2 and ETOPO5 Global Relief Data
• Marine Trackline Geophysics
• U.S. National Ocean Service (NOS) Hydrographic Survey Data
• U.S. Coastal Relief Model Data and Images
• Global Self-consistent Hierarchical High-resolution Shoreline (GSHHS) in Shapefile Form
• Selected Marine Seismic Reflection Data
• All Marine Geology Data
• Gridded Total Sediment Thickness of the Oceans & Marginal Seas
National Geophysical Data Center (NGDC)
July 2005


IHODCDB Report to GEBCO - 2005
Database Growth
Trackline Geophysics
• Received 87 cruises since last GEBCO meeting
• Now holds over 4,600 cruises
Multibeam Bathymetry
• Received 63 cruises (190 gigabytes) since last GEBCO meeting
• Now holds 373 gigabytes from over 750 cruises
• Over 3 terabytes of NOS high-resolution shallow-water multibeam survey data received for archive and distribution
Historic NOS Hydrographic Survey Documents
• Over 8,600 Descriptive Report documents containing detailed survey metadata
• Over 23,000 final smooth sheet images scanned from original plots of the survey area using corrected hydrographic data
NOS Sidescan Sonar
• Currently holding over 3.6 terabytes of sidescan sonar data and mosaic imagery
National Geophysical Data Center (NGDC)
NOAA Satellite and Information
July 2005


IHODCDB Report to GEBCO - 2005
Coastal Relief Model (CRM)
• Contiguous U.S. Coast, Puerto Rico, and Hawaii completed
• Alaska scheduled
http://www.ngdc.noaa.gov/mgg/coastal/coastal.html
vol 8
vol 7
vol 6
vol 5
vol 4
vol 3
vol 2
vol 1
vol 9
vol 10
Hawaii
Puerto Rico
National Geophysical Data Center (NGDC)
NOAA Satellite and Information
July 2005

IHODCDB Report to GEBCO - 2005

New Products: Systems

On-demand Production of DVD-ROMs

- Coastal Relief Model Volumes 1 – 10
- Marine Geophysical Trackline Data, version 4.1.22
- NOS Hydrographic Survey Data, version 4.1.18

GEODAS for Macintosh OS-X

- GEODAS software is available for Macintosh OS-X at the following URL: http://www.ngdc.noaa.gov/mgg/dat/geodas/software/macintosh/geodas-install.dmg

New data and updated GEODAS software added since version 4.1

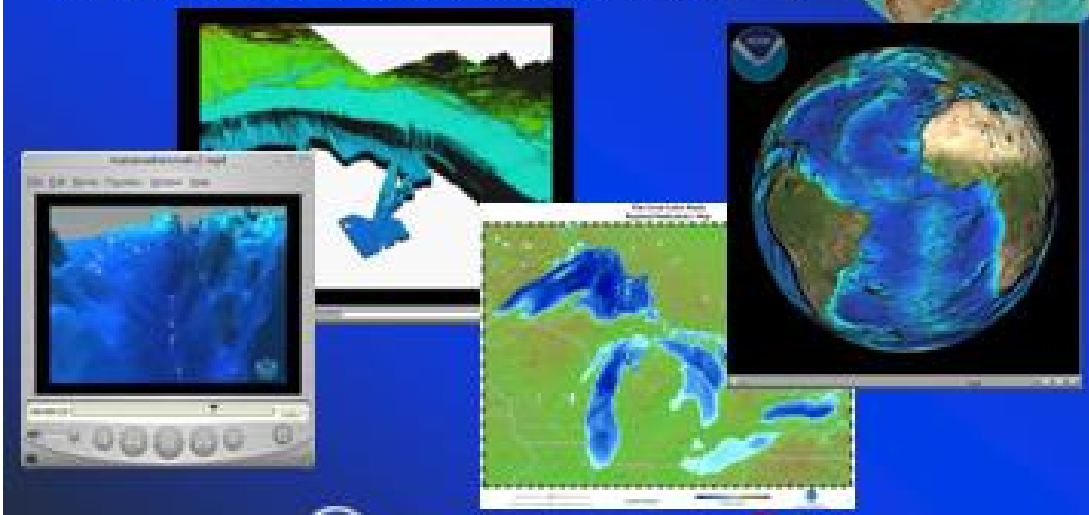
National Geophysical Data Center (NGDC) NOAA Satellite and Information

July 2005

IHODCDB Report to GEBCO - 2005

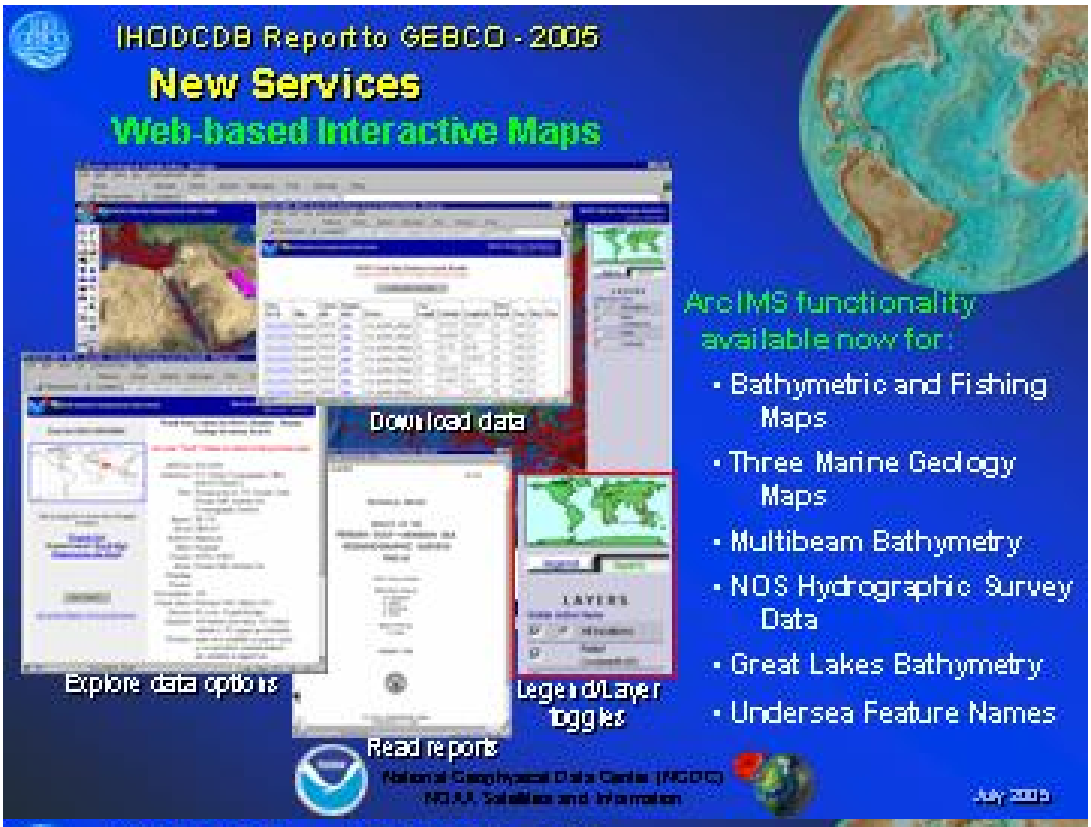
New Products: Imagery

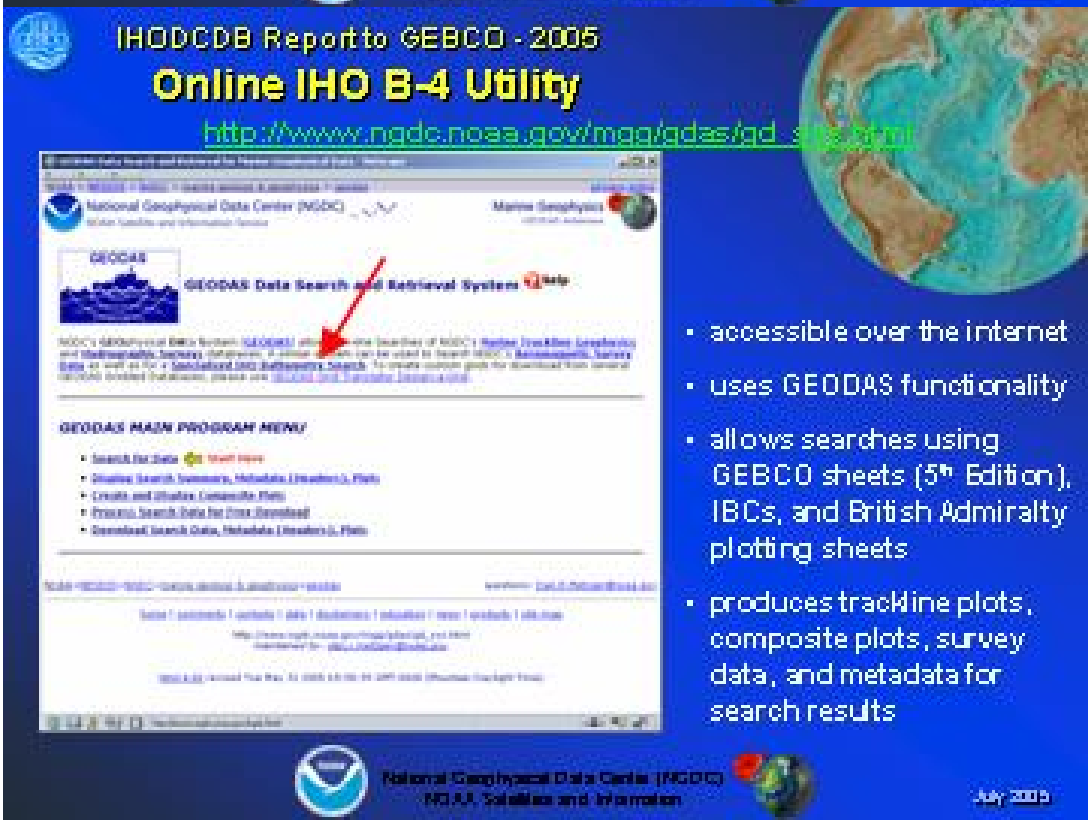
Data Visualization: Higher Resolution Global Relief Imagery and New Posters and Animations Available at http://www.ngdc.noaa.gov/mgg/image/images.html

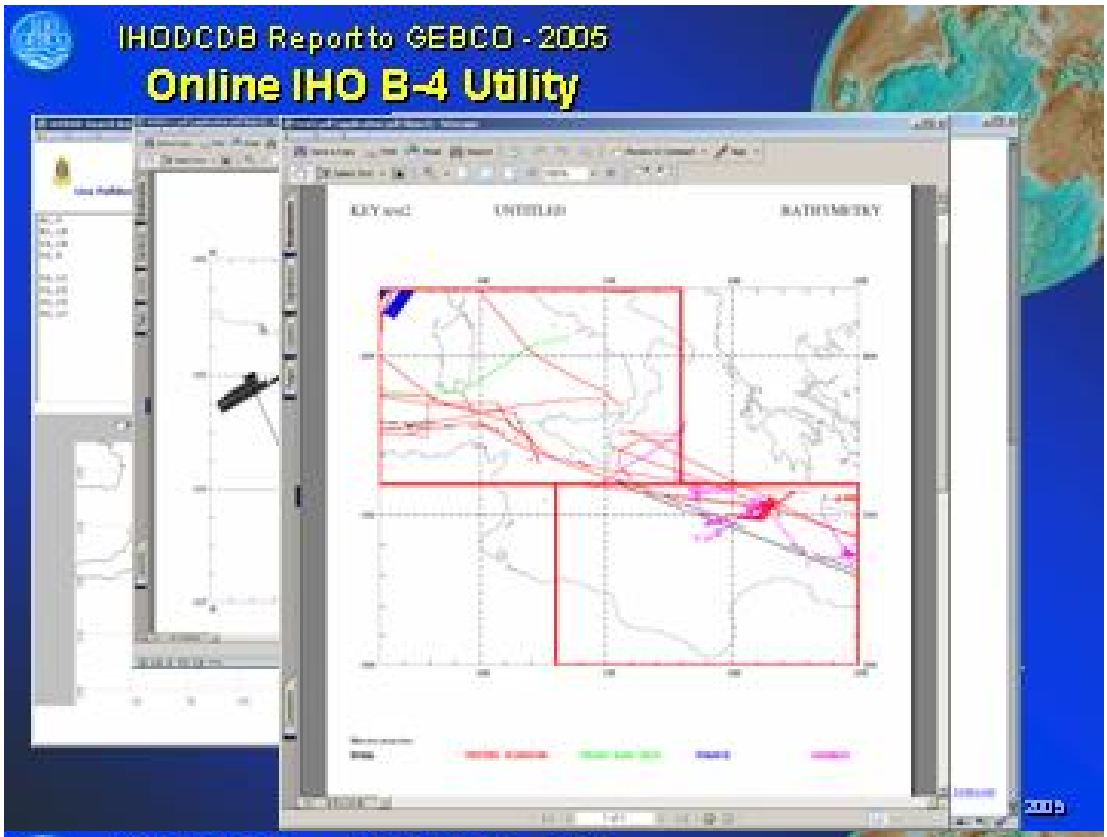


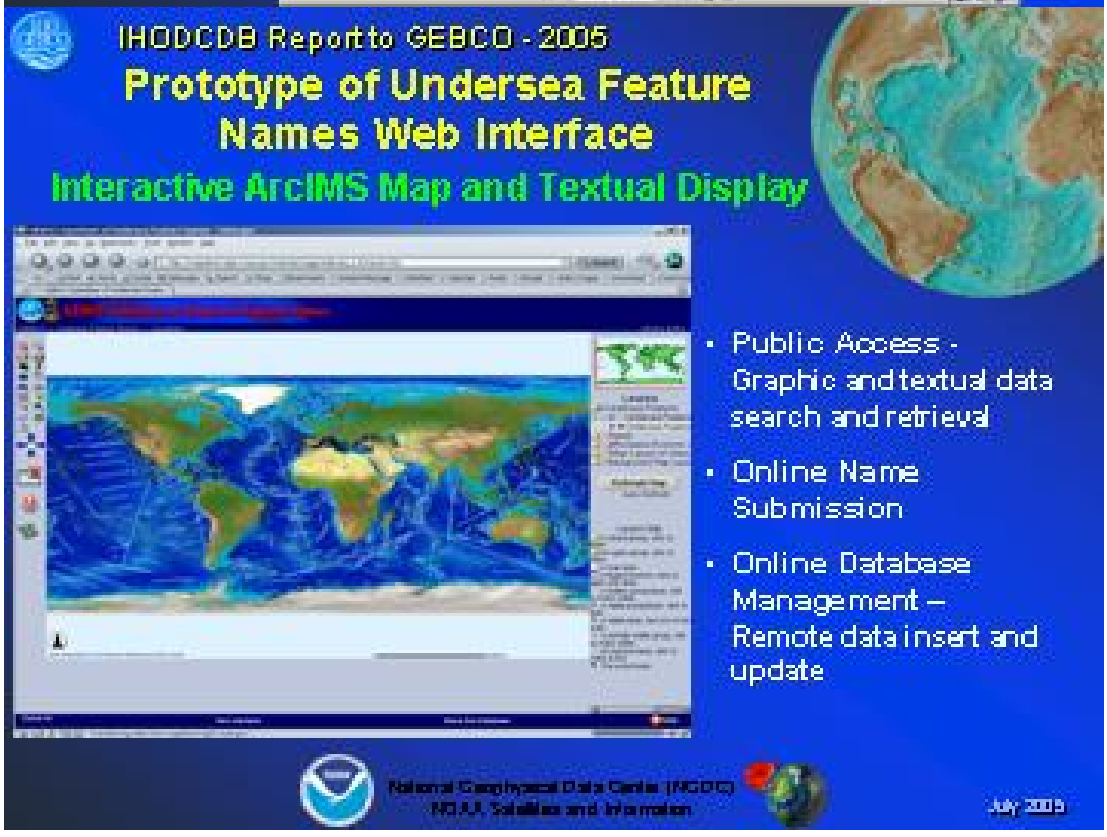
National Geophysical Data Center (NGDC) NOAA Satellite and Information

July 2005


IHODCDB Report to GEBCO - 2005
New Services
Web-based Interactive Maps
Download data
Explore data options
Legend/Layer toggles
Read reports
Arc IMS functionality available now for:
• Bathymetric and Fishing Maps
• Three Marine Geology Maps
• Multibeam Bathymetry
• NOS Hydrographic Survey Data
• Great Lakes Bathymetry
• Undersea Feature Names
National Geophysical Data Center (NGDC)
NOAA Satellite and Information
July 2005


IHODCDB Report to GEBCO - 2005
Online IHO B-4 Utility
http://www.ngdc.noaa.gov/mgg/gdas/gd_sids.html
GEODAS Data Search and Retrieval System
GEODAS MAIN PROGRAM MENU
• accessible over the internet
• uses GEODAS functionality
• allows searches using GEBCO sheets (5th Edition), IBCs, and British Admiralty plotting sheets
• produces trackline plots, composite plots, survey data, and metadata for search results
National Geophysical Data Center (NGDC)
NOAA Satellite and Information
July 2005

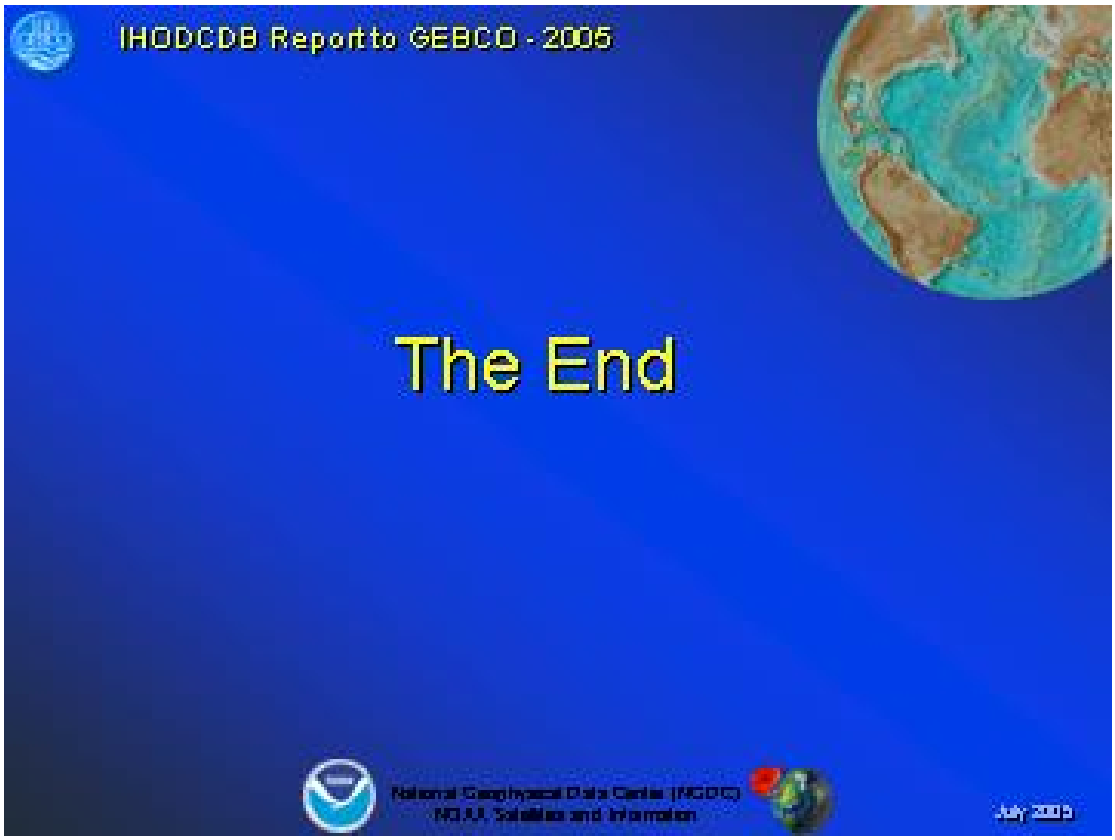

IHODCDB Reportto GEBCO - 2005
Online IHO B-4 Utility


IHODCDB Reportto GEBCO - 2005
Prototype of Undersea Feature Names Web Interface
Interactive ArcIMS Map and Textual Display
• Public Access - Graphic and textual data search and retrieval
• Online Name Submission
• Online Database Management – Remote data insert and update
National Geophysical Data Center (NGDC)
NOAA Satellite and Information
July 2005


IHODCDB Report to GEBCO - 2005
International Activities
- Intergovernmental Oceanographic Commission (IOC) Regional Mapping Programs
• Western Indian Ocean (IBCWIO)
• Western Pacific (IBCWP)
• Arctic Ocean (IBCAO)
• Mediterranean (IBCM)
• Central Eastern Atlantic (IBCEA)
• South Eastern Pacific (IBCSEP)
• Caribbean Sea and the Gulf of Mexico (IBCCA)
• Southern Ocean (IBCSO)
- U. S. – Canada Cooperation on New Bathymetry for the Great Lakes
- List servers for IBCAO, IBCCA, IBCEA, IBCSO, GEBCO Guiding Committee, GEBCO Folk, GEBCO Gridders, SCUFN, and the SCDB
- WWW Pages for GEBCO, IBCAO, IBCCA, IBCM, IBCWIO, IBCEA, and coming soon IBCSEP
National Geophysical Data Center (NGDC)
NOAA Satellite and Information
July 2005


IHODCDB Report to GEBCO - 2005
International Activities
Contributors of Bathymetric Data (since last GEBCO meeting)
Singlebeam -
Australia – Geoscience Australia
Japan – Japan Oceanographic Data Center
U.S. Antarctic Research Commission
Scripps Institute of Oceanography
Integrated Ocean Drilling Program
Multibeam -
Scripps Institution of Oceanography
U.S. National Marine Fisheries Service
Lamont-Doherty Earth Observatory
NOAA Office of Ocean Exploration
IHO DCDB Activities
• responded to 107 international requests for data from 30 countries, which included 27 IHO member States
• customer requests expected to decrease with data available online for direct download
• provided six custom plots of bathymetric data from the Indian Ocean to the IHO for consideration of an IBC of the North Indian Ocean (IBCNIO) following the 2004 tsunami
National Geophysical Data Center (NGDC)
NOAA Satellite and Information
July 2005


IHODCDB Report to GEBCO - 2005
NGDC In-Kind GEBCO Support
$ 46,000 / yr
or about 3% of the MGG Budget
Personnel Costs
Total 0.35 FTE
$37,000 / yr
IT Support Costs
$5,000 / yr
Travel Costs
$4,000 / yr
National Geophysical Data Center (NGDC)
NOAA Satellite and Information
July 2005


IHODCDB Report to GEBCO - 2005
The End
National Geophysical Data Center (NGDC)
NOAA Satellite and Information
July 2005

ANNEX 4
Hans Werner Schenke

Report about the Kick-Off-Meeting of the
International Bathymetric Chart of the Southern Ocean

21st Meeting GEBCO Sub-Committee on Digital Bathymetry

09:00 - 10:30
Introduction, Data Review
1. Opening of the meeting
2. Establishment / confirmation of agenda
3. Introduction of participants
4. Existing data archives, availability, data status

Coffee break 10:30-10:45

10:45 - 12:00
Project goals / Organization
5. Aspired products
6. International cooperation / contribution
7. Funding opportunities, core group / staff, archive location
8. Time frame / perspective
9. Proposal for an IBCSO Editorial Board

Lunch break 12:00 - 14:00

14:00 - 16:00
Technical Issues, Actions
10. Introductory talk:
Sharing Ocean Science data:
A WebServices Approach
Peter L. Pulsifer
Carleton University, SCAR GIG
11. Data processing strategy
12. Data and metadata standards
13. Processing software / GIS
14. Outreach and publication
15. Milestones and next actions

1

Some related questions:

4. Existing data archives, availability, data status
5. Aspired products
6. International cooperation / contribution
7. Funding, core group / staff, archive location
8. Time frame / perspective
11. Data processing strategy
12. Data and metadata standards
13. Processing software / GIS
14. Outreach and publication

2

IBCSO / SCAR Meeting 30.07.2004
at the XXVIII SCAR Meeting in Bremen, Germany

Participants:

Canals, Miquel	University Barcelona		miquel@geo.ub.es
Cooper, Paul	BAS UK		paul.cooper@bas.ac.uk
Davey, Fred	GNS New Zealand		f.davey@gns.cri.nz
Fox, Adrian	BAS, ADD		a.fox@bas.ac.uk
Galindo-Zaldvar, J.	Univ. Granada		jgalindo@ugr.es
Haxby, Bill	LDEO US		bill@ldeo.columbia.edu
Hothem, Larry	USGS, SCAR GSSG		lhothem@usgs.gov
Huet, Michel	IHB Monaco		mhuet@ihb.mc
Kirkwood, Bill	MBARI US		kiwi@mbari.org
Kleinschmidt, Georg	Uni Frankfurt		kleinschmidt@em.uni-frankfurt.de
Klenke, Martin	AWI Germany		mart@daxma.de
Leimer, Volkmar	BSH Germany		volkmar.leimer@bsh.de
Leitchenkov, German	VNIIOkeangeologia		german_l@mail.ru
Macnab, Ron	GSC Canada	(ret'd)	ron.macnab@ns.sympatico.ca
Manning, John	SCAR GIG		johnmanning@auslig.gov.au
McGillivary, Phil	US Icebr. Science Liason		pmcgillivary@d11.uscg.mil
Mullins, Jerry	USGS		jmullins@usgs.gov
Park, Byong-Kwon	Research Council Korea		bkpark@korp.re.kr
Pulsifer, Peter	Carleton Univ. Canada		pulsifer@magma.ca
Schenke, Hans-W.	AWI Germany		hschenke@awi-bremerhaven.de
Shibuya, Kazuo	NIPR Japan		shibuya@nipr.ac.jp
Smits, Fred	NIWA New Zealand		f.smits@niwa.cri.nz
Stagpoole, Vaughan	GNS New Zealand		v.stagpoole@gns.cri.nz
Taylor, Fraser	Carleton Univ. Canada		fraser_taylor@carleton.ca
Udintsev, Gleb	Vernadsky Inst. Russia		elkor@geokhi.msk.su

3

Opening
Special welcome to Michel Huet (IHO) and Ron Macnab (IOC)

Agenda confirmed

Fraser Taylor: representing an International Organization (Chair of ISCGM) with interest in linkage to IBCSO.

Personal introduction
Cooper: IBCSO outcome to support ADD
Taylor: Linkage to Cybercartographic Atlas, Steering Committee for Global Mapping
Manning: SCAR-GSSG-GIG, wants IBCSO as new Group of Experts inside GSSG

Introduction
AWI work in the Weddell Sea (AWI BCWS)
Mentions need for Bathymetric data by almost all scientific disciplines
Some points:
1. Georeferencing of marine observation,
2. Supporting Ocean Circulation Modelling,
3. Nautical Charts,
4. etc.

General overview:

Todays data sources/stocks:
IHO DCDB with NGDC (ETOPO2, ...)
GEBCO 1min Grid

Work with BSH on INT charts (new nautical charts 9055, 9057)

AWI High Res Areas: BCWS and GNS/Davey/Stagpoole map.
New Indian Ocean bathy by Bob Fisher (SCRIPPS),
mostly analogue data, sources and products will be available
Three AWI-„Vernadsky" BCWS maps

Data collection could be done by AWI
Importance of quality assessment

Main final Product 2 km grid, (plus 1:1 Mio chart series)
Contact persons for the IBCSO project:
IOC CGOM (Dr. G. Giermann)
IHO HCA (Cpt. Gorziglia)
SCAR GSSG (Dr. A. Cappra)
Antarctic Mailing List (http://gerg.tamu.edu/archive/answer/)

5

Available sources:

•NGDC DCDB
•GEBCO
•Palmer 1992-1999
•Russian Data: East Antarctic, Peninsula, Ross Sea
•Japan
•Australia
•South Africa
•Argentine
•SCRIPPS
•BAS

Asks the people for data:

Haxby: Palmer – All data that is older than 2 years is available in source.

Canals: Usually release gridded (50m to 1km, can be discussed) data, maybe as well sources whith a "good deal".

Galindo-Zaldvar: Will check about contributions from his group.

6

Discussions:

Cooper: Mentions biologists as main BAS Data (ADD) users.
Taylor: User need analyses is necessary to decide how to go about it, propriatary software may be problematic, proposes open source.
Davey: Mentions importance of quality assessment and good metadata.
McGillivary: Problems (refraction, etc.) in Ross Sea bathymetry with fresh water lenses even from multibeam, so even MB data has to be carefully checked.
Recommendations should be set up that nations can follow.
Taylor: Problems in digitizing old data and merging with actual data.
Cooper: Very important to use the last coast lines, mention AEGIS conference.
Macnab: Outdated coastlines caused problems in the IBCAO project.
Old data came in the public domain and was then distributed widely.
Schenke: Problem: source or as well gridded input data?
Macnab: Original data important, particularly if data sets have to be merged.
Experience from IBCAO that gridded data is not so helpful.
Cooper: BEDMAP had to accept gridded data in some areas.
Stagpoole: mentioned importance of transit data.
McGillivary: brings up problenmatic quality of transit data .
Taylor: Recommends to look after what we want before looking after what we could get.
McGillivary: Recommends CTD measurement network to process transit data.

7

Further dicussions:

OUTREACH:

Taylor: Recommends IPY connected outreach approach
McGillivary: SCAR educational coordinator will be named soon, should be contacted
Macnab: describes SSPARR program of Bob Anderson. Agreement that this will be a significant source for IBCSO.
McGillivary: no funds for Antarctic SSPARR operations raised so far.
Taylor: On the basis of his experiences in the Global Mapping Initiative "Cooperation better than competition".
Schenke: AWI will contribute to SSPARR and can deploy buoys, e.g. in the Polar Oceans.
McGillivary: plans to map the seafloor under the Ross Shelf with the MBARI AUV. Moreover, LIDAR instruments to map shallow water (up to 60m?!) bathymetry.
Schenke: importance of sub-shelf bathymetry for the modeling of tides and currents.

8

National contacts

New Zealand:	Stagpoole
China:	Dongchen
Japan:	Shibuya
Korea:	Park (will provide information)
India:	n.n.
South Africa:	Neill Guy to be contacted
Italy:	n.n.
GB:	Roy Livermore, Peter Morris, Rob Larter
Spain:	Canals, Maldonado
Norway:	Sand
Russian Fed.:	Leitchenkov, Udintsev
Ukraine:	Greku
Chile:	n.n.
Argentina:	n.n.
Chile:	n.n.
Brasil:	n.n.
Uruguay:	n.n.
USA:	n.n.
Canada:	n.n.

IBCSO working group:

Gleb Udintsev
Hans Werner Schenke
Ron Macnab
Fraser Taylor
Paul Cooper
Vaughan Stagpoole (supported by Fred Davey)
Michel Huet
Bill Haxby
agree.

Rob Larter, Roy Livermore at BAS,
Henk Brolsma at AAD
to be asked?

General Remarks

Schenke:	Funding is open, SCAR just travel, etc. IHO/IOC?
McGillivary:	SCAR/SCOR Relationship?
Taylor:	Summerhayes could introduce IBCSO to SCOR (Summerhayes asked for projects in his 11:00 talk)
Macnab:	Recommends to contact Martin Jakobsson learn about the data storage and handling concepts of IBCAO.
Schenke and Taylor:	2 years for a first result (Circum-Antarctic Grid) to support IPY initiatives.
AWI:	1 PostDoc mid 2005, plus 1 technician (partial)

Finally:

IBCSO is accepted as:
Expert Group within the SCAR Geoscience Standing Scientific Group
http://www.geoscience.scar.org/expertgroups/ibsco/

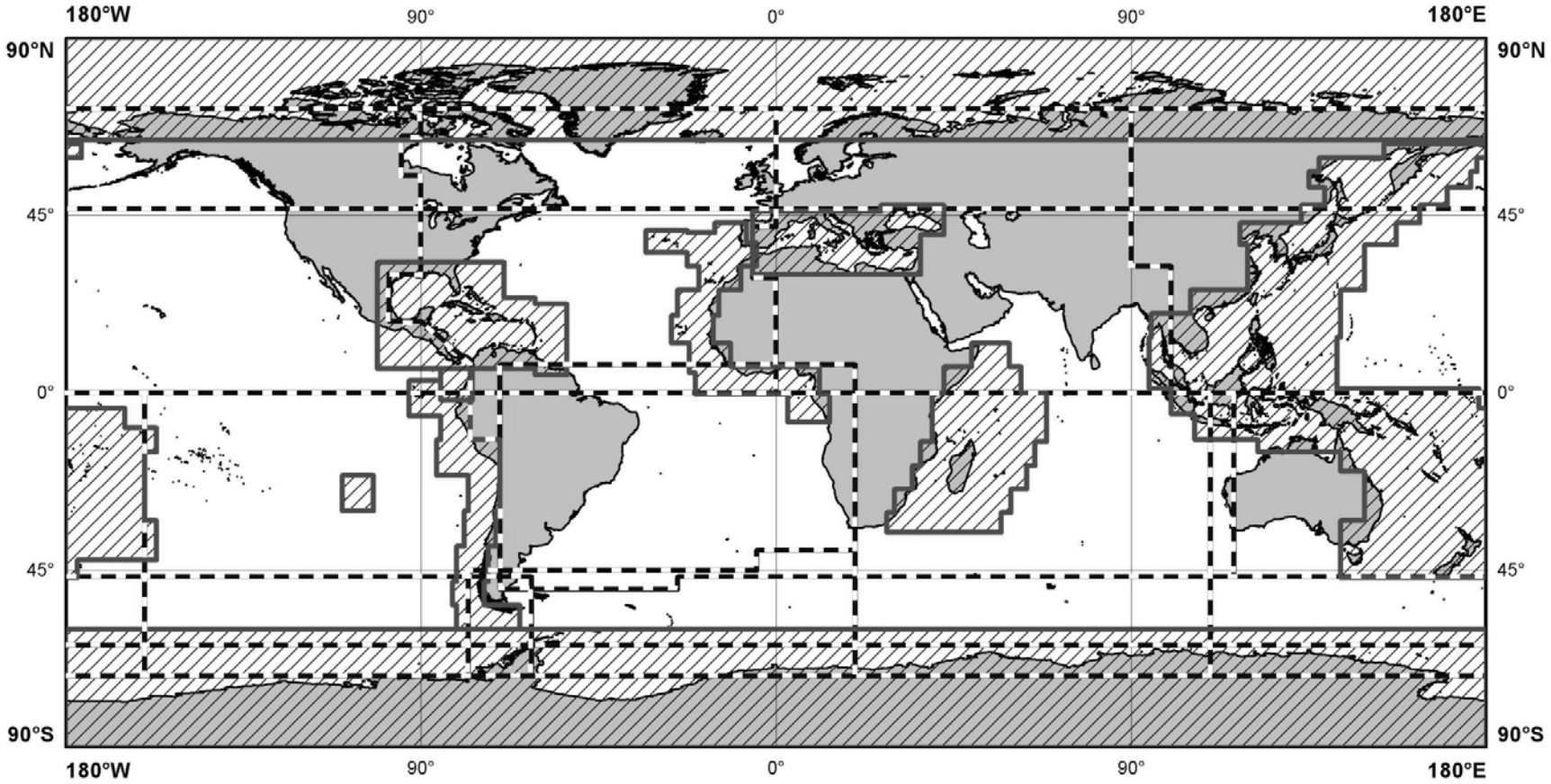
11

ANNEX 5

File too large to download

ANNEX 6

Areas covered by the IOC Regional Mapping Programme (continuous lines enclosing grey areas) and GEBCO Sheet limits (dashed lines)
Ron Macnab



ANNEX 7

File too large to download

ANNEX 8

International Bathymetric Chart of the Arctic Ocean
Report to the Meeting of the GEBCO Sub-Committee for Digital Bathymetry
Aguascalientes, Mexico, July 7-8, 2005

Ron Macnab
Geological Survey of Canada (Retired), ron.macnab@ns.sympatico.ca

IBCAO: THE INTERNATIONAL BATHYMETRIC CHART OF THE ARCTIC OCEAN

Hardcopy edition

Through the good offices of Chris Fox, George Sharman, and David Divins (all of NGDC) and with the financial support of the US Office of Naval Research, some four thousand full-sized copies of IBCAO were printed on high-quality stock. These are available at nominal cost through the NGDC website. Users with access to suitable wide-format printing facilities can also download the map's print file free of charge. The bathymetric grid from which the map was constructed remains available for free downloading from the IBCAO website hosted by NGDC, for the convenience of users who prefer to construct their own visualization products.

Intercomparison with HDNO map of Arctic bathymetry

This activity was first proposed in mid-2003 during informal discussions with representatives of the Head Department of Navigation and Oceanography (HDNO) and VNIIO (All-Russia Research Institute for Geology and Mineral Resources of the World Ocean). A formal agreement was reached and a work plan developed in early 2004, whereupon digital isobaths for the IBCAO and HDNO maps were exchanged between the Russian and international teams to facilitate direct visual intercomparison. This work was undertaken by German Naryshkin of VNIIO/HDNO, who identified a total of 31 discrepancies within four categories, and who described them in a report delivered in December 2004. The most significant problem area lay in the representation of bathymetry in the vicinity of Gakkel Ridge, and it was recommended that both maps would benefit from a review and rationalization of all available data in that area.

A Work Session at Stockholm University was then hosted by Martin Jakobsson in March of this year, drawing together members of the project team who reviewed the reported discrepancies and discussed their resolution. Satisfactory solutions were devised in most instances. In a few cases it was agreed that further actions were necessary, and responsibilities for those actions were assigned. The Gakkel Ridge remained the most intractable problem, and it was agreed that the most practical approach was to blend two sets of information: one from the flanks of the Ridge as portrayed on the HDNO map, the other consisting of corrected AMORE (Arctic Mid-Ocean Ridge Expedition) soundings from the median valley. A team member was designated to begin this blending task within the weeks following the Work Session, but it soon became clear that the raw AMORE observations (necessary to apply sound velocity corrections) could not be made available to the project team within the projected time frame.

Notwithstanding the unavailability of the raw AMORE data, it is planned to proceed with an updating of the IBCAO grid later this year through revisions, corrections, and the assimilation of newly-obtained soundings. The updated grid will be posted on the IBCAO website, where it will be accompanied by revised imagery. In the meantime, exploratory discussions will be initiated concerning prospects for obtaining selected HDNO soundings in digital form from the Chuckchi, East Siberian, and Kara Seas.

ANNEX 9

Proposed International Bathymetric Chart of the Atlantic Ocean

Report to the Meeting of the GEBCO Sub-Committee for Digital Bathymetry
Aguascalientes, Mexico, July 7-8, 2005

Ron Macnab
Geological Survey of Canada (Retired), ron.macnab@ns.sympatico.ca

IBCNA: THE INTERNATIONAL BATHYMETRIC CHART OF THE NORTH ATLANTIC

Introduction

It is proposed to launch an undertaking that will assemble and rationalize all available bathymetric observations from the Atlantic Ocean and adjacent seas north of the Equator, with a view to developing a research-grade database that can be used for the construction of accurate grids and maps, and for a variety of scientific and technical investigations. One of the project's primary outputs will be a new International Bathymetric Chart of the North Atlantic Ocean – IBCNA. The acronym IBCNA is also used to denote the overall project.

The compilation will encompass the Atlantic Ocean from the Equator to the Arctic Circle (approximately 66.5°N) with linkages to adjacent seas, notably the Caribbean Sea, the Gulf of Mexico, the Labrador Sea, Hudson Bay, the Norwegian-Greenland Sea, the North and Baltic Seas, and the Mediterranean Sea.

In its organization and execution, IBCNA will closely follow the principles and practices that were applied during the implementation of IBCAO - the International Bathymetric Chart of the Arctic Ocean. Documents describing that activity are available on the project website at NGDC.

Rationale

Of all the world's oceans, the North Atlantic is arguably the best mapped, with vast quantities of bathymetric measurements collected along reconnaissance tracks and during systematic surveys throughout the region. In recent years, these soundings have been complemented significantly through the collection of bathymetry for determining the outer limits of the juridical continental shelves of several wide-margin states, according to the provisions of Article 76 of UNCLOS.

Representing a substantial accumulation of information, bathymetric observations in the North Atlantic remain unevenly distributed and highly disparate, having been gathered over many decades for a variety of purposes with the aid of echo-sounding and positioning technologies that have evolved with the passage of time. Taken together, the soundings comprise an incoherent database that features a tremendous variability in accuracy, resolution, and density of coverage. IBCNA will gather all known and available observations, screen them intensively in order to eliminate unsuitable data points, and apply corrections where appropriate. The resulting data sets will then be combined and used to construct a digital model of the seabed with known statistical characteristics, rendering it suitable for manipulation, analysis, and visualization with advanced computer tools.
Beyond improving bathymetric knowledge of the North Atlantic Ocean, the activity will have several beneficial spin-off effects: promoting liaison and networking of institutions and bathymetric specialists within the region; developing effective linkages between regional specialists and the global bathymetric community; providing opportunities for training, technology transfer, and capacity-building to participants from South America, the Caribbean region, and Africa.

Participating organizations and composition of project team

Participating organizations will be drawn principally from the community of research, mapping, and data centers that are located within the project area, with supplementary representation from other regions where appropriate. The Intergovernmental Oceanographic Commission (IOC) and the International Hydrographic Organization (IHO) are expected to assume advisory and oversight roles. Some advisory functions could be exercised by GEBCO – indeed, several prospective participants in IBCNA are already active members of the GEBCO community.

Membership of the Team will be drawn largely from the region, although members from outside the region will be welcomed if they wish to take part. The Team composition will include a mix of: national and institutional representatives; technical experts in ocean mapping, data management, GIS, oceanography, and geomorphology; advisors and coordinators who will assist in related activities such as fund-raising, and international liaison; and representatives of sponsoring and/or endorsing bodies. Team leadership will consist of a Principal Investigator or Scientific Authority plus an elected executive (chairman, secretary, etc).

Base of operations

The project's main base of operations will likely be housed in an existing government, research, or academic centre, equipped with the necessary human and technical resources. This base of operations could include a data centre, however it is not essential that the latter facility be co-located with the former, as long as participating organizations possess effective communications links with the data centre.

Project mobilization

Project mobilization will consist of two primary activities. The first activity will begin with the circulation of a project prospectus that outlines the objective of the undertaking and invites prospective participants to participate. Depending on the level of response, a planning meeting will be scheduled to bring together prospective participants at the executive level who will: (a) assess levels of interest in proceeding with the project; (b) discuss the scope of the activity; and (c) appoint a Planning Group to develop contacts, enlist participants, and investigate fund-raising mechanisms.

The second activity will begin with a technical meeting involving participants at the working level, who will: (a) consider technical procedures and specifications; (b) review necessary measures for training and capacity-building among participating organizations; (c) consider appropriate budgetary measures; and (d) appoint a Project Team that will be charged with the project•s technical implementation.

Regular meetings will take place thereafter, providing participants with opportunities to review progress and to discuss results.

ANNEX 10

Proposed International Bathymetric Chart of the Indian Ocean

Report to the Meeting of the GEBCO Sub-Committee for Digital Bathymetry
Aguascalientes, Mexico, July 7-8, 2005

Ron Macnab
Geological Survey of Canada (Retired), ron.macnab@ns.sympatico.ca

IBCIO: THE INTERNATIONAL BATHYMETRIC CHART OF THE INDIAN OCEAN

Introduction

The proposition to build a new, all-digital bathymetric map of the Indian Ocean had its genesis in side discussions that took place in April 2004, during the GEBCO Meeting in Porto Venere, Italy. At that time, the discussions were motivated by the desire to preserve the 'Bob Fisher Legacy', i.e. the mammoth accumulation of hand-made plotting sheets that provided the foundation for Fisher's bathymetric contours that were eventually used to generate the Indian Ocean portion of the GDA grid. In Porto Venere, there was concern that portions of the Fisher data base were (a) not in the public domain, (b) still in analogue form, and (c) susceptible to loss. It was agreed that it would be highly desirable to review the Fisher data base with a view to determining which of the 'missing' data sets were amenable to recovery in digital form, and to assimilation with available data in a coherent fashion. Then they could be readily merged with new data sets for re-cycling in the preparation of updated and upgraded grids and maps.

Scanning and converting the Fisher plotting sheets

Following the Porto Venere meeting, Andrew Goodwillie arranged with Bob Fisher for procurement of a full set of plotting sheets, which were duly forward to John Hall at CCOM. The sheets were then transferred to Norm Cherkis, who arranged to have them scanned at NGA.

The scan files are now preserved on CD-ROM while the conversion question is considered. Fisher's plotting technique was legible and consistent, but it was multidirectional, in that many if not most of his underway values were plotted orthogonally to their ship tracks. For this reason, the plotting sheets may not lend themselves very well to the automated or semi-automated transformation of hand-plotted numbers to digital values with lat-long attributes. An alternative technique would be to consider a heads-up digitizing approach, which would entail the use of human operators to perform real-time quality control by closely monitoring their machines' progress and accuracy in the recognition and transformation of characters as they appear in the scan files. This process is well-developed, but given its highly labour-intensive nature, it clearly would not be the preferred option.

The impact of the Boxing Day Tsunami

The Boxing Day Tsunami introduced a measure of urgency into the proposition by underscoring the need for accurate, high-resolution descriptions of shallow- and deep-water bathymetry throughout the Indian Ocean, which the Fisher map was not designed to provide. As part of a concerted international response to the disaster, the IHO invited hydrographic offices from afflicted Indian Ocean states to articulate their needs for reconstruction purposes, and for the implementation of measures designed to mitigate the effects of future tsunamis. At the same time, hydrographic offices from non-affected states were invited to indicate how they could help meet those needs. This process took place during a meeting of the North Indian Ocean Hydrographic Commission in Jeddah, Saudi Arabia in March 2004.

The IOC has aligned itself with this initiative by proposing to mount a capacity-building initiative that will enable affected coastal states to analyze their future mitigation needs and to participate in the implementation of appropriate programmes for the development of human resources and the transfer of necessary technology. The particular focus adopted by the IOC is the improvement of coastal bathymetry, which in the tsunami context includes descriptions of the water depth on and near the continental shelf and in the intertidal zone, and of near shore topography. As it gets underway, this initiative is expected to prompt a serious scrutiny of the Fisher plotting sheets, which could mobilize a programme for extracting their contents in key areas.

ANNEX 11

Reported bugs for the Centenary Edition of the GEBCO Digital Atlas

Pauline Weatherall

BODC, Proudman Oceanographic Laboratory, Liverpool, U.K.

The following relates to reported bugs for the data sets and interface software of the Centenary Edition of the GEBCO Digital Atlas (GDA) published on CDROM in April 2003.

1.1 Interface software (version 1.0, April 2003)

1. Links to web sites through the Help Menu have not been enabled. The user can access a list of useful web sites through the 'Data Sets User Guide' available either from the Help Menu of the software interface or directly from the Manual.pdf file in the top level directory of disc 1 of the CDROM set.

2. If the following error is displayed on loading: '-180.0' is not a valid floating point value

Your system has been set up to use a comma as the decimal separator instead of a dot. In order to run the GDA you will need to change this. From the Control Panel, change the decimal symbol in Regional Settings (this may be Regional and Language Options and require you to select the Customize button) to a full stop or dot.

1.2 GEBCO One Minute Grid (version 1.0)

Please note

The GEBCO One Minute Grid is based largely on the bathymetric contours contained within the GEBCO Digital Atlas. Generally, the shallowest contours are either at a depth of 100 m or 200 m, i.e. it is essentially a deeper water data set and does not include detailed bathymetry for shallow shelf waters.

When building the grid, additional information was used in some shallow water areas and semi-enclosed seas, largely to help constrain the gridding process and to prevent overshoots. Users should be aware of this when using the data set in shallower water regions and proceed with caution.

Problems reported

1. North Atlantic

Northeast Atlantic

i. Depths greater than 3000 m are shown between the 2900 m and 3000 m bathymetric contours in the region 14°W to 12°W, 54°N to 55°N. This 'hole' is the result of the gridding algorithm allowing the surface to over shoot the deepest contour in the region.

ii. There is a line of discontinuity in the gridded data set from 10°W to 5°E at 65°N.

Hudson Bay Area

i. There is a line of discontinuity in the gridded data set from 90°W to 77°W at 60°N.

ii. There is a line of discontinuity in the gridded data set from 60°N to 51°N at 80°W.

Around the Azores

i. Within the Azores Archipelago area, 29°W to 24° 54'W, 39° 3'N to 36° 47'N there is a discrepancy between the position of the coastline included in the digital bathymetric contour data set and the coastline used in the development of the GEBCO One Minute Grid. In some areas in this region, this has led to a number of nodes being wrongly assigned to a value above zero.

2. South Atlantic

Off the west coast of Africa

There is a line of discontinuity in the gridded data set between 13°E and 13°30'E at 10°S.

3. Caspian Sea

i. North of 40°N there are errors in the grid in the Caspian Sea region.

ii. A discontinuity is shown along a line at 40°N between approximately 47°E and 53°E in this region.

4. South Pacific

Arafura Sea

A number of nodes have been erroneously set to a value of 1 m in the shallower water regions of the Gulf of Carpentaria in the region 15°S 136° 35'E.

Coral Sea

There is a line of discontinuity in the gridded data set from 158°E to 159°E at 20°S.

Grid nodes on the top of bank features in the region of the Lord Howe Seamount Chain have been set to a single value giving a 'flat topped' effect to the feature. This occurs for Capel Bank, Kelso Bank, Argo Bank and Nova Bank (from 158° 40'E, 20°S to 159° 36'E, 25° 31'S) and for Lansdowne Bank at 161°E, 20°S.

North of New Zealand

There is a line of discontinuity in the gridded data set from 160°E to 180°E at 30°S.

5. Straits of Hormuz

There is a line of discontinuity in the gridded data set at approximately 57°E, 26°N.

ANNEX 12

File too large to be downloaded.

ANNEX 13

Accessing ENC depth data for use in the GEBCO grid

Peter Hunter
National Oceanography Centre, Southampton, U.K.

Two or three years ago, the UK Hydrographic Office at Taunton provided me with examples of their ENCs for the purpose of using the depth and contour data they contained for the shallow water component of the GEBCO grid around the British Isles. Unfortunately I was unable to extract the data in the S-57 format. However, later on Ray Cramer at BODC wrote a program that was successful in creating DXF format and thus XYZ format files.

These data would still need to be converted to the GEBCO mean sea level and WGS84 datums.

I would also stress the importance of only using this data for creating the grid. Using the contours as they are would not go down well with the hydrographic offices as they would see this as encroaching on their territory. Any contours GEBCO puts out should be derived from the grid.

ANNEX 14

Proposal to Harvest Shallow Water Bathymetry from ENC, DNC and Digital Paper Chart Coverage.

Tony Pharaoh, International Hydrographic Bureau, Monaco

(text created from a PowerPoint presentation)

• **Need For Shallow Water Bathymetry**
GEBCO's 1998 Wellington meeting recognized that vast amounts of continental shelf data, are being held by Hydrographic Offices that could be used for the GEBCO global bathymetry.

• **IHO issued Circular Letter 43/1998 enquiring whether IHO Member States would be prepared to provide bathymetric data in one of the following formats**;

a) an HO may wish to make its continental shelf bathymetric data available for compiling into the GEBCO Digital Atlas,
b) only the 0, 10, 20 or 25, 50, 100, 150 and 200 meter bathymetric contours be provided for inclusion in the GDA.
c) the contours are retained by the Hydrographic Office but are available on request.

• **The following summary of MS response to CL43 was distributed via CL60/98;**

➢67% of those Member States who replied, advised the IHB that they would be prepared to make the data available either as bathymetric survey data or as 0, 10, 20 or 25, 50, 100 and 200 meters contours.
➢One of these Member States indicated that it would make its data available in a gridded format.
➢The rest of the Member States said they would consider the release of data on request.

• **How much data was provided ?**

• **CL43/1998 was doomed to failure before it was sent out because,**

- A large percentage of hydrographic survey data are still in analogue (paper) format.
- Digitising is expensive – filtering dense sounding data is time consuming
- HOs have limited resources – their primary mandate is to provide nautical publications and services – bathymetric mapping is a lower priority
- Most HOs are extremely reluctant to release full density hydrographic surveys (with a few exceptions).

• **Question**
How should we go about getting Shallow Water Bathymetric Data from Member States (MS) that;

1. Is in a digital format – and can be easily integrated into a GIS system
2. Is at a suitable granularity (density) level, - no need for data filtering
3. Has consistent geographic parameters – no need for projection and datum transformation
4. Can be made available with minimum effort from MS.

• **Answer – harvesting SWB from ENC, DNC, and Digital Paper Charts.**
This presentation focuses on:

- What ENC coverage is presently available
- What are some of the characteristics of Nautical Chart Data
- What features should be extracted?

- Which ENC Navigational Purposes (i.e. chart scale) are most suitable for integration with GEBCO
- How can we extract these features

• What ENC Coverage is Presently Available ?

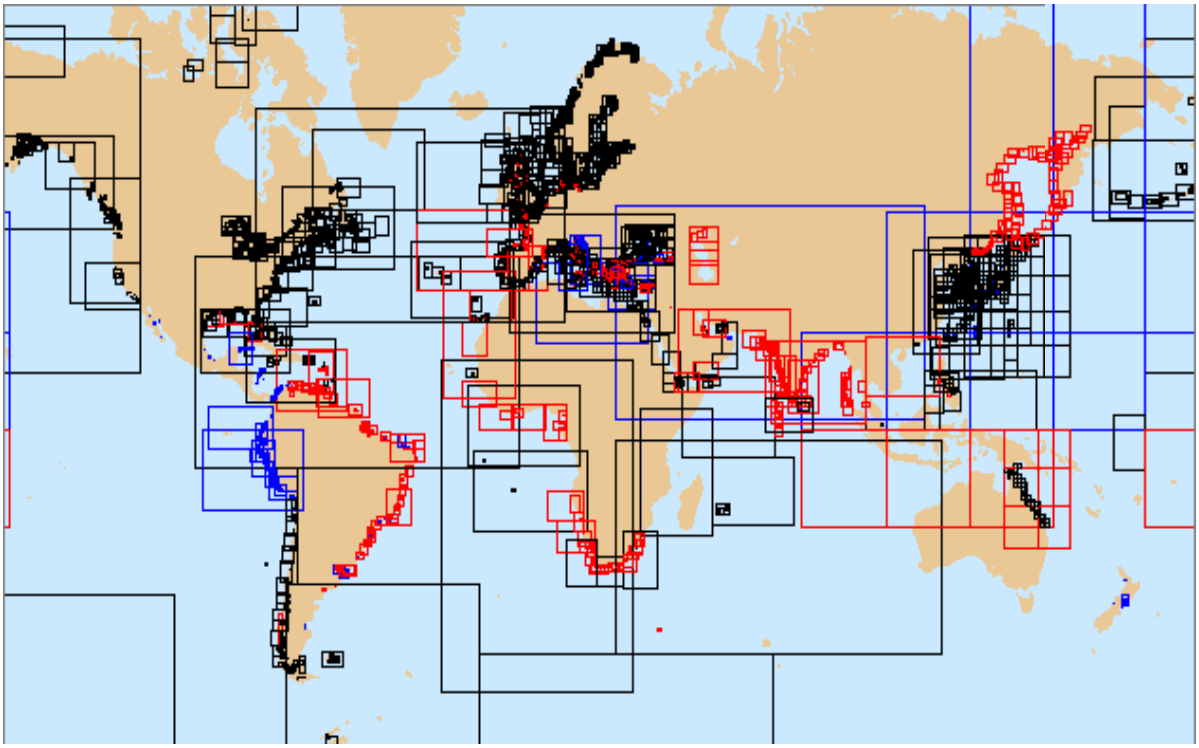
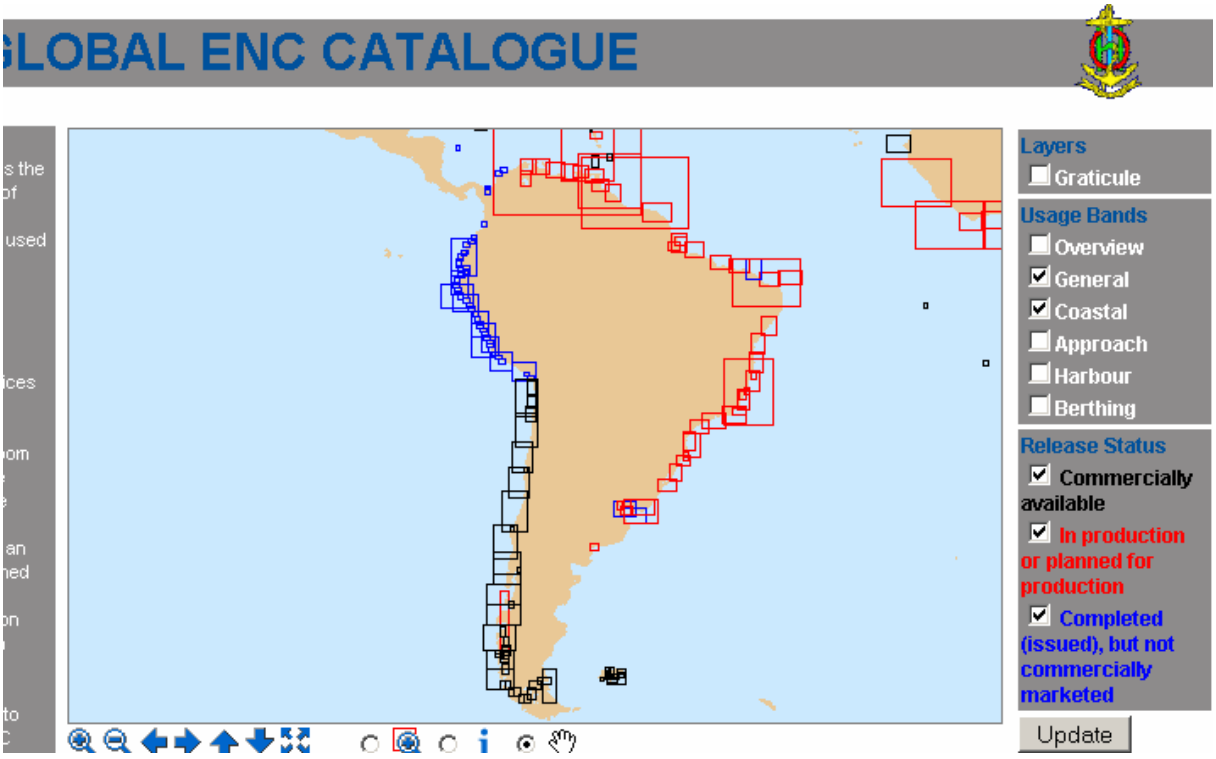


Figure 1 snapshot of the IHO Global ENC Catalogue (http://www.iho.shom.fr ENC > ENC Catalogue)

• ENC Coverage of South America



• **What are some of the Characteristics of Nautical Chart Data?**

➢Nautical charts are designed almost exclusively for marine navigation, and the way in which bathymetric information is depicted differs from bathymetric maps. Some of these differences which may impact on the suitability of nautical chart data being used for bathymetric mapping are as follows;

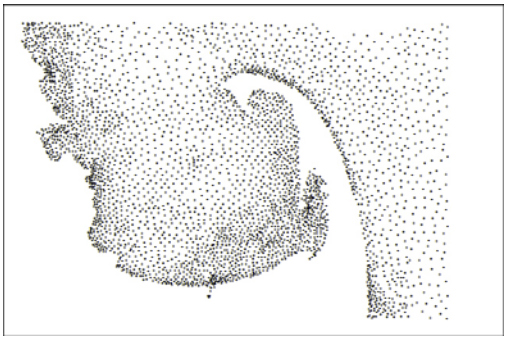
➢Whereas bathymetric maps attempt to faithfully depict the nature of the seabed using equally spaced contours, nautical charts attempt to highlight potentially hazardous areas, and use uneven contour internals. The contour interval is smaller in shallow water and increases with water depth. Typically a coastal series chart would display the following contours; 5, 10, 20, 30, 50, 100, 200 ….

➢The way in which contours are generalized is different. A mean deviation method is used for bathymetric maps, whereas a shoal bias method is used for generalizing contours on nautical charts.

➢Nautical charts provide additional bathymetric information, in the form of point soundings, which are not usually included on bathymetric charts.

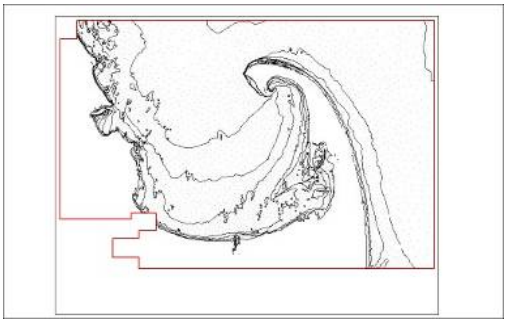
• **What features should be extracted (harvested)?**

Soundings.



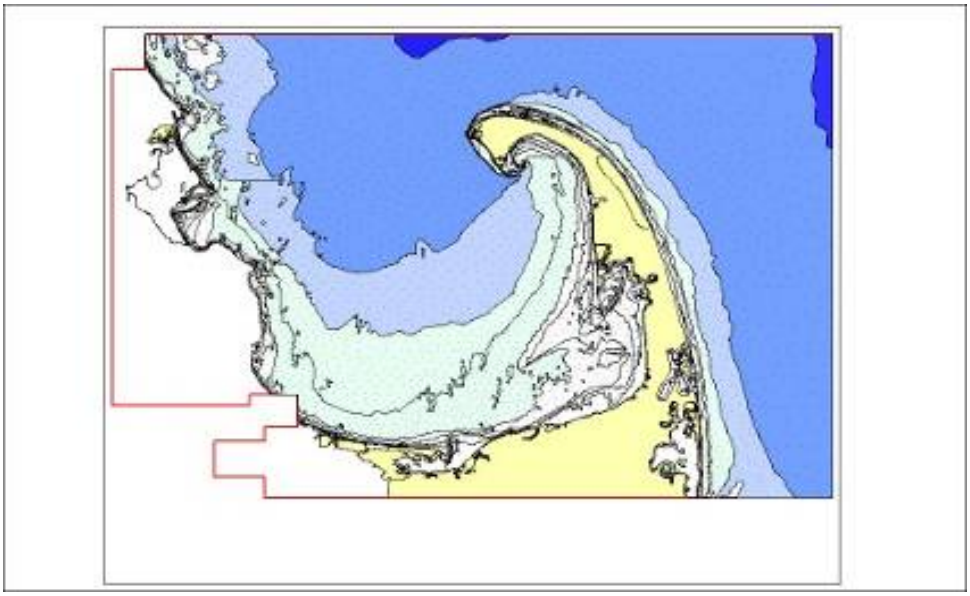
- The relative density of point soundings is dependant on the Navigational purpose and water depth).

Depth contours.



- Depth contours, often represent an approximate location of the line of equal depth as related to the surveyed line delineated on the source. Also referred to as depth curve.

Depth areas (DEPARE)

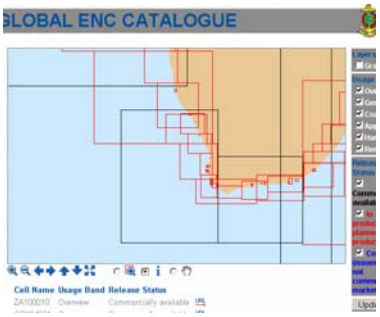


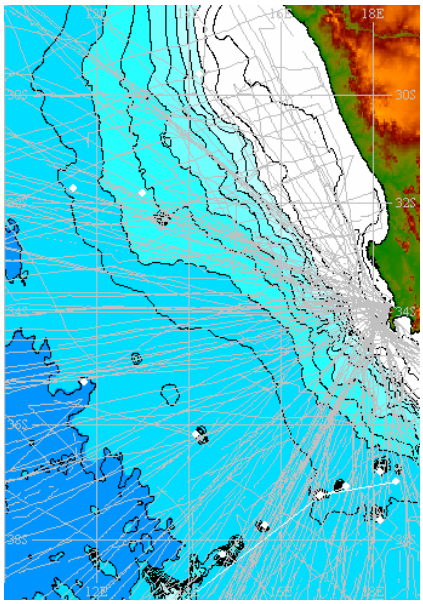
Which ENCs – Navigational Purpose (Scale) is Most Appropriate for GEBCO?

Navigational Purpose	Name	Scale range	Available Compilation Scales	Matching Range Scales
1	Overview	<1:1,499,999	≤3,000,000	200 NM
			1,500,000	96 NM
2	General	1:350,000 – 1:1,499,999	700,000	48 NM
			350,000	24 NM
3	Coastal	1:90,000 – 1:349,999	180,000	12 NM
			90,000	6 NM
4	Approach	1:22,000 – 1:89,999	45,000	3 NM
			22,000	1.5 NM
5	Harbour	1:4,000 – 1:21,999	12,000	0.75 NM
			8,000	0.5 NM
			4,000	0.25 NM
6	Berthing	>1:4,000	≥3,999	< 0.25 NM

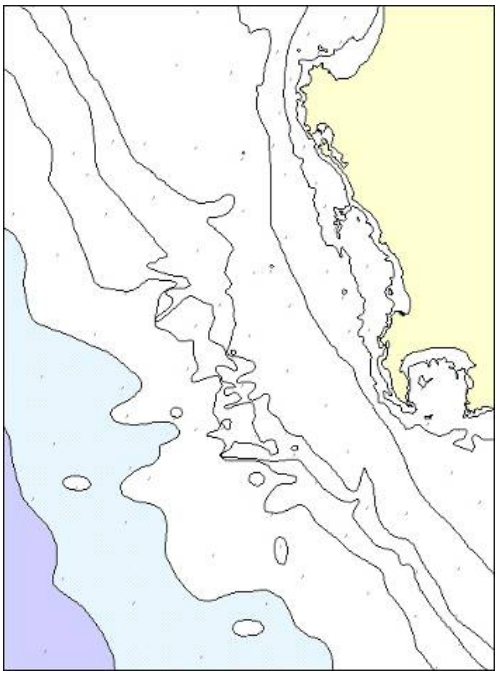
- **Navigational Purpose 1 – Overview - Compilation Scale ≤3,000,000 to 1,500,000**

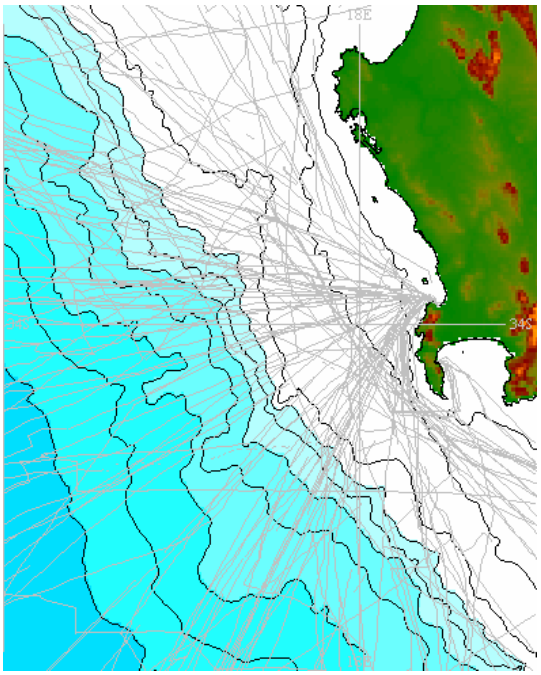
(ENC Cell ZA100010 West Coast, South Africa).



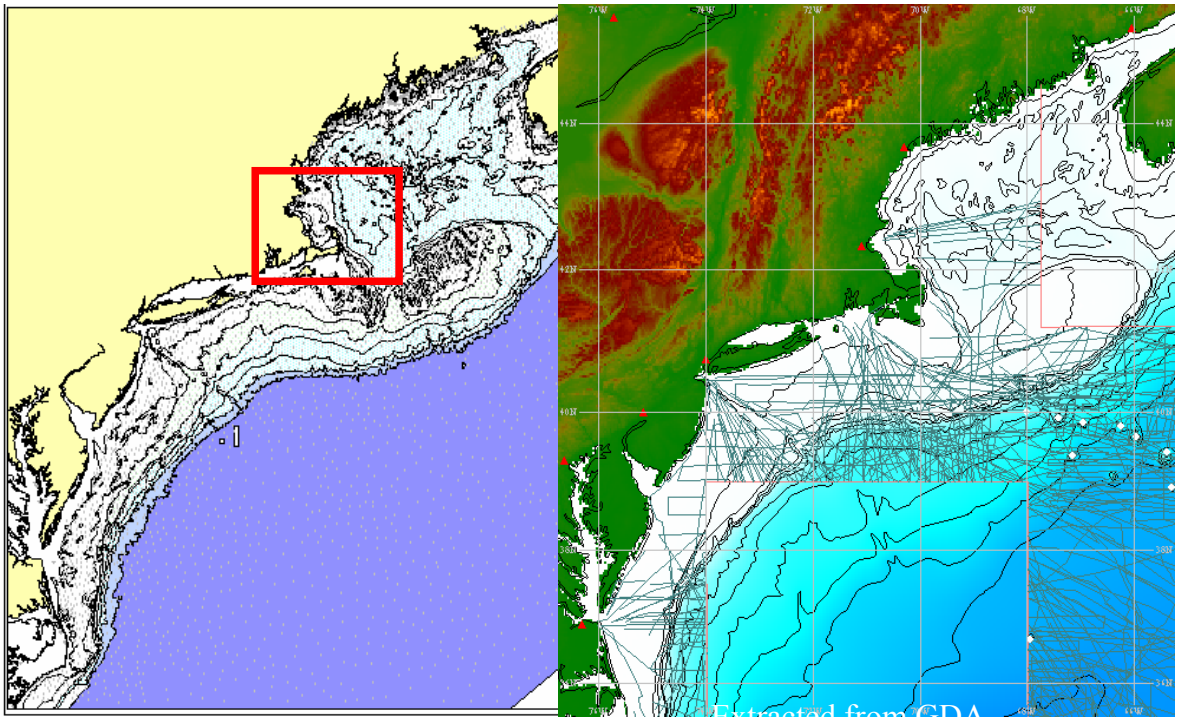


Contours available: 30,100, 200, 500, 1000 m

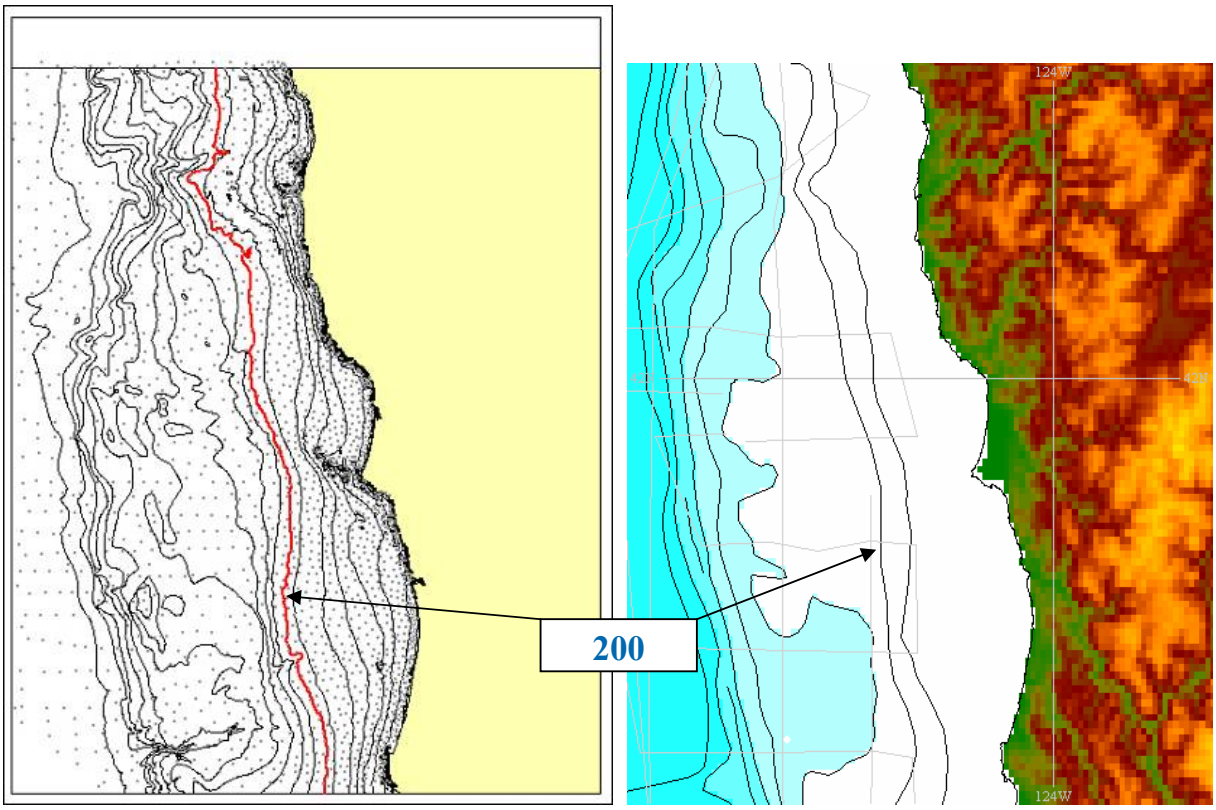




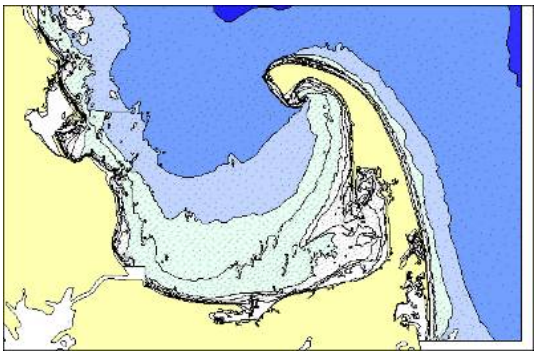
- **Navigational Purpose 2 – General - Cape Sable to Cape Hatteras, USA**

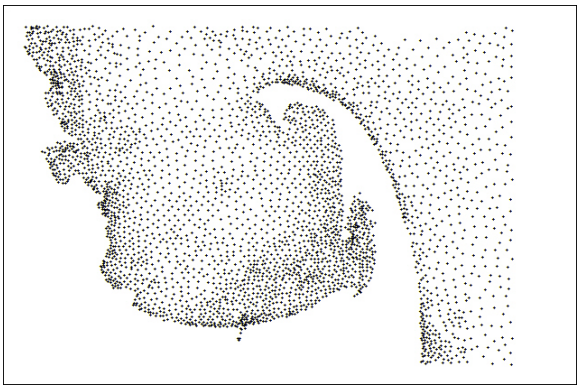


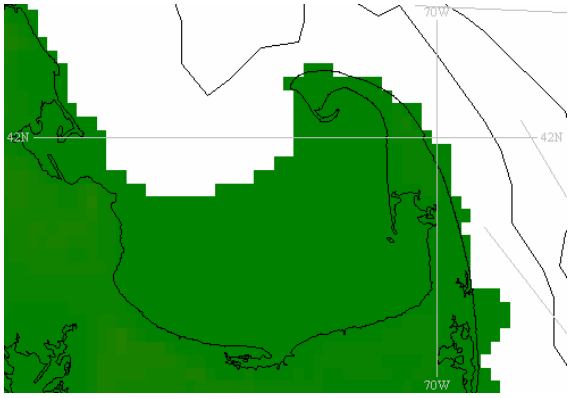
• **Navigational Purpose 3 – Coastal - Trinidad Head to Cape Blanco, USA.**



• **Navigational Purpose 4 - Approaches - Cape Cod Bay, USA**







• **Which Navigational Purpose?**

- Navigational Purpose 1 (Overview) was not sufficient to add value to the GEBCO shallow water data.
- Navigational Purposes 2 and 3 (General and Coastal) provided good compromise between coverage and data density.
- Navigational Purposes 4, 5 and 6, good density very limited coverage.

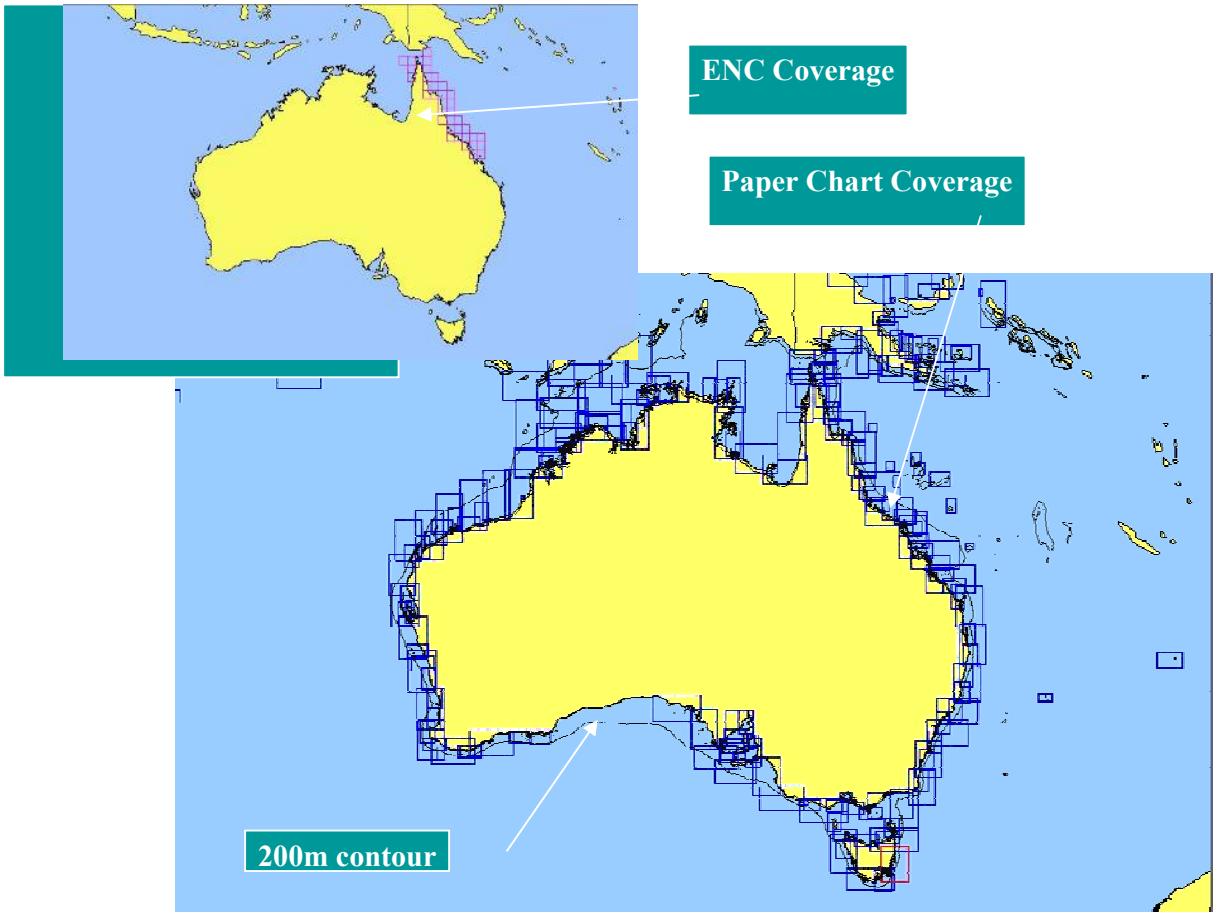
• **How can we extract these features?**

Developing a Shallow Water application that;

- has the ability to extract appropriate bathymetric features from ENCs
- writes the data to a text file allowing HOs to verify the data that they are providing
- can be made freely available to IHO Members

• **Other Sources of Data?**

- DNC
- Digital Paper Chart Files


ENC Coverage
Paper Chart Coverage
200m contour

ANNEX 15

GEBCO-CE : Virtual Sounding Nodes

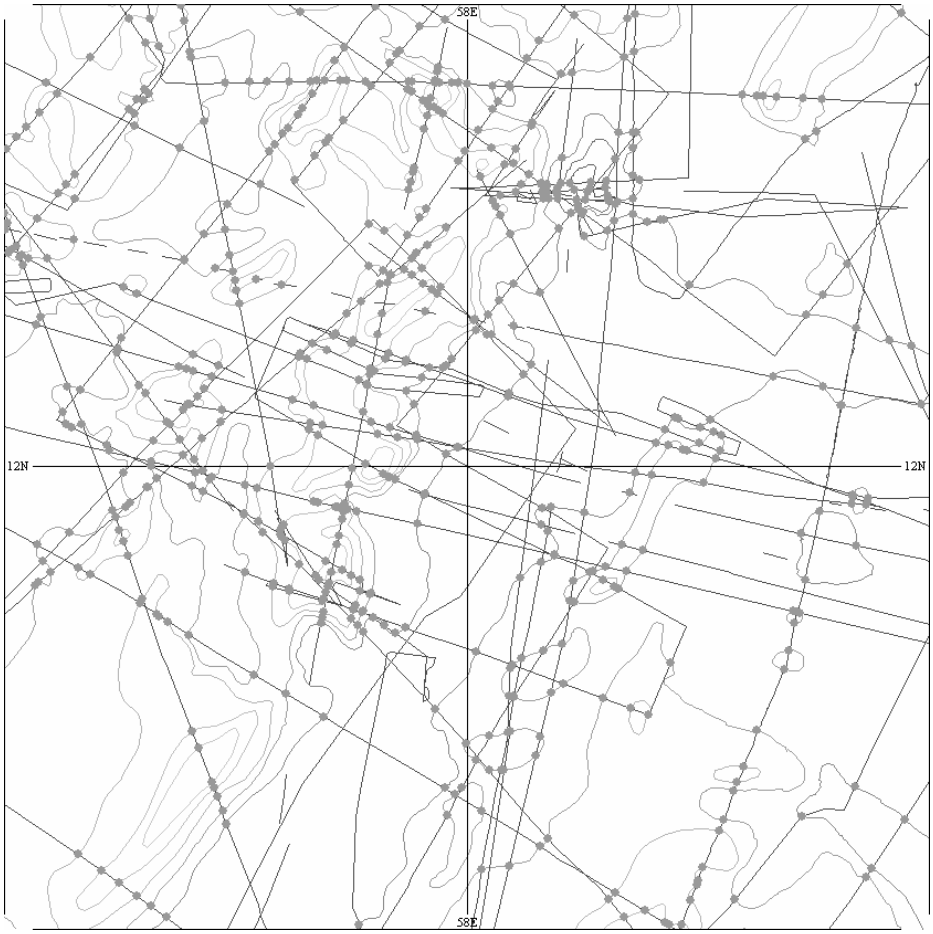
Ray Cramer
British Oceanographic Data Centre, Joseph Proudman Building, 6 Brownlow Street, Liverpool, L3 5DA, England.

As part of the effort to assist in the creation of some form of quantification of the quality of the one minute bathymetry grid, a list of the intersections of the track lines and bathymetry vectors has been created. I'm sure there is a proper term for these points, but I've called them 'virtual sounding nodes'.

The software was created using the code within the GDA to read both the tracks and vectors. The intersections of each were then computed within the ten degree square area covered by each. It should be noted that this effort has not been optimised in any way, other than restricting the area coverage into the ten degree squares, and is to be regarded as a crude and brute force approach which takes over five days of PC effort!

I did look into creating a distributed effort to run in spare PC time within BODC, for example over night on up to 30 PC's, but the first attempt was poor because of networking issues.

Below is an image of part of the created file.


58E
12N
12N
58E

ANNEX 16

Extracting the depth values at the crossover locations of the GDA contours and tracks

Peter Hunter
National Oceanography Centre, Southampton, U.K.

The region chosen for this study was located in the Indian Ocean (30°-90°E x 30°S-30°N). The reason for selecting this region was that there seemed to be sufficient tracks and contours to provide a good test and there were no boxes of Special Surveys which do not provide any tracks. I presume that these boxes contain almost blanket track coverage.

The method employed a mixture of FORTRAN programmes and GMT utilities running under DOS on a 3GHz PC with 1.5GHz of RAM. Bill Rankin kindly provided information about the GMT routine x2sys, unfortunately I could not follow this method as it is only available to UNIX users.

The following is a copy of my processing script, with extended comments (REM) added by me for this report.

REM XoverIn is a FORTRAN programme to convert GDA export files of contours and
REM tracks in ascii format to suitable input formats for the rest of the
REM script. At this stage a linear interpolation is applied to the tracks
REM and the contours to make sure there are values at all points along the lines.
REM The x,y resolution of these points is also selected, I used 0.005° which is
REM slightly greater than one quarter of a minute (longitude and latitude).
XoverIn
REM The following GMT routines, xyz2grd creates a grid file from the ascii contour file REM and places a value of 9999 at nodes not represented by data, and grdtrack
REM samples the grid file along the GDA tracks. A grid is created at 0.01° resolution, REM slightly less than 1 minute
xyz2grd cont.xyz -Gcont.grd -I0.01 -R30/90/-30/30 -N9999 -V
grdtrack track.xyz -Gcont.grd -M -R -S -V > TrackInt.dat
REM the following GMT routines are my clumsy way of outputting a clean file of
REM data points. It removes repeated values (my memory is slightly hazy as to the REM logic).
blockmean TrackInt.dat -R -I0.01 -V > TrackInt.blm
xyz2grd TrackInt.blm -GTrackInt.grd -I0.01 -R -NNaN -V
grd2xyz TrackInt.grd -S > XTrack.out
REM This FORTAN programme removes 9999 values, introduced earlier on. A NaN
REM option failed for some reason.
Del9999
REM The following create PostScript plots of the results.
psbasemap -Jm1.0 -R -Ba10g10f1 -K -V > Xover.ps
psxy Xover.dat -Jm -R -B -W1/255/0/0 -Sa0.1 -O -K -V >> Xover.ps
pscoast -Jm -Di -R -B -W1 -O -V >> Xover.ps
REM
REM Deleting intermediate files.
del cont.xyz
del track.xyz
del cont.grd
del TrackInt.dat
del TrackInt.blm
del TrackInt.grd
del XTrack.out

A 60° by 60° chunk of the Indian Ocean took about 30 seconds to process
on my PC, using the grid resolutions as above.

Drawbacks:

It is constrained by the resolutions of grids etc used in the script, a vector based approach (I think as used by Ray Cramer) would be far more accurate.

Some areas covered by Survey Boxes cannot be addressed this way.

I haven't tested it for polar regions.

ANNEX 17

GEBCO Digital Atlas Manager – Terms of Reference (Revised 19/7/05; 3/12/05)

Pauline Weatherall
BODC, Proudman Oceanographic Laboratory, Liverpool, U.K.

The GEBCO Digital Atlas (GDA) Manager will be responsible for:

1. receipt of a copy of digital bathymetric contour; trackline control; gridded bathymetry and coastline data intended for use in the updating of the GDA
2. carrying out quality control checks on the data for errors, ambiguities and inconsistencies
3. making any necessary edits to the data and/or reporting any errors, ambiguities and inconsistencies to the data originator or to the Chairman of the Sub-Committee on Digital Bathymetry for correction
4. maintaining a list of reported bugs in the GDA and its data sets and publishing this list on BODC's web site
5. carrying out any digitization of data from paper charts for intended inclusion in the GDA or for use in the update of the GDA and assist with any data reformatting work
6. maintenance of the GDA; the periodical updating of the GDA by the integration of new data sets when approved for inclusion and the dissemination of the data sets
7. substitution of the existing coastline in the GDA with other approved coastlines where appropriate
8. researching and implementing new output presentations from the GDA to meet the needs of users and to demonstrate its flexibility
9. maintaining and updating the GEBCO Digital Atlas web pages hosted at BODC
10. answering enquiries concerning the GDA and its data sets; providing user support to GDA users and maintaining contact with the user base
11. providing feedback from users of the GDA and its data sets to the Chairman of the Sub-Committee on Digital Bathymetry
12. producing yearly statistics of the sales of the GDA
13. setting up license agreements for the use of the GDA and its data sets where appropriate

ANNEX 18

File too large to be downloaded

ANNEX 19

fFile too large to be downloaded

ANNEX 21

Acronyms

Acronym	Full name
AMORE	Arctic Mid-Ocean Ridge Expedition
BODC	British Oceanographic Data Centre (UK)
CCOM	Center for Coastal and. Ocean Mapping
CD	Compact Disk
DCDB	Data Center for Digital Bathymetry (IHO)
DEM	Digital Elevation Model
DIF	Directory Interchange Format
DNC	Digital Nautical Chart (DNC®) of the National Geospatial-Intelligence Agency (USA)
DVD	Digital Video Disc
ENC	Electronic Navigation Chart
ETOPO2	Earth Topography (2 arc-minute grid)
FGDC	Federal Geographic Data Committee (USA)
GAPA	International Geological-Geophysical Atlases of the Atlantic and Pacific Oceans
GDA-CE	GEBCO Digital Atlas – Centenary Edition
GIS	Geographic Information System
GMT	Generic Mapping Tool
HDNO	Head Department of Navigation and Oceanography
HO	Hydrographic Office
IBC	International Bathymetric Chart
IASC	International Arctic Science Committee
IBCAO	International Bathymetric Chart of the Arctic Ocean (IOC/IASC/IHO)
IBCCA	International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (IOC/IHO)
IBCEA	International Bathymetric Chart of the central eastern Atlantic (IOC/IHO)
IBCIO	International Bathymetric Chart of the Indian Ocean
IBCM	International Bathymetric Chart of the Mediterranean (IOC/IHO)
IBCNA	International Bathymetric Chart of the North Atlantic
IBCSEP	International Bathymetric Chart of the Southeast Pacific (IOC)
IBCSO	International Bathymetric Chart of the Southern Ocean (IOC)
IBCWIO	International Bathymetric Chart of the western Indian Ocean (IOC/IHO)
IBCWP	International Bathymetric Chart of the western Pacific (IOC)
IHB	International Hydrographic Bureau (Secretariat of IHO)
IHO	International Hydrographic Organization
INEGI	Instituto Nacional de Estadística, Geografía e Informática (Mexico)
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
IODP	Integrated Ocean Drilling Program
IPY	International Polar Year
LDEO	Lamont-Doherty Earth Observatory
mgDMS	marine geophysical Data Management System
MGD77	Marine Geophysical Data Exchange Format - 'MGD77'
NASA	National Aeronautics and Space Administration (USA)
NATO	North Atlantic Treaty Organisation
NERC	Natural Environment Research Council (UK)
NF	Nippon Foundation (Japan)
NGA	National Geospatial-intelligence Agency (USA)
NGDC	National Geophysical Data Centre (USA)

NOAA	National Oceanographic and Atmospheric Administration (USA)
NSF	National Science Foundation (USA)
ODP	Ocean Drilling Program
PEMEX	Mexico's national oil company
PI	Principal Investigator
PMEL	Pacific Marine Environmental Laboratory
SCAR	Scientific Committee on Antarctic Research (ICSU)
SCDB	Sub-Committee on Digital Bathymetry (GEBCO)
SCOR	Scientific Committee on Oceanic Research (ICSU)
SCUFN	Sub-Committee on Undersea Feature Names (GEBCO)
SRTM	Shuttle Radar Topography Mission
SSPARR	Seafloor Sounding in Polar and Remote Regions
UNOLS	University-National Oceanographic Laboratory System (USA)
WDC	World Data Centre
WG	Working Group
WMS	Web Map Services