Preparatory Actions for European Marine Observation and Data Network

1st INTERIM REPORT FOR THE PERIOD JUNE 2009 – MAY 2010

Version 1.0

Service Contract No. "MARE/2008/03 - Lot 1 Hydrography – SI2.531515"

Prepared by: Dick M.A. Schaap – MARIS (Coordinator)

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CONTENT:

1. INTRODUCTION

EMODNET (European Marine Observation and Data Network) is a contribution to the EU Integrated Maritime Policy. The European Commission, represented by the Directorate-General for Maritime Affairs and Fisheries (DG MARE), has concluded several service contracts for creating pilot components of the EMODNET. The overall objective is to create pilots to migrate fragmented and inaccessible marine data into interoperable, continuous and publicly available data streams for complete maritime basins.

The results will help to define processes, best technology and approximate costs of a final operational European Marine Observation and Data Network. It will also provide the first components for a final system which will in themselves be useful to the marine science community.

This Report describes the activities undertaken and progress made for the **Hydrography Lot** during its 1st year.

The specific objectives of the Hydrography Lot are to:

- collate existing data from public and private organisations relating to the state of maritime basins; process them into interoperable formats which includes agreed standards, common baselines or reference conditions;

- assess their accuracy and precision and assemble them into common datasets;

- develop, test, operate and maintain a **portal** allowing public access and viewing of these data and a link to WISE-marine

- monitor and report on the effectiveness of the system in meeting the needs of users in terms of ease of use, quality of information and fitness for purpose of the products delivered;

- analyse what further steps need to be taken to improve the accuracy, precision, coverage and ease of use of the data, including a scheme for sustainable quality assurance and control of the data delivered to the system, both in this preparatory action and in the future larger system.

- analyse the necessary requirements to maintain the components built up in each lot as a sustainable infrastructure

- keep the portal operational afterwards and be prepared to transfer to the Commission.

The following geographical information system layers have to be produced and made available in the hydrographic lot:

1. water depth in gridded form over whole of maritime basin on a grid of at least quarter a minute of longitude and latitude.

2. water depth in vector form with isobaths at a scale of at least one to one million.

3. depth profiles along tracklines

4. multibeam surveys along tracklines

5. coastlines

6. underwater features – wrecks, seabed obstructions etc

Thereby it is accepted that the accuracy and precision of the gridded data will vary over the basin in question. No new data should be collected specifically for the project, but the aim is to provide access to data from existing monitoring programmes. All data delivered by EMODNET should be INSPIRE compliant.

The hydrographic project deals with the following geographical regions:

- the Greater North Sea, including the Kattegat and stretches of water such as Fair Isle, Cromarty, Forth, Forties,Dover, Wight, and Portland.

- the English Channel and Celtic Seas.

- Western Mediterranean, the Ionian Sea and the Central Mediterranean Sea.

The Marine Strategy Framework Directive's Marine Regions will be largely based on the ICES Ecoregions. Following discussion in the MODEG group it has been agreed with the EU in September 2009 to adopt the ICES Ecoregion boundaries, supplemented by EEZs (where they extend beyond ICES ecoregions). These boundaries are documented by VLIZ and made available in the VLIMAR website with the VLIZ Marine Gazetteer:

http://www.vliz.be/vmdcdata/vlimar/

The following image gives an overview of the relevant areas and boundaries for the Hydrography Lot.
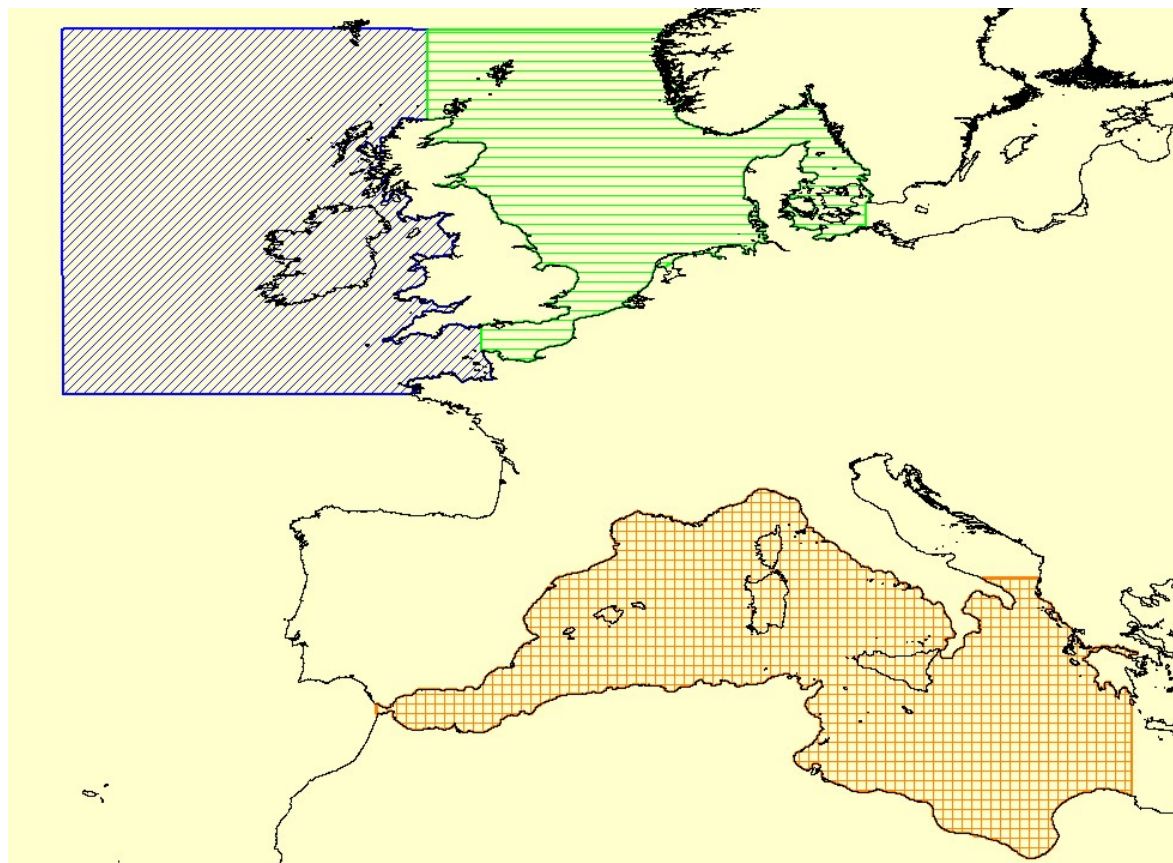
The Hydrography Lot is undertaken by a consortium of 7 partners consisting of:

- Mariene Informatie Service 'MARIS' BV (MARIS) – The Netherlands (coordinator)

- Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER) – France

- ATLIS – The Netherlands

- NERC - National Oceanography Centre, Southampton (NERC-NOCS) – United Kingdom

- Institute of Oceanography (IEO) – Spain

- Geological Survey of Ireland (GSI) – Ireland

- Service Hydrographique et Océanographique de la Marine (SHOM) – France

The partners combine expertises and experiences of collecting, processing, and managing of bathymetric data together with expertises in distributed data infrastructure development and operation and providing OGC services (WMS, WFS, and WCS) for viewing and distribution.

The portal must be developed with the main purpose to allow the download of data for further analysis by users and to make it available for combination with data from other portals including the other portals developed in this preparatory action. The portal must also allow the maritime community and potential users to understand how the data was collected as well as the overall aims of the EMODNET project.

SeaDataNet (http://www.seadatanet.org) is the leading infrastructure in Europe for marine & ocean data management. It is actively operating and further developing a Pan-European infrastructure for managing, indexing and providing access to ocean and marine data sets and data products, acquired via research cruises and other observational activities, in situ and remote sensing. It is also developing and governing common standards for metadata and data formats, common vocabularies and quality flags as well as standard software tools.

Therefore the consortium decided to base the Hydrographic Pilot on SeaDataNet standards and infrastructure and to seek synergy by applying the following approach:

- Develop a high-end Hydrographic portal, outfitted with a powerful spatial database, that is complemented with WMS, WFS and WCS services (OGC) to serve users and to provide layers for e.g. the other EMODNET portals, the prototype European Atlas of the Seas, and the broad-scale European Marine Habitats map;

- Involve research institutes, monitoring authorities, and HO's, in providing hydrographic data sets for producing Digital Terrain Models (DTM) with specific resolution for each geographical region, that are loaded and integrated afterwards into the portals' spatial database

- Include in the portal a metadata discovery service, by adopting the SeaDataNet CDI metadata standard, that inter alia gives clear information about the background data used for the DTM, the access restrictions and distributors; this also ensures the connection of the Hydrographic portal with the SeaDataNet portal.

This 1st Interim Report gives an overview of the activities undertaken for the Hydrography Lot during the 1st year from June 2009 till May 2010. In this 1st year very good progress has been made with all planned work packages and this has resulted in an operational proto-type EMODNET Hydrographic portal which can be found at:

http://www.emodnet-hydrography.eu

The underlying report describes the progress made with each of the Work Packages. It also gives an outlook on the activities that are underway and that will result in updating and upgrading of the portal, its services and data products in the second year of the contract.

2. WP1: Project Management

2.1 Contract

The contract between the MARIS and the European Commission DG-MARE was signed the 29th of May 2009. Financial and exclusion statements of all partners' institutes were collected and send to the Commission.

2.2 Consortium Agreement & Payments

A Consortium agreement between the consortium partners and MARIS was drafted by MARIS and after several modifications accepted and signed by all partners. MARIS arranged a bank guarantee for the pre-financing by the Commission and received the pre-financing after submitting an invoice. The pre-financing has been shared with all partners following the internal budget division.

2.3 Project Meetings

- MARIS and some other partners participated in the EMODNet Kick-Off Meeting in Brussels – Belgium at the EU on 26th June 2009. A presentation about the objectives and proposal of the Hydrography Lot was presented to the Commission and the other lots. A short summary has been drafted by MARIS and distributed to all partners.

- The Hydrography Lot Kick-Off Meeting with all partners took place 1st July 2009 at ATLIS offices in Bunnik, The Netherlands. Minutes and an action list have been drafted by MARIS and distributed to all partners.

- MARIS and some other partners participated in the EMODNet Concertation Meeting in Brussels – Belgium at the EU on 24th November 2009. A presentation about the progress so far of the Hydrography Lot was presented to the Commission and the other lots. A short summary has been drafted by MARIS and distributed to all partners.

- MARIS and ATLIS had a bilateral meeting in Bunnik, The Netherlands on the 10th December 2009 to finalise the technical specifications of the hydrography portal and the integration with the SeaDataNet CDI metadata and data access service. This has resulted in a draft of the Technical Portal Specifications document by ATLIS and MARIS, that has been distributed to all partners.

- A 2nd full project group meeting with all partners took place 14th – 15th January 2010 at NOC offices in Southampton, United Kingdom. Minutes and an action list have been drafted by MARIS and distributed to all partners.

- A 3rd full project group meeting with all partners took place 2nd – 3rd March 2010 at MARIS offices in Voorburg, The Netherlands. Minutes and an action list have been drafted by MARIS and distributed to all partners.

- A 4th full project group meeting with all partners took place 21st April 2010. Due to the ashclouds and difficult air traffic the meeting took place as a video conference. Minutes and an action list have been drafted by MARIS and distributed to all partners.

- MARIS and some other partners participated in the EMODNet Concertation Meeting in Copenhagen – Denmark at EEA on 25th May 2010. A presentation about the progress so far and a demonstration was given of the Hydrography Portal prototype for the Commission and the other lots. A short summary has been drafted by MARIS and distributed to all partners.

- A 5th full project group meeting with all partners took place 16th – 17th June 2010 at MARIS offices in Voorburg, The Netherlands. Minutes and an action list are underway by MARIS and will be distributed to all partners.

2.4 Progress Reports

During the first year five bi-monthly progress reports have been produced by MARIS and submitted to the Commission.

2.5 Website, Extranet and Mailinglist

Already early in the project, MARIS has registered the EMODNET Hydrography website at:

http://www.emodnet-hydrography.eu.

Activities were undertaken for preparing a site map with navigation options, that was adopted to configure an online Content Management System (CMS) that facilitates the editing and filling of the web pages. Inspired by the hydrographic and under water theme some drafts of a layout and look & feel were designed. The selected design was converted into stylesheets, that have been integrated into the online CMS and that make sure that the contents is presented to website visitors in a nice way. Further activities were undertaken to prepare the texts and images for each of the web pages. Partners contributed with images.

Later in the project the EMODNET logo and style were developed by the Commission and derived from this, MARIS has prepared an EMODNET stylesheet. The website recently has been updated by adopting the stylesheet. Note: the stylesheet has also been distributed to all other EMODNET lots for adoption to establish a common look & feel between the EMODNET lots.

Image: Homepage of EMODNET Hydrography portal: http://www.emodnet-hydrography.eu

The website has been kept up-to-date following the activities and progress in the project. It now describes the backgrounds of EMODNET, the project and the approach, activities and partners. Moreover it gives access to the services that have been developed in the meantime for getting overview and access to the data products and data services.

The website also gives access to the **Extranet**, which was set up already in July 2009 and that gives partners an archive of all contract documents and project documents. Each partner has his/her personal log-in. Furthermore use is made of the **projectgroup@emodnet-hydrography.eu** mailing list, which includes all partners. Only included partners can write to this list, which then distributes their message to all partners.

2.6   Dissemination and promotion

MARIS, IFREMER and SHOM have participated in the GEBCO Bathymetric Science Day that was held in September 2009 in Brest – France. MARIS gave a presentation to inform GEBCO members (incl HO's) about the EMODNET Hydrography project and to seek good cooperation. The presentation is included in the Extranet. As an outcome GEBCO has decided to initiate a new committee, that is going to establish a metadata format and directory for datasets, of use for GEBCO. It is agreed that the EMODNET Hydrography group can contribute through e.g. IFREMER and SHOM by bringing in the CDI metadata format. That way GEBCO might validate and adopt the same format and approach, which is in favor for EMODNET for the longer term.

The EMODNET Hydrography project has been presented by MARIS with a poster at the IMDIS conference, that took place 29th – 31st March 2010 in Paris – France. See http://www.seadatanet.org/imdis2010. The poster can be downloaded as PDF file from the EMODNET Hydrography website from the section 'Promotion'.

3. WP2: DATA COLLECTION AND METADATA COMPILATION

3.1 Objectives and approach of WP2

The hydrographic data concerns the following 3 geographical regions:

- the Greater North Sea, including the Kattegat and stretches of water such as Fair Isle, Cromarty, Forth, Forties,Dover, Wight, and Portland.

- the English Channel and Celtic Seas.

- Western Mediterranean, the Ionian Sea and the Central Mediterranean Sea.

The objectives of the work package WP2 are:

- To identify and gather hydrographic data sets for these regions

- To compile metadata for all hydrographic data sets in CDI format

Hydrographic data are acquired and managed by the following types of organisations:

- Hydrographic Offices, that are responsible for surveying the navigation routes, fairways and harbour approach channels and producing from these the nautical charts on paper and as Electronic Nautical Charts (ENC), that are used for navigation. The HO's are members of the International Hydrographic Organisation (IHO) and have their own data policy, which has restrictions. Partly this is due to the fact, that many HO's are part of the navy and that high resolution data sets are treated as confidential for security purposes; partly it is also due to the fact, that HO's have more or less a monopoly on the production of nautical charts and create income from this. These charts have a legal status. Every captain must use certified nautical charts and the production and publication of these is an activity which must follow stringent international procedures. The latter results in a condition that HO's are careful in delivering and distributing bathymetric survey data sets.

- Authorities, responsible for management and maintenance of harbours, coastal defences, shipping channels and waterways. These authorities operate or contract regular bathymetric monitoring surveys to assure that an agreed nautical depth is maintained or to secure the state of the coastal defences. Part of these data is already included in SeaDataNet, because its data centres belong to the same institutes, that perform the surveys.

- Research institutes, that collect multibeam surveys as part of their scientific cruises. Part of these data is already included in SeaDataNet, because its data centres belong to the same research institutes.

- Industry, especially the energy industry, that contracts multibeam surveys for pipeline and cable routes (in case of windfarms) and the telecommunication industry for phone and internet cable routes.

Summarizing, there are 4 types of organisations, that perform bathymetric surveys, thereby partly overlapping and mostly complementing their geographical coverages. Data are collected at different frequencies and even date back to previous centuries.

The consortium has decided to focus on Hydrographic Offices, Authorities and Research Institutes. In a later stage Industry might be approached once the portal has matured.

The overall strategy applied is to achieve good external cooperation and to gather as many data sets as possible. It is emphasized to potential suppliers, that they will stay in control of their data sets, that their data sets are to be used internally by the project partners for generating a digital bathymetry with a gridsize of .25 minute by .25 minute (ca 500 * 500 m2) and that metadata describing their data sets will be provided to users with the SeaDataNet functionality for requesting access to the actual data sets. This way, the EMODNET portal

can offer to data providers an excellent shop window to reach other users in search of data and to promote their services. The implementation and cooperation can be further encouraged by making limited financial arrangements with data suppliers for preparing the appropriate metadata. For this purpose the project has a budget set aside. This approach in combination with naming data suppliers as associate partners at the website and in other promotional activities encourages potential suppliers to cooperate and contribute data sets for the EMODNET Hydrography Lot.

3.2   Types of bathymetric data sources

An important objective of the EMODNET Hydrographic Lot is to produce a digital bathymetry for the maritime regions as a Digital Terrain Model (DTM) with a gridsize of .25 minute by .25 minute. This must be based upon available bathymetric data sources. In practice there are 3 types of bathymetric data sources:

- **Bathymetric surveys**, such as single and multibeam surveys, echosoundings and even historic leadline soundings. These data sets are most preferred as data source because of their high resolution.

- **Composite data sets**, giving a gridded bathymetry. In practice it appears that Hydrographic Offices (HO's) do not want or can not deliver primary surveys but composite data sets from the Digital Terrain Models that they maintain themselves for producing and maintaining their nautical charts following international IHO procedures. As regular practice the HO's process new surveys and incorporate these into the latest version of their DTM that is geared towards use by the maritime community for navigation. In a number of cases it appears that the HO's do not even archive the original surveys but only maintain their DTM.

- **GEBCO 30" gridded data.** The General Bathymetric Chart of the Oceans (GEBCO) (see http://www.gebco.net) aims to provide the most authoritative, publicly-available bathymetry data sets for the world's oceans. It consists of an international group of experts who work on the development of a range of bathymetric data sets and data products, including gridded bathymetric data sets, the GEBCO Digital Atlas, the GEBCO world map and the GEBCO Gazetteer of Undersea Feature Names. GEBCO makes the following gridded bathymetry data sets available:

  - The GEBCO One Minute Grid — a global one arc-minute grid; Released: 2003, updated: 2008 — largely based on the most recent set of bathymetric contours contained within the GEBCO Digital Atlas.

  - The GEBCO_08 Grid — a global 30 arc-second grid; Released: January 2009, updated November 2009 — generated by combining quality-controlled ship depth soundings with interpolation between sounding points guided by satellite-derived gravity data.

  GEBCO is used by the EMODNET project to complete area coverage in case there are no survey data or composite data sets available to the partners.

3.3   Metadata formats

3.3.1   Metadata format for survey data sets

The SeaDataNet Common Data Index (CDI) data discovery and access service will provide the basis for giving overviews and access to the **high resolution survey data sets**, that are used to produce the digital bathymetry DTM for the selected maritime regions.

The Common Data Index (CDI) is the central discovery service in SeaDataNet, that enables users to have a detailed insight of the availability and geographical extent of marine data, archived at the connected data centres. It gives the description of individual data sets and

measurements with key fields (what, where, when, how, who etc.). It is also the linking pin from the discovery services towards the delivery services, because it is directly related to the data sets, to which the users can request access. Users can freely search and browse in the CDI discovery services and identify relevant data sets. The CDI User Interface includes a shopping basket and transaction processing mechanism, by which users can request access to selected data sets. Access is given as downloading services, whereby the data sets can be downloaded by users from the data centres in the SeaDataNet standard data exchange formats.

Considerable work has been undertaken, first in Sea-Search and later in its successor SeaDataNet, to define the CDI metadata format (xml) and XML schema (xsd) as an extended profile of the ISO 19115 standard for geographical data sets. The latest version makes use of standard mark-up terms, wherever possible, which are managed in the SeaDataNet Common Vocabularies, while for Organisations standard references are included to the EDMO – European Directory of Marine Organisations. Furthermore tools and services have been developed in SeaDataNet for generating CDI XML records from the data management systems of data centres, a CDI XML validation Web service, parsing the CDI XML records against an extended CDI schema including vocabularies support, and tools for importing CDI records into the central SeaDataNet CDI Directory and its Portal User Interface. The latter includes a combined alphanumeric – geographical interface.

The original CDI metadata format is fit for all types of observations, but at the start of the EMODNET Hydrography project the CDI format was well suited for point observations, while tracks and polygons could only be handled in a schematic way by using bounding boxes. However for the users of the EMODNET Hydrography portal it is required to provide insight in the actual tracks and coverages of bathymetric surveys. Therefore activities were undertaken by the project team in cooperation with the SeaDataNet Technical Task Group (TTG), that is governing the CDI metadata format, and also together with the Geo-Seas project team, to extend the CDI format for describing bathymetric and seismic surveys in good detail. A number of extensions were made to the original CDI format:

- Option to include a GML object, so that tracks and polygons can be described in much more geographical detail

- Option to include an extra service bindings element, which can be handy for linking to previewing and visualisation services

- Option to include positioning systems via multiple entries of measurement devices and supported by a new class the SeaDataNet L05 Common Vocabulary

- Option to include a resolution in space or time via entry of a numeric value in combination with a unit from the SeaDataNet P061 Common Vocabulary. This way e.g. the survey resolution (gridsize) can be added, which together with the positioning system info gives more insight in the data quality.

This has resulted in an upgraded CDI V1.6 format that has been fully documented and made available as:

- Documentation: 5.00; Common Data Index (CDI); Version 1.6; Metadata Format; 10 June 2010 with XML Schema, XLS description of all XML tags and XML examples

This documentation can be retrieved from the SeaDataNet website in the section 'Standards & Software: http://www.seadatanet.org/standards_software

Moreover activities have been undertaken as part of the Geo-Seas project to upgrade also the tools for handling the upgraded CDI metadata format. CDI metadata records in XML have to be generated from the database systems of each of the data suppliers and provided in the agreed CDI XML format. Local XML export can be produced by data suppliers using the **MIKADO Java Tool**, developed in SeaDataNet. Following the CDI format upgrade the

MIKADO tool has recently been upgraded and is available for use since May 2010. It can be downloaded from the SeaDataNet website from the section Standards & Software.

The number of coordinates for describing the tracks and polygons following the navigation might be quite large. Such a high resolution is not needed for the CDI discovery service. Therefore IFREMER has made freely available a PC programme 'Ends and Bends', previously also used in the EuroSeismics project, to reduce the number of coordinates and to generate a lower resolution smooth track or polygon, that is perfectly suited for discovery purposes.

Furthermore all the CDI portal software applications and central database have been upgraded in support of the upgraded CDI format. These applications are now operational at the SeaDataNet portal (http://www.seadatanet.org) and all related portals, such as the EMODNET Hydrography portal, since end May 2010.
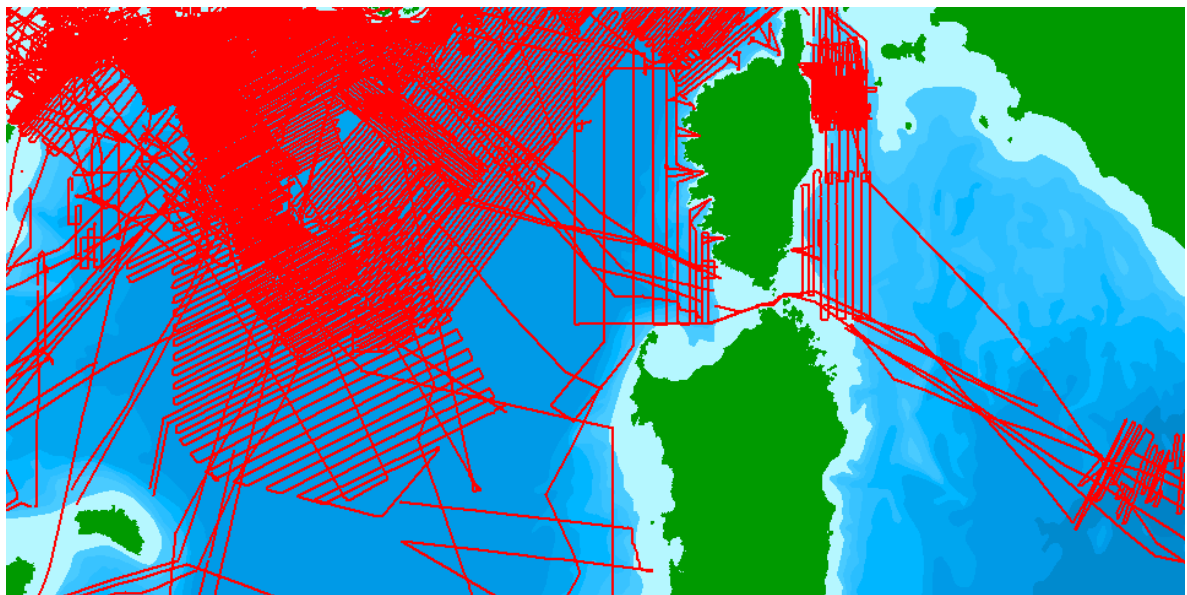
Image: Example records of the upgraded CDI for bathymetric surveys in the Mediterranean

3.3.2 Metadata format for composite data sets

The consortium strives for gathering and basing the digital bathymetry on high resolution bathymetric surveys, which will be referred by the CDI metadata. However as explained earlier this will be difficult in practice, because external data suppliers might provide composite data products (local DTM's) themselves with limited references to used background data surveys, and in a number of cases only GEBCO data might be available without background references.

Therefore recently also a metadata format has been proposed and adopted for describing these composite data sets. The chosen format is based upon the CAMIOON catalogue of products, developed and maintained by IFREMER. Originally this data products metadata format has been designed in the MerSea project, using the ISO 19115 and an earlier version of the CDI format as a basis. Recently further developments have taken place as part of the MyOcean project and the CAMIOON catalogue is now operational with a stable metadata format supported by the SeaDataNet Common Vocabularies and EDMO, an online Content Management System and a retrieval and presentation system:

see http://www.myocean.eu.org/products-services/catalogue.html

The same basis can be adopted and adapted to enter, maintain and provide metadata documentation for the composite data sets that are being used in the EMODNET digital bathymetry product.

This system will be worked out for EMODNET in the coming months and suppliers of composite data sets will be requested to populate entries. At the same time these data suppliers will also be requested to bring forward CDI metadata on the underlying bathymetric surveys, if available.

3.4   Progress of data gathering per maritime region

3.4.1   the Greater North Sea

The data gathering for the Greater North Sea, including the Kattegat and stretches of water such as Fair Isle, Cromarty, Forth, Forties,Dover, Wight, and Portland is coordinated by ATLIS and NERC-NOC.

For this area a good cooperation and data supplier commitments have been achieved by ATLIS with the Hydrographic Offices of Norway, Denmark, Germany, Netherlands and Belgium. These services have provided composite data sets in a number of resolutions as can be seen in the following table.

Hydrographic Office	Coverage	Vertical Datum	Data type	Source Grid	Metadata	Remark
Norway	Economic Zone	LAT	ENC usage 4	500 m x 500 m	No	Gridded ENC
	North Sea	LAT	ENC usage 2	500 m x 500 m	No	Gridded ENC
	North Sea		Underwater features	N.A.		
Denmark	Kattegat North	LAT	DTM	50 m x 50 m	Partly	
	Kattegat South	LAT	DTM	50 m x 50 m	Partly	
	North Sea (Economic Zone)	LAT	DTM	100 m x 100 m	Partly	
Germany	North Sea (Economic Zone)	MSpNW	DTM	70 m x 70 m	No	MSpNW: Mean astronomical low water tide
Netherlands	North Sea (Economic Zone)	LAT	DTM	100 m x 100 m	Yes	
Belgium	North Sea (Economic Zone)	LAT	DTM	400 m x 400 m	No	

Table: deliveries of composite data sets by Hydrographic Offices for the North Sea

In a number of cases the HO's were prepared to deliver a high resolution DTM for their area, which was very much welcomed. However further efforts are required to seek improved metadata for these DTM's adopting the new format (see 3.3.2), more quality information and where possible, to gather CDI records for underlying surveys.

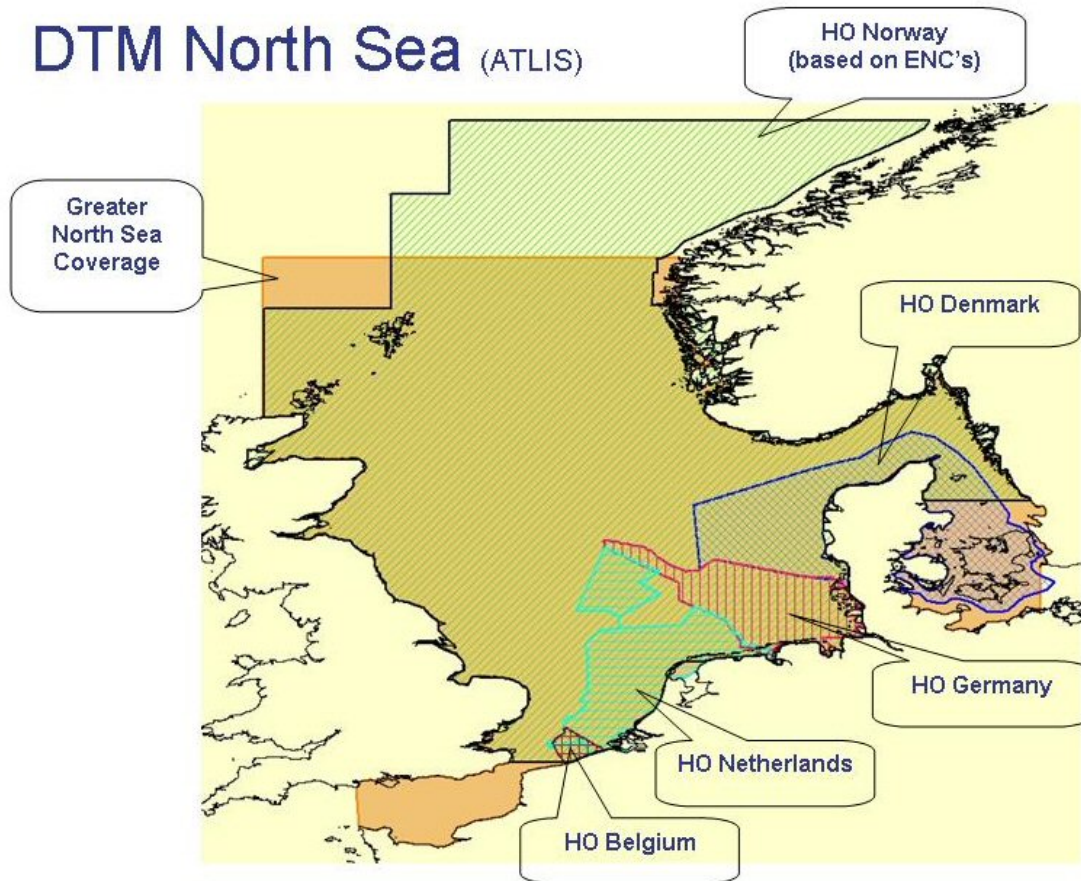The following image gives the geographical coverage of the data supplies by each of the Hydrographic Offices.

Image: geographical coverage of the composite data supplies by Hydrographic Offices.

In the Southern North Sea hydrographic surveys were provided by SHOM (the French HO and partner). For these also CDI records have been produced by which associated data sets can be requested. This is illustrated in the following image.

Image: CDI records of bathymetric surveys by SHOM in the Southern North Sea

All these deliveries implicate that high resolution data sets have been gathered for generating the digital bathymetry for the Eastern part of the North Sea and the Kattegat with high quality.

However for the Western part of the North Sea and in fact the shallow waters around the United Kingdom it is a different story so far and use is made of the GEBCO 30" data set.

For the UK sector high resolution digital bathymetry has been produced by **SeaZone**, which until recently was a company owned by the UK Hydrographic Office (UKHO). SeaZone has digitized **UKHO** fair sheets and other UKHO surveys to produce a digital bathymetry up to a 25 meter grid. The following image shows the coverage of data by SeaZone in grey. Considering this coverage negotiations were undertaken by NOC and MARIS with SeaZone to retrieve a composite data set for these areas at the EMODNET grid size and CDI metadata for the underlying survey data, where available. In return a financial compensation would be given for the CDI preparations as well as some extra promotion for the SeaZone products via inclusion of some very high resolution tiles in the EMODNET portal. The negotiations took place in March 2010 and seemed to go well, until it was released at 23rd March 2010 that SeaZone had been sold by UKHO to HR Wallingford. The partnership had been negotiating with the founder and Managing Director of SeaZone, who was no longer in command after the take-over. Due to this fact the negotiated deal became uncertain.

Therefore negotiations were started directly with the UKHO, also to get access to additional surveys undertaken by the UK Maritime Coastguard Agency's (MCA) Civil Hydrography Programme which are indicated in blue in the image below. The MCA already has given permission to NOC to use these surveys for the EMODNET project, but the surveys have been processed by the UKHO, so permission and cooperation by the UKHO is required.
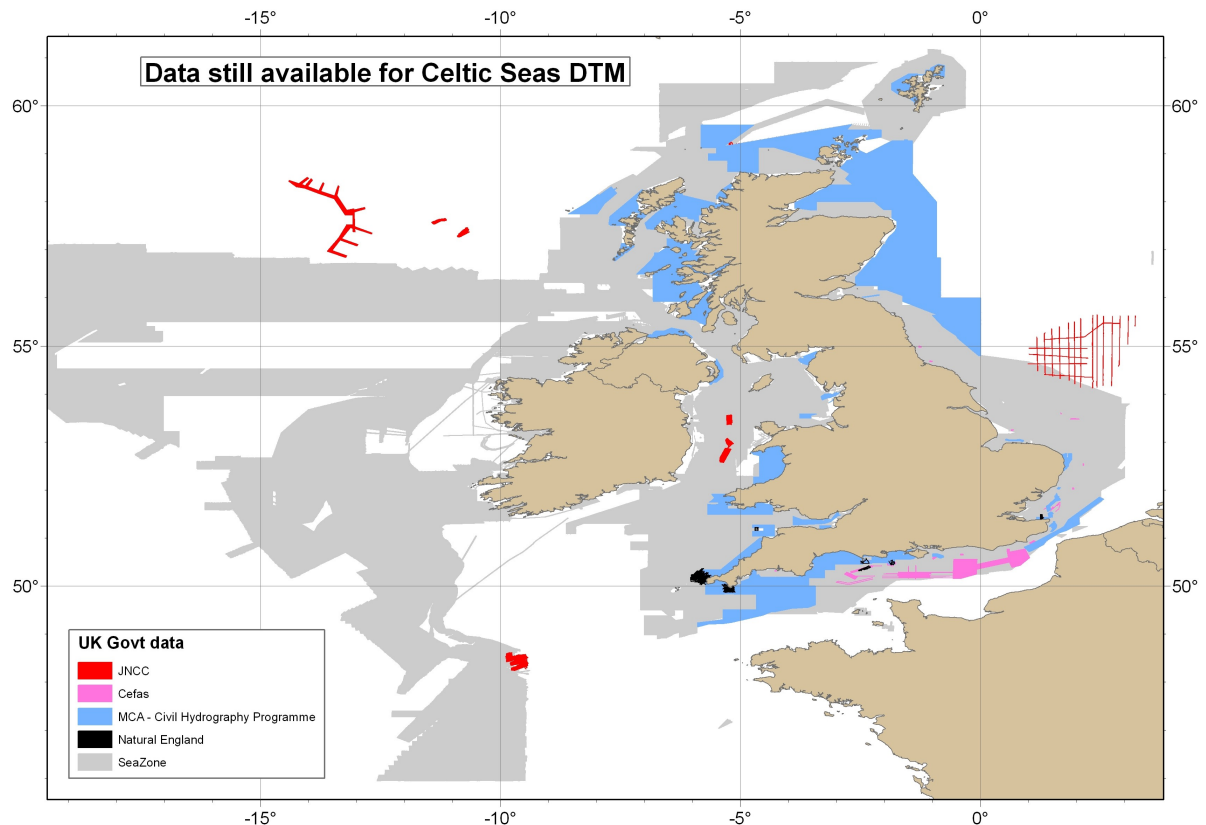
Image: Possible additional data sets especially for the UK sector

So far the negotiations with the UKHO have not led to a satisfactory solution because UKHO is only willing to release a license with limited options and pay per view while the EMODNET consortium has a golden rule and policy that it will not pay for data and that the resulting EMODNET data products must be published and be available for viewing and downloading by users without any restrains.

If the SeaZone / UKHO agreement will be unsuccessful then these areas will be unrepresented by any data other than GEBCO and from the Geological Survey of Ireland (GSI). Considering the image it should be noted that some of the area offered by SeaZone is covered by other surveys, in particular by the Geological Survey of Ireland (partner) for the Irish continental shelf.

3.4.2   the Channel and Celtic Sea

The data gathering for the Channel and Celtic Sea is coordinated by NERC-NOC and the Geological Survey of Ireland (GSI).

Except for the still missing data sets as indicated in the previous paragraph by SeaZone / UKHO for the English part of the Channel and the waters between Ireland and the UK there has been gathered a lot of high resolution survey data from NERC cruises, SHOM, IFREMER and the extensive mapping programme of the GSI.

The main components are:

- Multibeam bathymetric data collected under the Irish National Seabed Survey (INSS) and the Integrated Mapping for the Sustainable Development of Ireland's Marine Resources (INFOMAR) programme, jointly managed by GSI and the Irish Marine Institute

- Bathymetric surveys collected by SHOM in the Channel

- The CartoPEP survey by IFREMER

- Six multibeam bathymetry cruises by NERC

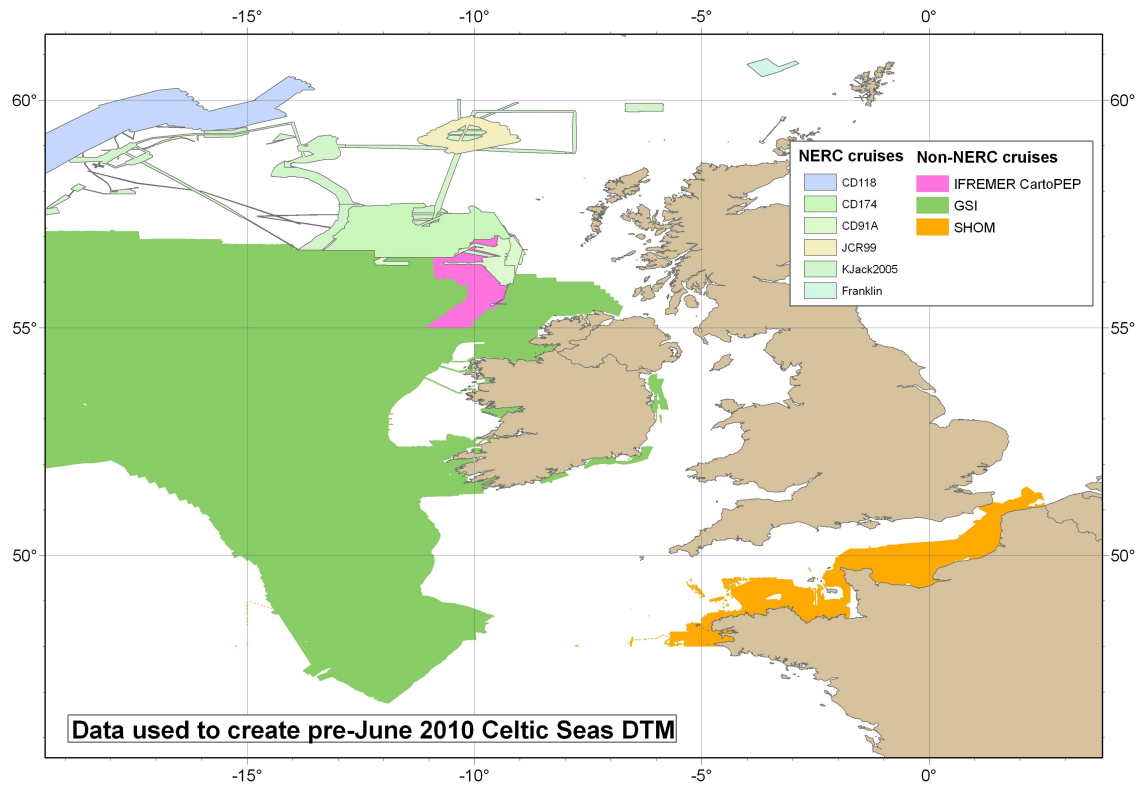This is illustrated in the following image.

Image: Gathered data sets for the Channel and Celtic Seas

For the SHOM and IFREMER surveys already CDI metadata have been produced and these are included in the EMODNET Hydrography CDI discovery and data access service (see Chapter 5). For the NERC and GSI surveys work is underway for preparing the CDI records.

3.4.3   the Western Mediterranean, the Ionian Sea and the Central Mediterranean Sea

The data gathering for the Western Mediterranean, the Ionian Sea and the Central Mediterranean Sea is coordinated by IFREMER, SHOM and IEO.

Very good progress has been made with gathering high resolution survey data as well as composite data sets for several regions. The main components are:

- All the SHOM (public) surveys (sampled every 25m) since the 19th century. Their coverage is illustrated in the following image. These include 2815 surveys, which are all included in the CDI discovery and data access service.

Image: Survey data provided by SHOM

All the IFREMER multibeam surveys since the end of the 70's, carried out for IFREMER and as the National Agency in charge of the National fleet for French research institutes (Universities, CNRS, BRGM, IRD, ...) plus a few commercial surveys. These include 575 surveys, which are illustrated in the following images.
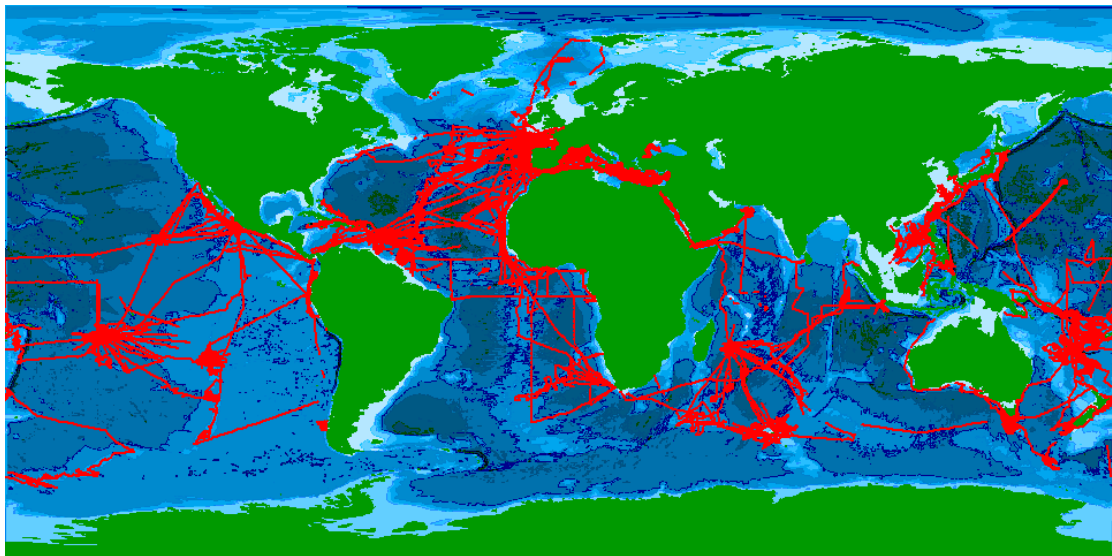
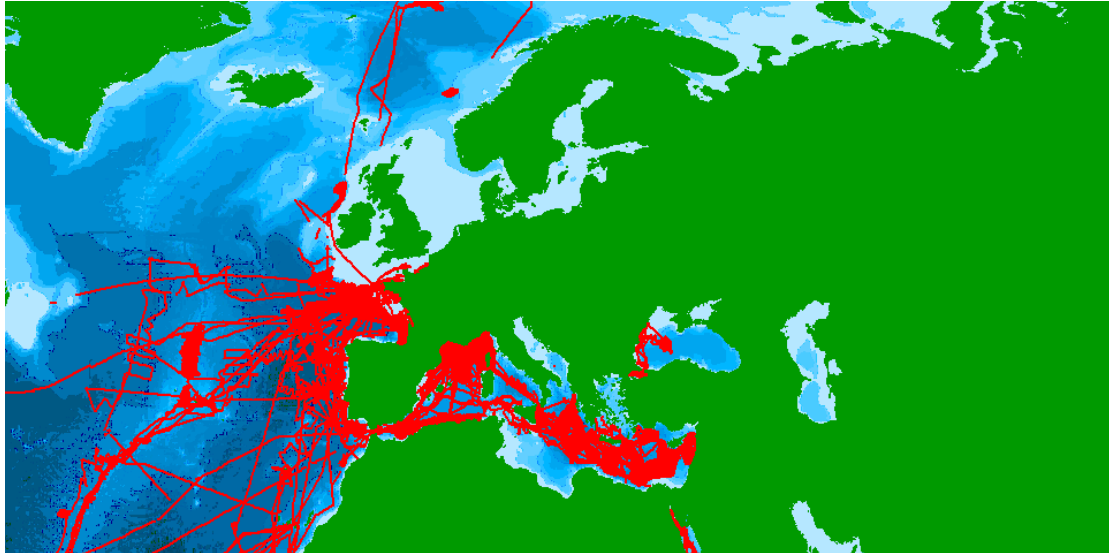Image: Survey data provided by IFREMER on a global scale (575 surveys), all included in the CDI discovery and data access service

Image: Survey data provided by IFREMER in the EMODNET regions (285 surveys)
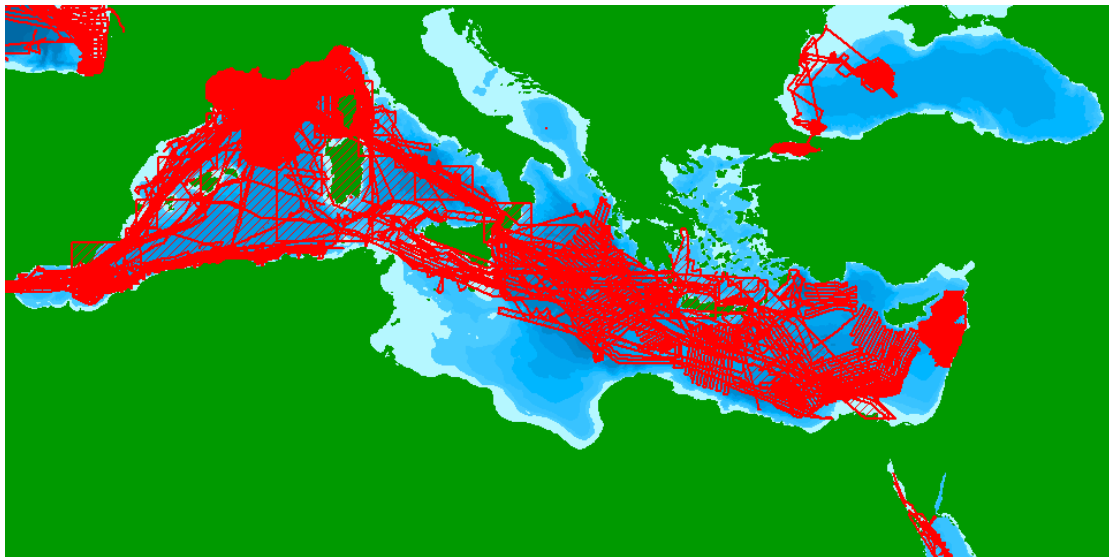
Image: Survey data provided by SHOM and IFREMER for the Mediterranean region (1224 surveys)

- Composite DTMs of the Spanish EEZ and continental shelf produced by IEO from data or composite data sets or isobaths from IEO, General Secretary of Maritime Fisheries (SGPM), University of Barcelona, Institut de Ciences del Mar (ICM), Consejo Superior de Investigaciones Cientificas (CSIC), Instituto Hidrografico de la Marina (IHM),S.N.E.D (Société Nationale d'Etudes du Détroit de Gibraltar), SECEG (Sociedad espanaola de estudios para la comunicacion fija a traves des estrecho de Gibraltar), DG Costas (Ministerio de Medio Ambiente). The following image gives an illustration.

  The IEO composite data sets comprises 8 local DTMs for: **Alborán Sea, Catalan Continental Margin, South of the Ibiza Island - Baleares Islands, South of the Formentera Island –Baleares Islands, Strait of Gibraltar, East Mediterranean Margin, ZEEE – Spain Exclusive Economic Zone - Baleares Islands, and IBCM-South Alborán Sea**. In all cases IEO has not (yet?) been able to retrieve the original surveys, but data owners have provided to IEO composite datasets in 2 formats. For most cases data sources have been a DTM in GRID format or in other cases isobaths with variable equidistant.

SPANISH CONTINENTAL MARGIN MAIN BATHYMETRIC DATA SETS. (SOURCES)

Legend
Source
- CIESM-IFRE
- COSTAS
- GEBCO
- IEO
- IEO - IHM
- IEO-BEICIP
- IEO-BEICP
- IEO-IHM
- IEO-SGPM
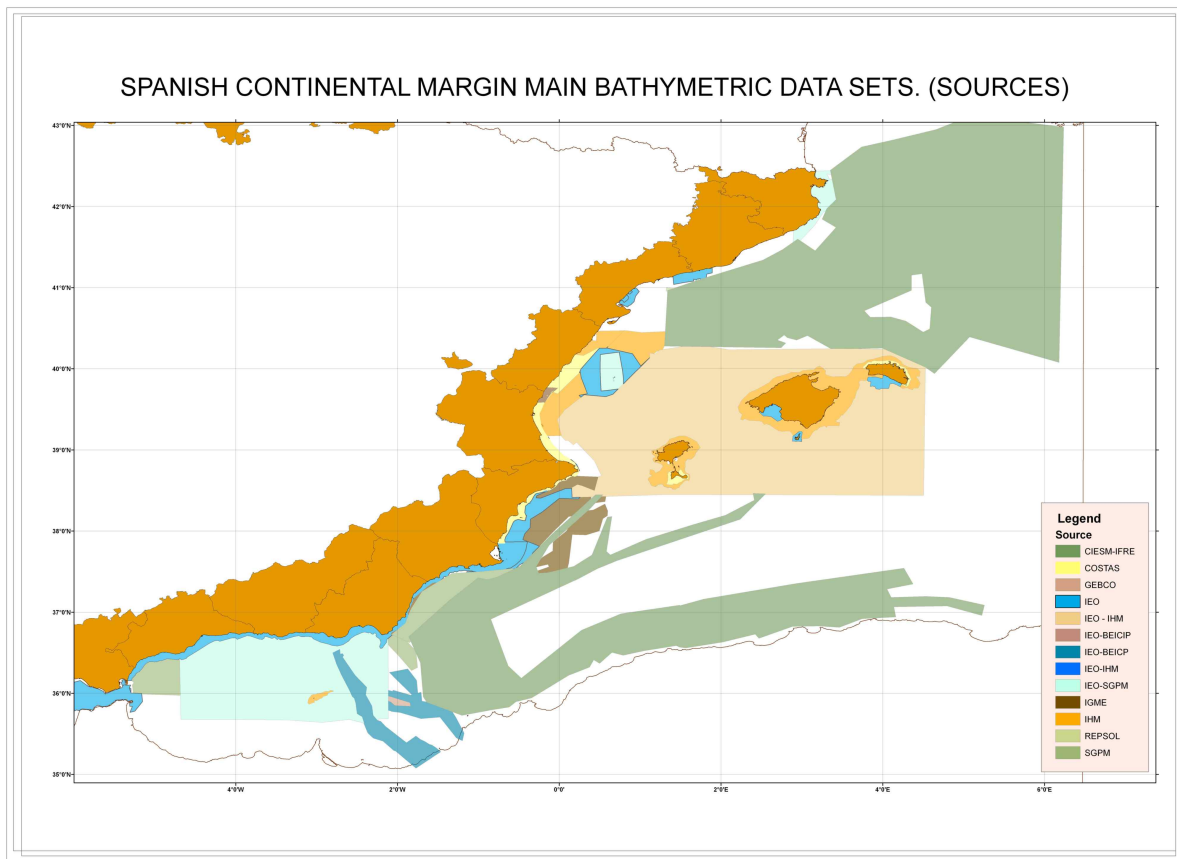- IGME
- IHM
- REPSOL
- SGPM

Image: Composite data sets produced and delivered by IEO

It is planned that IEO will complete the metadata descriptions for each of the 8 DTM's following the composite data set metadata format (see 3.3.2). Furthermore IEO will contact again its data suppliers in a new attempt to get CDI metadata on the underlying surveys and hopefully access to these surveys themselves, if still available, thereby explaining the EMODNET Hydrography philosophy and demonstrating the portal.

- IFREMER has subcontracted UNEP/Grid-Arendal, that maintains a global clearing house for hydrographic data sets because of its activities for UNOLS, to identify additional sources of data sets and to approach these for contributing to the EMODNET Hydrography Lot. This has resulted in 2 extra survey data sets for the Mediteranean Sea, one from Woods Hole Oceanographic Institute (USA) and one from BSH (Germany).

20

Image: Survey of WHOI

- MARIS and IFREMER have arranged that CNR-ISMAR from Italy has become an associate partner to the EMODNET Hydrography project. ISMAR is well involved in the bathymetric mapping projects for the Italian coastal waters and itself has an extensive multibeam survey data set for the Tyrrhenian sea. The latter data sets have been contributed and work is underway by ISMAR to prepare the associated CDI metadata records as well as exploring whether data sets for the Italian coastal waters can be released for EMODNET. .

The present coverage of data sets (surveys and composite data sets) for the Mediterranean Sea area is shown in the following image.
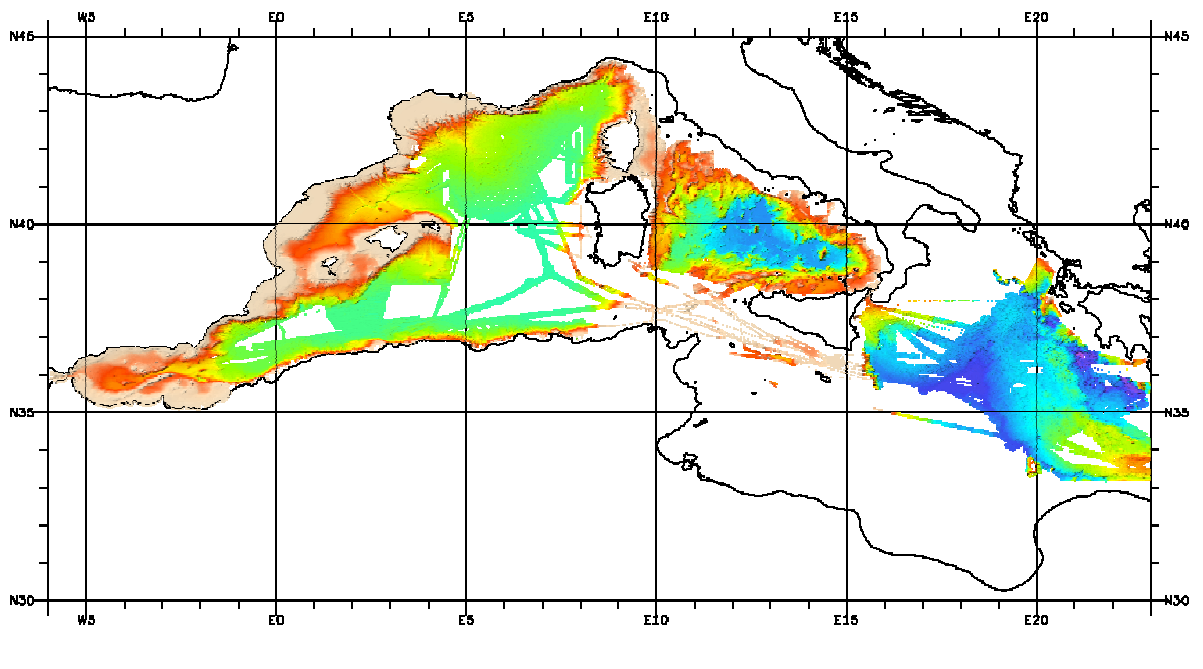
Image: Surveys and composite data sets gathered so far for the Mediterranean regions

Next to the activities already mentioned further actions are undertaken by partners to retrieve additional data:

- OGS has multibeam surveys for the Ionian Sea. A negotiation has been initiated with OGS to retrieve these data sets and to have OGS preparing the associated CDI metadata.

- There might be additional data sets for Italy at the Italian Hydrographic Service and at SACLANT (NATO). These parties will be approached.

- For France IFREMER seeks to retrieve data sets from harbours and Regional Equipment Services of the State. Also there are possibly new surveys from a cooperation of IFREMER with Italy for Sardinia and Corsica (to be confirmed). Furthermore a few old multibeam surveys of J. Charcot will be reprocessed for better data.

- Finally it is planned to contact IBCM (eg for Russian data off Lybian coast), Tunesia, where there exist a few multibeam surveys, and to contact CIESM for a possible cooperation.

3.5   Coast line data

A requirement of the EMODNET Hydrography pilot is to provide a common coastline for the European seas. This should be an existing data product, because compiling a coastline or upgrading an existing one is not part of the project. There were a number of options:

- World Vector Shoreline (WVS):
  WVS was produced by the US National Imagery and Mapping Agency (formerly the US Defense Mapping Agency) and has been adopted as the standard world coastline for the updating of GEBCO north of 60°S. South of 60°S, the WVS has been replaced for GEBCO use by the SCAR (Scientific Committee on Antarctic Research) coastline of Antarctica. The WVS provides a digital coastline with consistent global coverage at a scale of 1 : 250.000. The WVS is used as the coastline in the GEBCO's digital chart of the world. It has also been adopted as the standard coastline for use in IOC's Regional Ocean Mapping Projects. A description of the WVS may be found in Soluri,E.A. and V.A.Woodson (1990), 'World Vector Shoreline', International Hydrographic Review, Vol.LXVII(1), p27-36.

- Prototype Global Shoreline Data (GDS) (Satellite Derived High Water Line Data):
  The NGA Office of Global Navigation, Maritime Division is in the process of developing a new version of World Vector Shoreline and in support of this effort has acquired a prototype Global Shoreline Data set. This new shoreline is an approximation of the High Water Line. Plans are in work to fill cloud gaps. The prototype aims for a scale of 1 : 75.000. However it is not ready yet.

- Global Self-consistent, Hierarchical, High-resolution Shoreline Database (GSHHS):
  GSHHS is a high-resolution shoreline data set amalgamated from two databases (World Vector Shoreline (WVS) and World Data Bank (WDB)) in the public domain. The data have undergone extensive processing and are free of internal inconsistencies such as erratic points and crossing segments. The shorelines are constructed entirely from hierarchically arranged closed polygons. The data can be used to simplify data searches and data selections, or to study the statistical characteristics of shorelines and land-masses. It comes with access software and routines to facilitate decimation based on a standard line-reduction algorithm. One can say that it is an upgraded version of the WVS with a comparable scale of 1 : 250.000. A description of the GSHHS may be found in Wessel,P. and Smith, W.H.F. (1996), 'A global self-consistent, hierarchical, high-resolution shoreline database', Journal of Geophysical Research, Vol.101, No B4, p8741-8743, April 10, 1996.

After consideration it has been decided that the GSHHS coastline database provides the best choice and it has been adopted in the EMODNET Hydrography lot. The portal gives a link to the article as listed above. The portal does not provide a way to download the GSHHS dataset

itself, but it refers to the official GSHHS website, where other users can download the product and can find additional background information and possible updates. The official website is: http://www.ngdc.noaa.gov/mgg/shorelines/gshhs.html

3.6 Underwater features, such as wrecks

Another requirement of the EMODNET Hydrography pilot is to provide a GIS layer of underwater fetures, such as wrecks. As indicated in the agreed proposal the partnership will provide only underwater features derived from data supplies by HO's. These will comprise those underwater features, that are included in the nautical charts and Electronic Nautical Charts (ENC's). It includes no metadata.

So far this information has been received from the Norwegian Hydrographic Office and it concerns underwater features from an ENC for the whole North Sea area, that is made available as a GIS layer in the EMODNET portal for viewing and sharing as WMS service. It can not be downloaded, because the license with the HO does not allow for that.
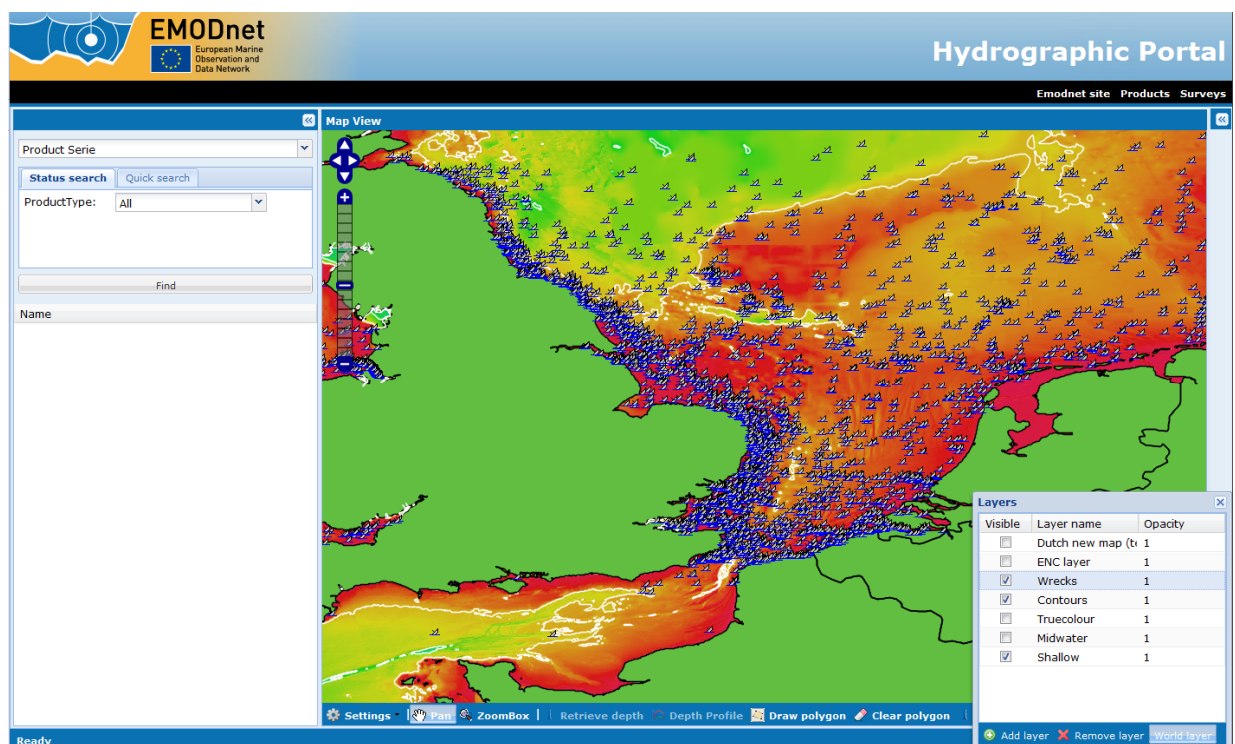
Image: Wrecks from ENC for the North Sea displayed in the Hydrographic portal

It should be noted that in practice there are far more wrecks than indicated in the ENC's, but these are not relevant for maritime traffic. Moreover these other wrecks are not published to prevent treasure hunting by enthousiastic divers causing safety issues and damaging cultural values.

The coverage of the underwater features will be extended for the other maritime regions in the EMODNET Hydrography project by contacting and negotiating with HO's. The French HO, i.c. SHOM (= partner) will provide access to the French wrecks layer by means of of a WMS service.

4.   WP3: QC/QA AND PRODUCING DIGITAL TERRAIN MODELS

The objectives of WP3 are:
- To validate and to harmonise the quality of all hydrographic data sets
- To generate a Digital Terrain Model (DTMs) per region of the waterdepth
- To generate accuracy and reliability indicators

The partners have used their in-house software packages for the Quality Control of all the collected data sets as described in the previous chapter. The packages have been configured according to an agreed methodology and accuracy indicators, that has been formulated beforehand by the partners IFREMER, SHOM, NOCS and Atlis. This preparatory work has resulted in a guideline titled "Guidelines for metadata, data and DTM QA/QC, Version 1.4, April 2010, produced by IFREMER, SHOM, NOC and ATLIS for EMODNET Hydrography" that is available from the public website. It also lists the way to complete the CDI metadata and the composite data sets metadata forms with mandatory information relevant for assessing the quality of the surveys and composite data sets.

4.1   QA-QC methodology applied

The following extract from the Guidelines gives details about the methodology that has been applied for producing the 3 regional Digital Terrain Models (DTM's) for the 3 maritime regions, that then are integrated into 1 overarching EMODNET DTM. The Guidelines document itself gives additional details. It can be downloaded from the EMODNET website.

4.1.1   Parameters

The parameters have been chosen to allow the widest use of the DTM together with an evaluation of the accuracy of the interpolated values from observed data.

However, the fact that some data providers have opted for delivering composite data products which are not based on the same specifications (and in some cases on specifications not really well known) limits the possibility to give an estimate of the accuracy over the entire DTM.

For areas covered by soundings, the depth parameters to be delivered for each DTM grid cell have been defined and agreed as follows :

- Mininum cell water depth

- Maximum cell water depth

- Average cell water depth

- Standard deviation of cell water depth

- Number of values used for interpolation of cell water depth

In addition, and to take into account the heterogeneous data sources, the following is also provided:

- Number of elementary surfaces used to compute the average cell water depth

- Average water depth smoothed by means of a spline function

- An indicator of the offsets between the average and smoothed depth (as a % of the water depth).

Furthermore each grid cell contains an identifier indicating the source material used for the computation of the water depth:

- the source dataset whose soundings are the most frequently represented in the cell ie the Local_CDI_ID associated to the description of the dataset in the CDI discovery service

- the source composite data set used to fill the cells without soundings when this data set is better than GEBCO. This ID will allow to find the description of the composite data set in the CAMIOON metadata service.

- the GEBCO reference

Later in the project additional indicators will be included for the purpose of documentation, in particular:

- the age of the youngest and oldest sounding in each grid cell, expressed by year of survey.

4.1.2 DTM reference framework

Horizontal coordinate reference system:

The regional and overarching EMODNET DTM 's are produced in angular coordinates at a resolution of ¼ arc-minute of latitude and longitude.

The Datum is set at Geodetic system WGS84 (EPSG identifier: 4326).

Axis conventions are as follows:

X = longitude in decimal degrees from -180 to +180 with East >0;

Y = latitude in decimal degrees from -90 to +90 with North > 0

Bounding box and origin of DTMs are set as follows:

All DTMs start in the South West corner of South West grid cell and end in the North East corner of North East cell. .
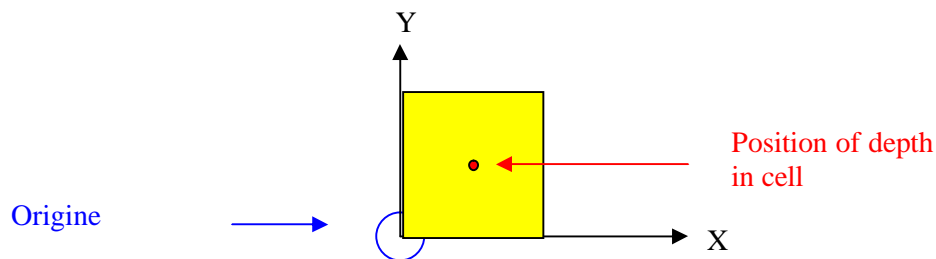
In order to avoid interpolation of the 30 arc-second GEBCO grid values, rows and lines of the EMODNET DTMs must be aligned with rows and lines of the GEBCO grid as below in the image.

Example of the bounding box of the Mediterranean area:

- Origin of the bounding box (SW corner) : N 30° 00' 07.5" , W005° 59' 52.5"

- Coordinates of the cell in the SW corner (yellow) : N30° 00' 15" , W005° 59' 45"

- NE corner of the bounding box : N44° 59' 52,5" , E22° 59'52.5"

Emodnet 15 sec. grid

Gebco 30 sec. grid

Emodnet bounding box origine
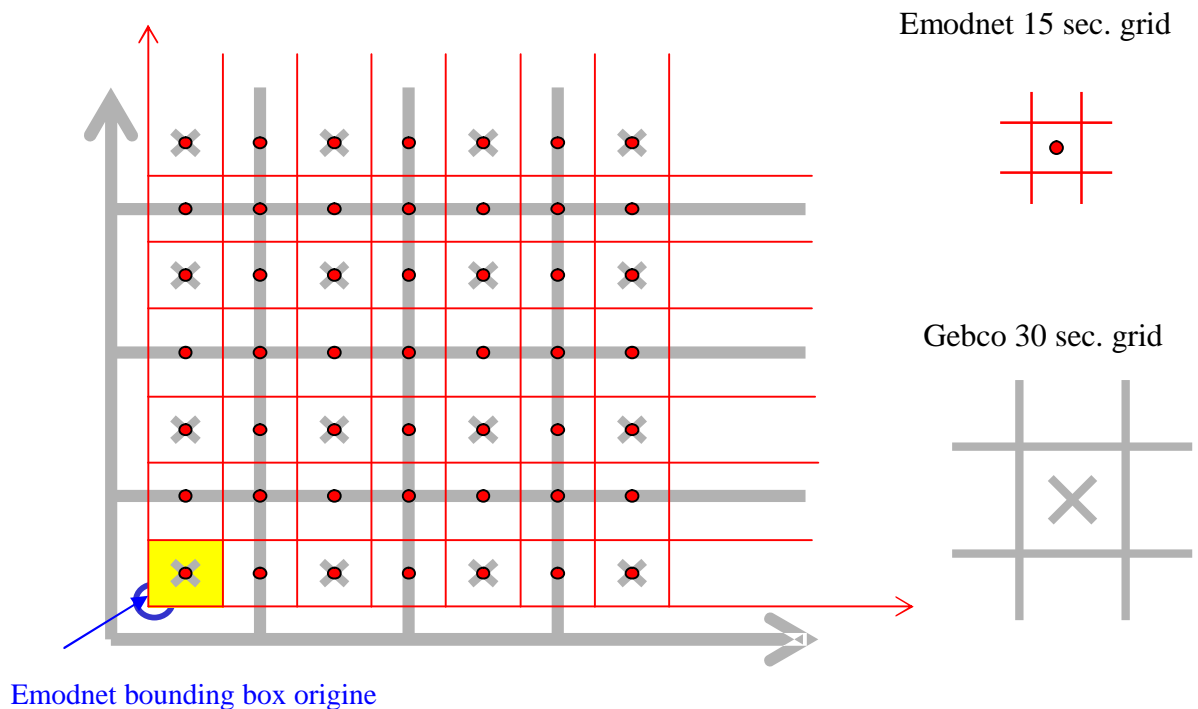
4.1.3 Alternative CRS for 2nd year project

The angular coordinate system is convenient for wide areas but it should be noted that this choice will have a statistical impact, as the cell surface decreases by 57% from 30°N to 60°N (1 arc-minute of latitude decreases approximately from 1604m to 926m). It also should be noted that the X and Y resolutions will always differ.

The use of the conic projection defined in the Inspire directive (ref. D2.8.I.2 INSPIRE Specification on *Geographical Grid Systems* - Guidelines) for homogeneous map of EU at 500m of resolution will therefore considered in the second year of project.

4.1.4 Depth reference system

Reference level:

Lowest Astronomical Tide (LAT) is adopted.

Mean Sea Level (MSL) is an appropriate surface but LAT has the advantages of being :

- also a potential surface which fits the needs of hydrodynamic applications
- the system recommanded by OHI for data delivery by HOs.

Note: in the second year a possible transformation from LAT to MSL will be added to the product services.

Axis convention:

Depth in metres, >0 down, (to 2 decimal places)

4.1.5 Procedure of production of DTM

For this description it is assumed that all the datasets are in WGS84 (or compatible with WGS84 at the scale of work ie horizontal differences in position are less than 1/16 arc-minute) and depth values are compatible with the depth reference level and sign convention.

4.1.5.1 Soundings:

Definition:

Very shallow multibeam echosounder surveys result in very large data sets requiring filtering of the soundings to be handled. A common solution adopted by data providers is to provide a very high resolution DTM (at a few metres of resolution) of the survey instead of the full set of soundings. This is the most frequent solution adopted for LIDAR surveys.

For the purpose of EMODNET, these DTMs are considered as sets of soundings and as such are described as observation datasets in the CDI metadata format.

Sounding data set selection:

The accuracy of the positions of the soundings varies as a function of the source and also as a function of the conditions during acquisition. It is accepted that the accuracy will vary over the DTM. However, in order to keep the resolution of the bathymetric features as accurate as possible (ie ¼ arc-minute) it is suggested not to take into account data collected with a positioning system accuracy worse than 500m (2 sigma) when better located data are available. Therefore all datasets will be considered, but not all datasets will be integrated.

Data processing:

There may be instances of sources with a large number of soundings while others may have only one (this is especially the case when providers such as HOs supply subsets of their surveys). In order to avoid bias on depth due to the heterogeneity of spatial distribution of soundings from multiple sources within a cell, gridding will be carried out in 2 steps.

Step 1:

Data are gridded at 1/16 arc-minute of resolution. This means that each cell of the final grid is subdivided in 16 equidistant rectangles. The depth parameters will be calculated for each of these elementary polygons (or subcells) where soundings exist.

Subcell without soundings are not filled with an interpolated value.

(Note : the definition of neighbouring soundings used in the computation of the depth of the subcell will be reexamined in the light of the knowledge of the datasets collected during the first year and as a function of the results at the end of the first year)

16 Grid subcells
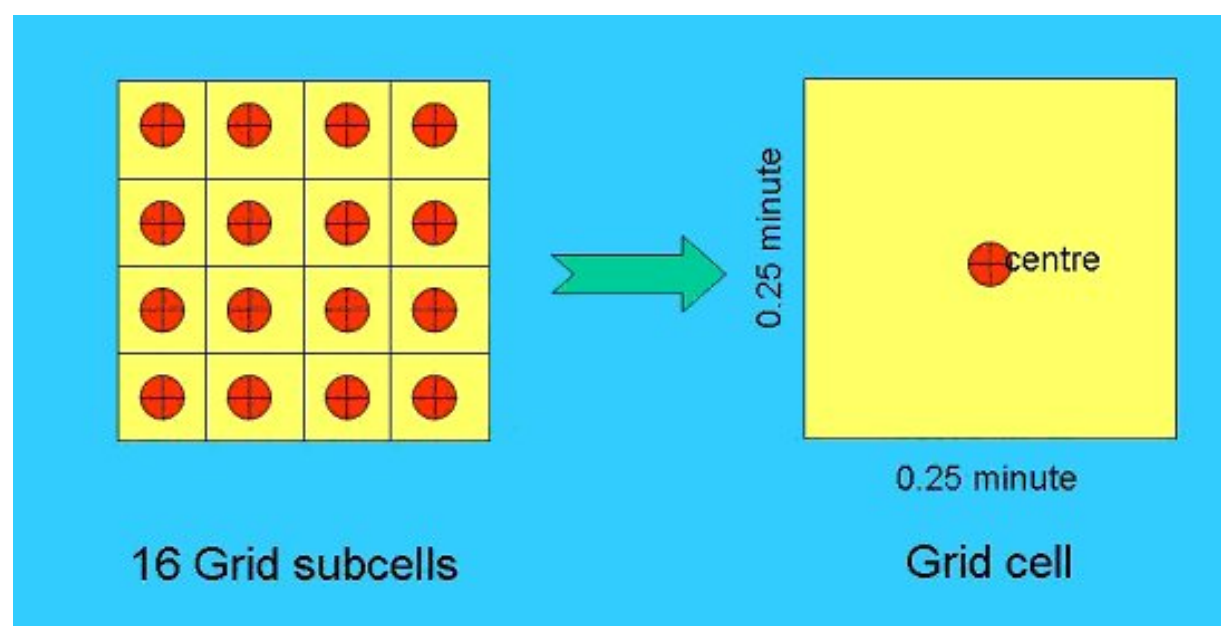
Grid cell

Step 2:

Next, the 16 subcell parameter sets are processed per grid cell to represent a more spatially balanced grid cell parameters set.

To increase the precision of the parameters to be supplied, the following is available:

- Minimum cell depth

- Maximum cell depth

- Average cell depth, ie the average of the mean depths computed at each subcell.

- Standard deviation of the cell depth

- Number of depths used for interpolation of cell depth

- The number of subcells used for the computation of the average cell depth

Cell without values:

There may be grid cells without any soundings. In those cases it is agreed to derive the grid cell values from the values of the bounding grid cells as far as a value is available in each quarter of the neighbouring space by linear interpolation as a function of the distance.

4.1.5.2 Integration of data supplied as composite data set

Definition:

A "composite data set" is a grid produced from multiple sources of data and surveys.

Selection:

A number of external providers have opted to deliver only **composite data products** (= DTMs with a specific grid resolution), so it is only possible to fill gaps by deriving depths from compiled DTM values. These are integrated as a function of their resolution (the highest resolution first) and as a function of their compatibility with the target reference framework and their consistency with validated observed data.

Composite data set processing:

Each composite data set is gridded separately at the resolution of the target regional DTM. The resulting DTM is then integrated in the regional DTM in the area specified as a polygon by the regional integrator. This is done in order to erase, if needed, isolated values of the target DTM to maintain the consistency of the values from the source composite data set.

The order to integrate composite data sets depends on their resolution: the higher the resolution, the higher the priority, however the choice of integrating a composite data set depends on other quality factors the evaluation of which is left to the regional integrator.

To be consistent with the definition of the depth of the target DTM (average over the cell), source soundings are gridded according to the following steps:

step 1 : production of a 1/16 arc-minute grid

step 2 : computation of the average over the cell.

Note : an additional step between steps 1 and 2 may be required in order to have a better consistency of the target DTM with the source composite data set especially if the input depth is an average over the cell ie. an interpolation of the subcell without values (bilinear interpolation of the 4 nearest values). This step is recommended for composite data sets of the same order of resolution or with larger resolution than the target DTM as this may introduce a visible systematic offset of the bathymetric feature under some circumstances (eg. when the centre of the source cell is near the border of the target cell).

4.1.5.3 GEBCO DTM

The 30 arc-second GEBCO-08grid, released January 2009 and updated November 2009 available for download from the British Oceanographic Data Centre (BODC) is used to fill gaps at the end of the process after having interpolated the values at the node of the target DTM. Note that the grid of the target DTM is specified in order to have for every 1/2 arc-minute a corresponding GEBCO value.

The GEBCO DTM is processed according to the processing of composite data sets.

The ID to be used to identify the GEBCO DTM is "GEBCO_20091120".

4.1.5.4 Inconsistencies between data sources

The use of composite data sets of various sources may result in inconsistencies at the limits of their respective coverage as the ways data have been processed vary from one source to another. It may not be possible to correct the resulting offsets between data sources. While it is important to be able to identify these offsets and to preserve in the target DTM the results from the sources, they can introduce artificial morphologic features which can preclude the use of the DTM for several applications .

Therefore it is decided to produce also a DTM with :

- depth smoothed by means of a spline function.

- the offset related to the average water depth (%)

4.1.5 DATA SETS QA/QC

4.1.5.1 Spatial CRS

See DTM reference framework for harmonisation. Note that datasets in projected coordinates as well as those in a different reference datum must be converted in the target reference framework before transmission to the data integrator .

4.1.5.2 Peaks and biases

Most of the data sets are processed data sets. However data sets with poor documentation related to processing traceability are checked for peaks and bias before transmission to the data integrator.

4.1.5.3 Internal consistency

Internal consistency is checked either using automatic comparison at the intersection of track lines or by visual checks (eg. MBES data)

4.1.5.4 External consistency

Identification of major anomalies is carried out by comparing soundings of data sets with a spline surface computed with all selected data sets. If offsets greater than 1% of the water depth are observed, source must be analysed to re-evaluate the quality of the source in function of the information available. Doubtful data must be rejected and DTM reprocessed.

4.1.6 DTM QC

At this stage, only a general description is given to identify anomalies. The solution(s) which depend on the quality and the consistency of the data sources which are not known is defined as a function of the preliminary results of the processing.

4.1.6.1 Visual expertise

Plotting the DTM:

- with several sun illuminations;

- depth contours;
- In 3 dimensions;

This helps in identifying remaining artefacts. If the sources of the artefacts are easy to track down, the originating data might be simply removed from the selected soundings and the interpolation recomputed.

4.1.6.2 Comparison with external soundings

Randomly selected bathymetric data might be deliberately left aside prior to the gridding phase. Variance of the residuals (gridding DTM – soundings) will be an indicator of the overall DTM creation mechanism.

4.1.6.3 Comparison with all the soundings

A thorough analysis of the residuals (gridded data – soundings) allows evaluation specifically of the quality of the sub-sampling method and the gridding algorithm.

4.1.6.4 Comparison with local krigged DTM

Although, the support size (grid cell) will be intrinsically different, vertical comparison with the DTM might be carried out for vertical consistency (distributions of depth).

4.1.6.5 Comparison at overlapping area of regional EMODNET DTM:

To ensure a seamless DTM at the overlapping limits of the regional areas of interest a vertical/horizontal comparison of the DEM will be performed. Values of vertical difference and autocorrelation will be defined as a function of the quality of data source in order both to limit the effect of any shift and to ensure the best coverage.

4.2   Production of 3 Regional Digital Terrain Models (DTM's)

The partners have undertaken the QC activities as specified above on all the so far gathered survey data sets and composite data sets. And per maritime region the regional DTM has been generated following the principles as described in the previous paragraph.

- The regional DTM for the Atlantic Ocean (Channel, Celtic Seas, Western Approaches) has been generated by NERC-NOCS
- The regional DTM for the North Sea and Kattegat has been generated by ATLIS
- The regional DTM for the Western and Central Mediterranean sea and Ionnian Sea has been generated by IFREMER.

A first release of the regional DTM's has been produced in May 2010 and it has been integrated into a central EMODNET DTM in time for the concertation meeting 25th May 2010 in Copenhagen – Denmark. This DTM has been loaded and demonstrated in the first release of the Hydrographic portal.

Since the first release a number of artefacts were discovered and also some additional data sets became available. Therefore in June 2010 a second release has been produced for each of the regional DTM's and a new integration has taken place into the central EMODNET DTM. This version has been loaded into the second release of the Hydrography portal that now supports a wide range of functionalities for viewing, retrieving and downloading as will be described in the next chapter.

A new release of the regional DTM's and thus a new integration into the central EMODNET DTM is planned end 2010, incorporating additional data sets (surveys and composite data sets) that are expected and additional metadata that is being produced.

In the following images some DTM results are given. The first one illustrates the use and combination of high resolution multibeam surveys, composite data sets (along the Corsican

coast) and GEBCO for one area. The GEBCO data fill the gaps and have less resolution as can be seen.
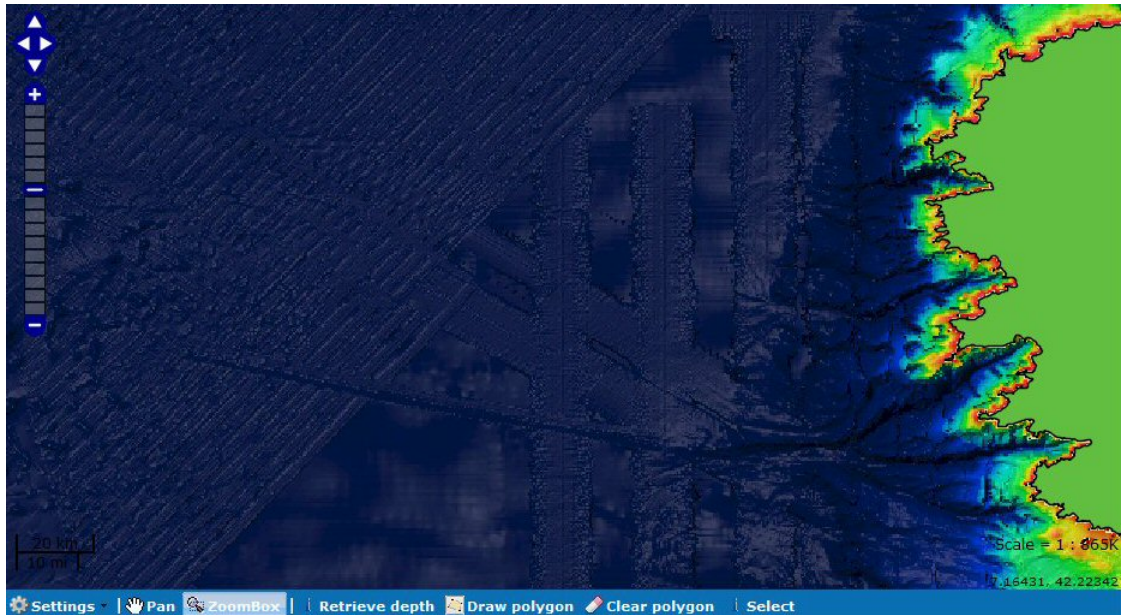

Image: resulting DTM near Corsica with use of surveys, composite data sets and GEBCO data

The following image illustrates the use of high resolution multibeam surveys and composite data sets on the Eastern side of the Southern North Sea and only GEBCO for the Western side due to no availability of UKHO data sets (yet). The Western side is filled by GEBCO.
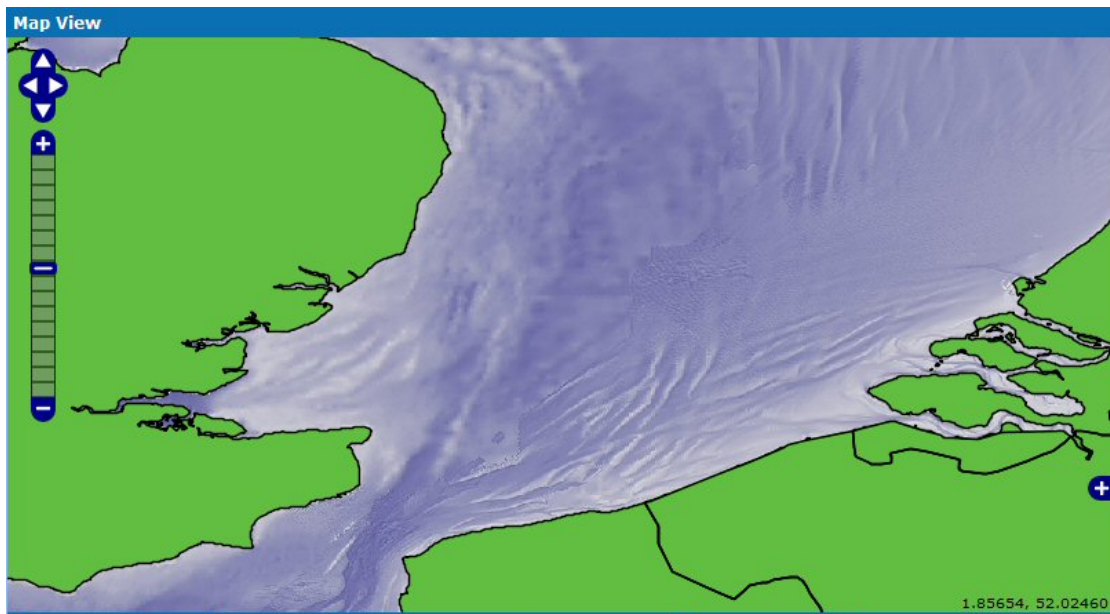

Image: resulting DTM with use of surveys of composite data sets on Eastern side of North Sea and GEBCO data on the Western side

The next 2 images give a comparison between the new EMODNET DTM and the GEBCO DTM for the same area which illustrates the improvements made.
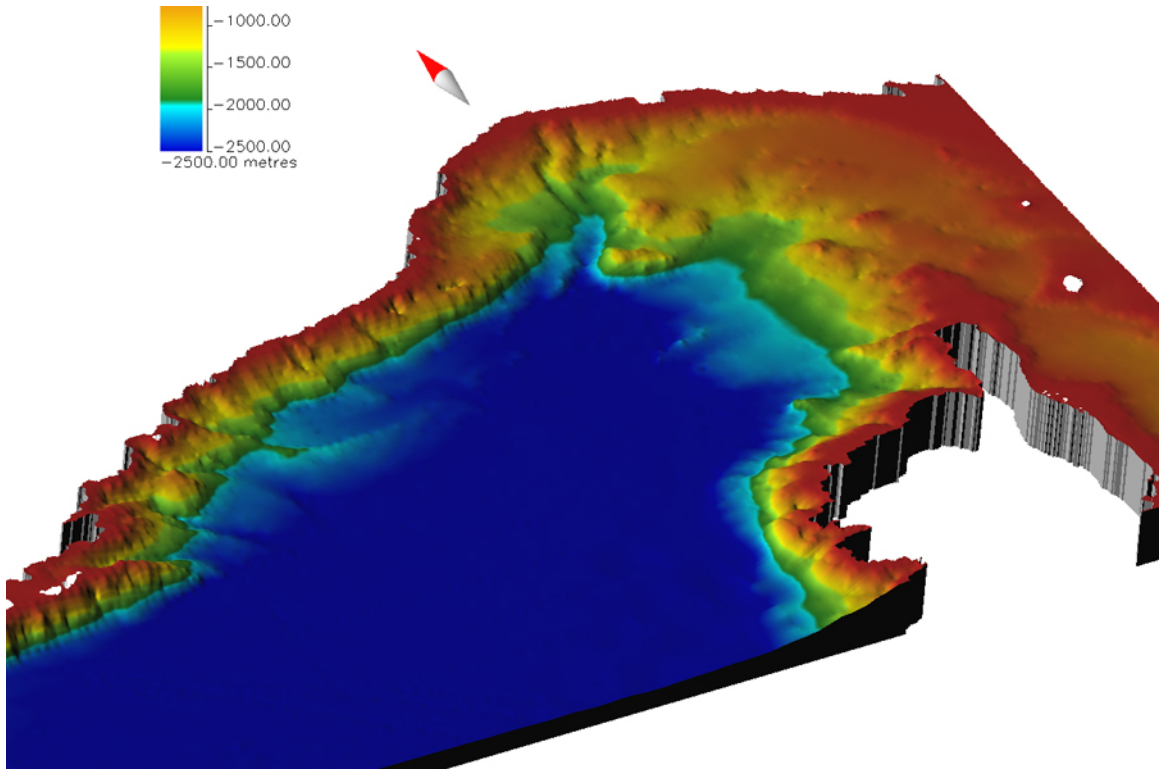
Image: Ligurian sea in GEBCO DTM
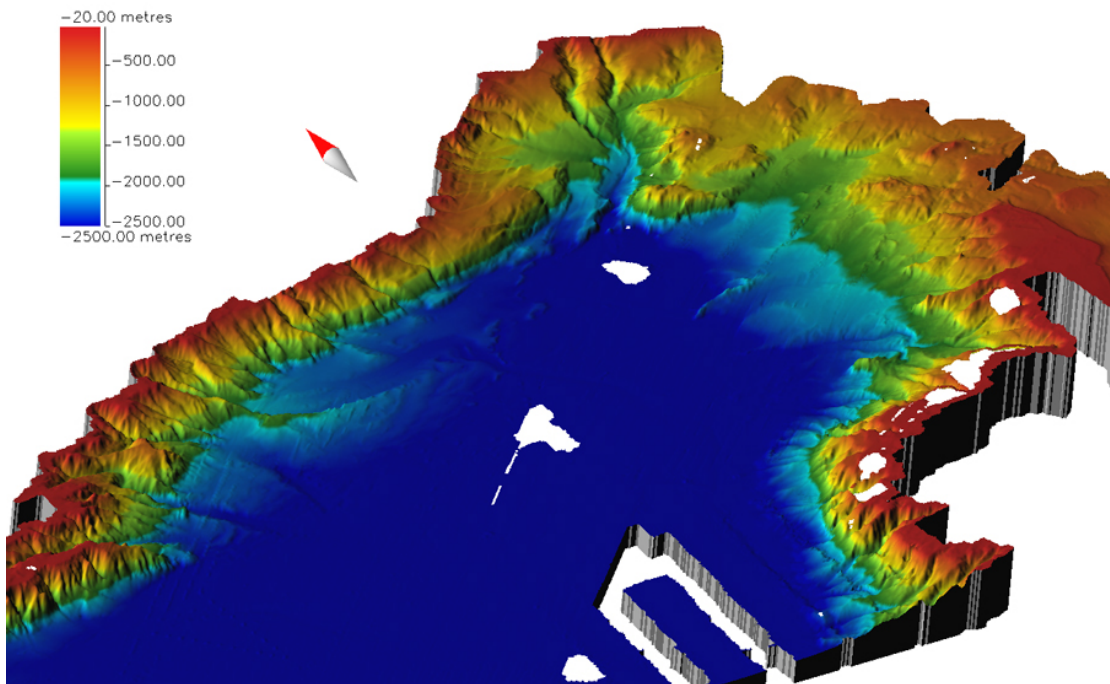
Image: Ligurian sea in EMODNET DTM

The following image gives an overview of the overall EMODNET DTM as it can be found now via the Hydrographic Portal.
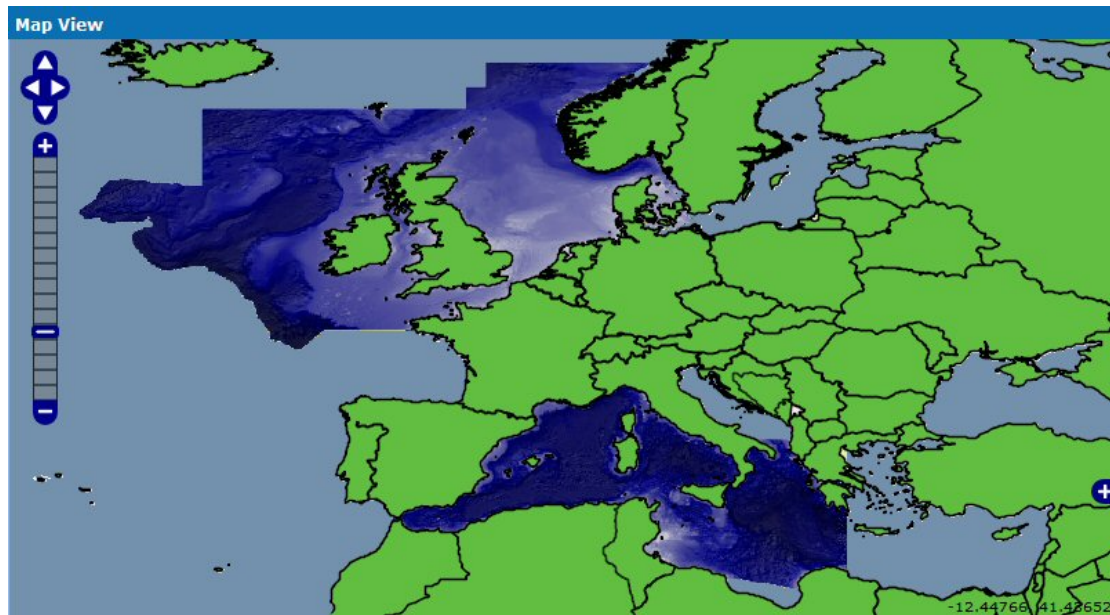
Image: overall EMODNET DTM in its present state

4.3 Check on EMODNET Hydrography product requirements

The tender specifications requires a number of products to be produced as part of the project. These requirements in practice have been translated by producing and providing the following geographical information system layers:

- water depth in gridded form over whole of maritime basin on a grid of 0.25 minute * 0.25 minute: is done by providing a DTM with multiple parameters per grid cell

- water depth in vector form with isobaths at a scale of at least one to one million: is done by producing isobaths at the central DTM derived from the gridded waterdepths

- depth profiles along tracklines: is done by providing functionality in the Hydrographic portal to users for making and retrieving cross sections of the DTM

- multibeam surveys along tracklines: is done by providing detailed tracks and polygons of surveys in the CDI data discovery and access service and also as a layer in the Hydrography portal

- Coastlines: is done by adopting the Global Self-consistent, Hierarchical, High-resolution Shoreline Database (GSHHS) 1 : 250.000

- underwater features – wrecks, seabed obstructions etc: is done by providing a layer in the Hydrography portal that is based upon deliveries by HO's of ENC features.

5.   WP4: TECHNICAL DEVELOPMENT AND OPERATION OF PORTAL

The objectives of WP4 are:

- To develop and launch the EMODNET website and portal services

- To keep the website and portal services operational, including monitoring

MARIS has developed and is operating the EMODNET Hydrography website at http://www.emodnet-hydrography.eu . The website is maintained via an online Content Management System. It gives background information about the project. Moreover it provides access to the developed services:

- The CDI data discovery and access service

- The Hydrography data products viewing service

Image: Homepage of the EMODNET Hydrography website at
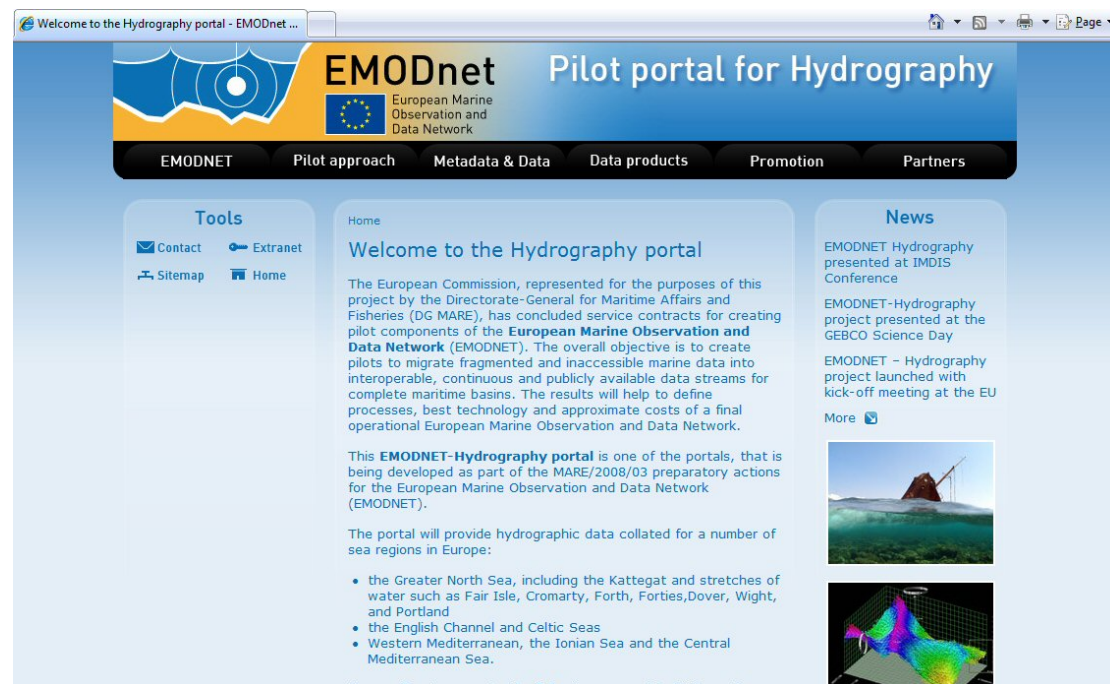
http://www.emodnet-hydrography.eu

The EMODNET Hydrography website provides various services and functionalities to users for viewing and downloading the hydrographic data products. The central integrated EMODNET DTM and the CDI metadatabase provide the basis databases, on which the user applications are provided. The Hydrographic viewer portal for viewing and retrieving the digital bathymetry layers is embedded in the Hydrography website via a link and extra tab / new browser window. The Hydrographic viewer portal also communicates with the CDI discovery service to submit and follow-up requests by users for possible access to the background survey data sets.

The following image gives an overview of the architecture of the 3 web components that together serve the users.
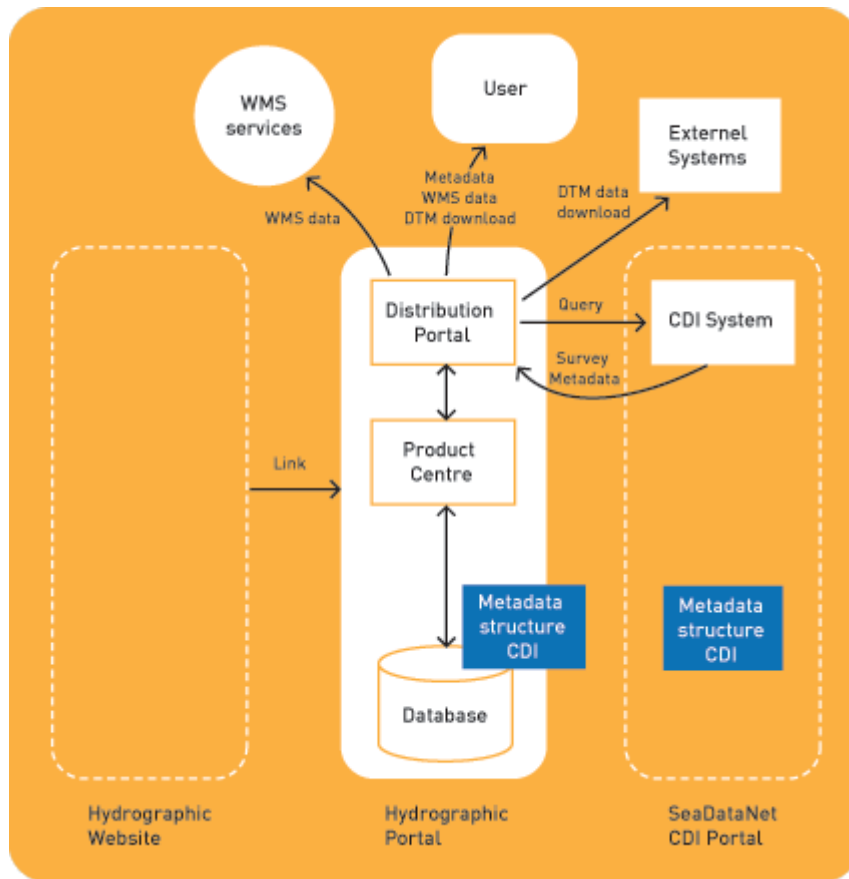
Image: Architecture of portal

ATLIS and MARIS initially have formulated the planned portal functionalities and in particular details about the foreseen downloading services (for users of the portal) and OGC services (for remote servers). Based upon these specifications the actual developments and implementation have taken place.

The following table gives the output formats as used by the download services and the OGC services per data products layer of the Hydrographic viewing portal.

No.	Source	Product			
		Type	Format	Interface	User
1	**Underwater features**	**WMS**	**WMS jpeg / gif**	**WMS**	**Systems**
2	**Coastlines**	**WMS (1:250K)**	**WMS jpeg / gif**	**WMS + URL for users to retrieve the dataset**	**Systems**
3	**DTM – waterdepth parameter sets**	**WMS layer**	**WMS - geotiff layer for waterdepth parameters**	**WMS, with identify option to retrieve full set per grid cell**	**Systems**
4		**gridded data for downloading**	**X,y,z, …. Covering all waterdepth parameters**	**CSV file**	**Public**
5			**X,y,z, …. Covering all waterdepth**	**ESRI ASCII**	**Public**

#					
			parameters		
6			X,y,z, …. Covering all waterdepth parameters	Fledemaus SD file for free viewer	Public
7			Geotiff, Covering all waterdepth parameters	Geotiff file	Public
8			NetCDF CF, Covering all waterdepth parameters	NetCDF CF file	Public
9	DTM – isobaths	WMS (1:1M)	WMS – geotiff automatically calculated from DTM parameters	WMS	Systems
10		gridded data for downloading	X,y,z, …. Min, max and av	See filetypes above	Public
10	Depth profile along track lines	Cross sections	jpeg / gif	User defined Cross sections	Public
11	DTM (GEBCO)	-	-	-	Public
12	Surveys (demo)	In 2nd Year			
13	Map location of surveys (tracks / polygons)	WMS	WMS – jpeg / gif	WMS	Systems
14	Requesting access to Surveys	CDI portal	CDI portal	CDI portal	Registered user
15	World map	-	-	-	Public

The actual downloading takes place on pre-processed files, that cover specific tiles. This is done because of the size of the DTM data sets. As can be seen from the table users are able to download DTM tiles in a number of formats. These formats are documented in the portal specification document. For the moment downloading is already possible in ASCII CSV and Fledermaus SD file formats. The latter can be used with the free Fledermaus software for 3-D visualising of downloaded data sets. In the second year also downloading of files in ESRI ASCII, NetCDF (CF), and GeoTIFF formats will become available.

The Hydrography viewing services are based upon the SENS Distribution software of ATLIS. The EMODNET DTM has been integrated into an Oracle Spatial database, managed by ATLIS. SENS Distribution is a scalable web-based solution for the distribution of bathymetric products (e.g. seafloor DTMs, contours and spotsoundings). It runs in a service oriented architecture and consists of a web portal for the definition and ordering of products, OGC map services and product services for serving maps and pre-defined products and one or more SENS product servers for the generation of user-defined products.

The following images give illustrations of the present services that the user can find at the website.
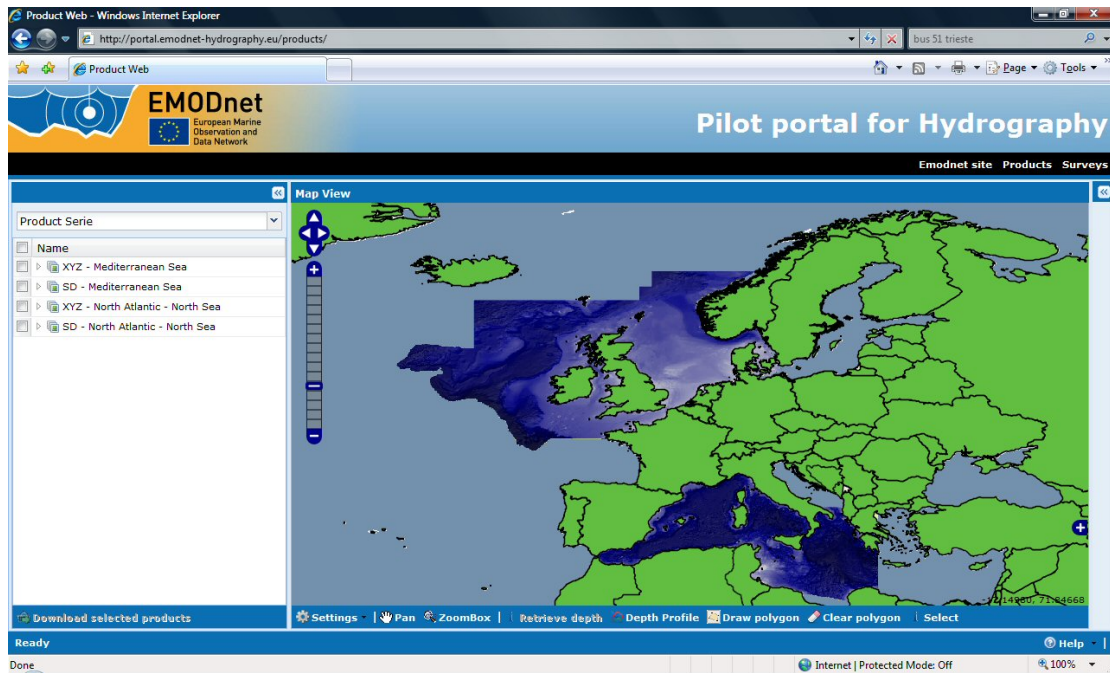
Image: Opening screen of the EMODNET Hydrography viewing service with functions for zooming, panning, making a cross section and retrieving the depth profile, setting the GIS layers, adding external WMS service layers, downloading tiles and searching metadata of surveys and composite data sets.
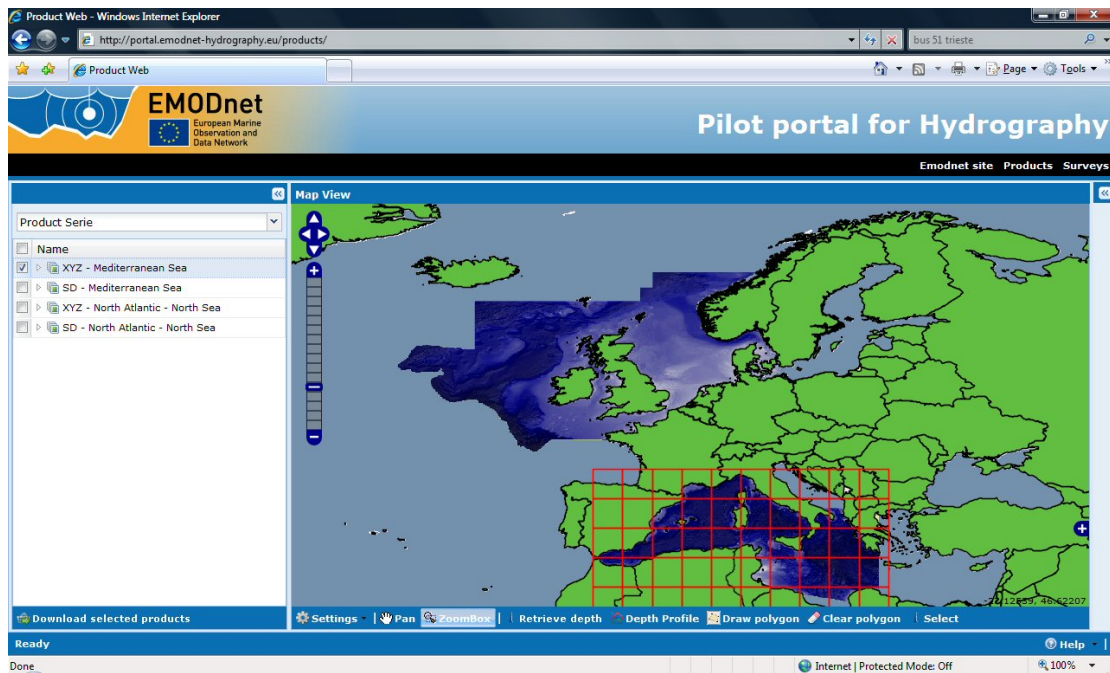

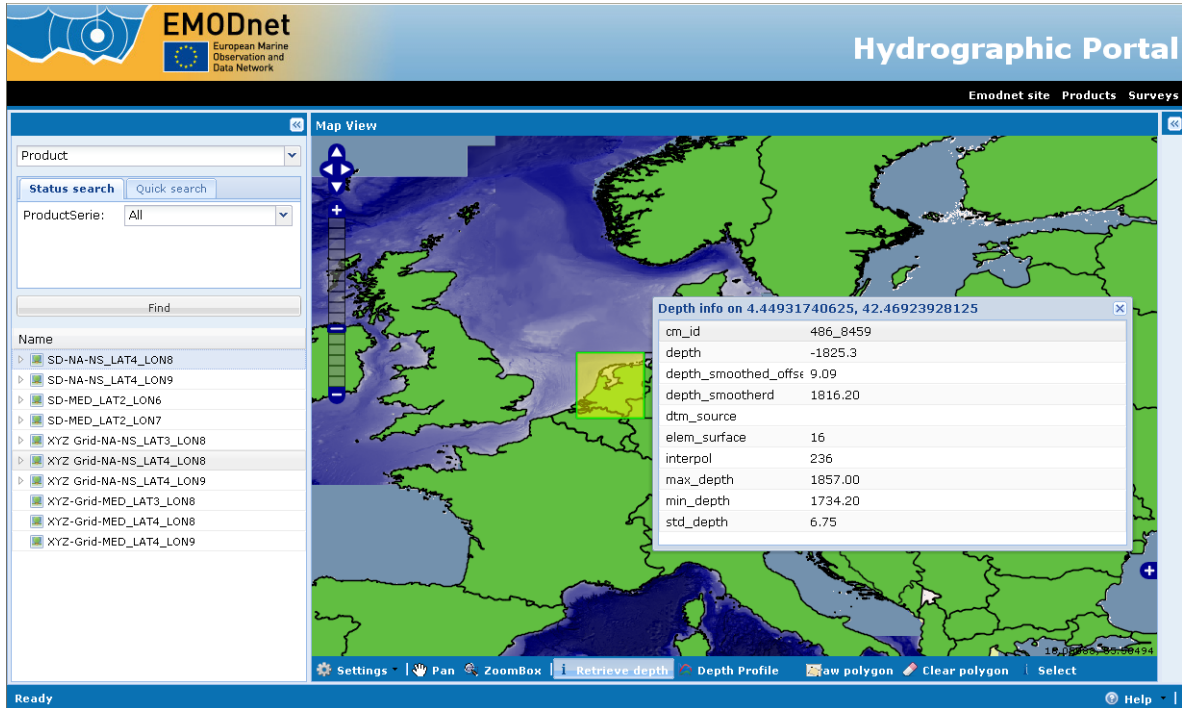Image: tiles for downloading data sets in various formats

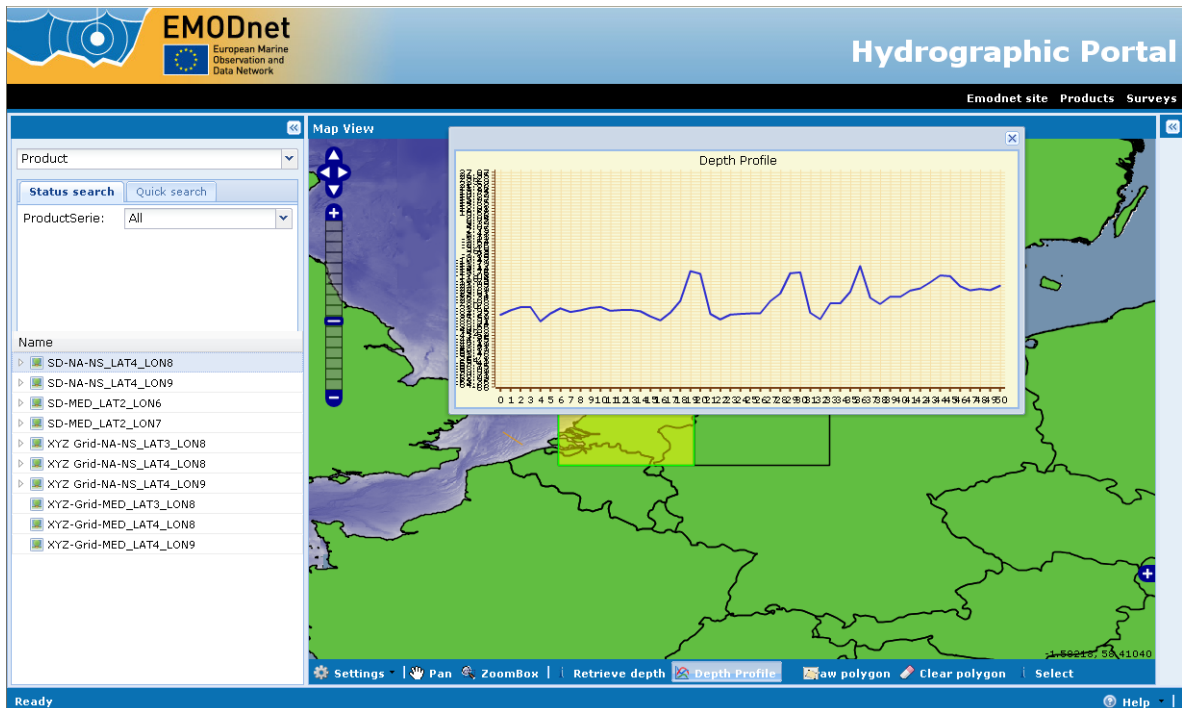Image: Retrieving the depth info of a DTM grid cell
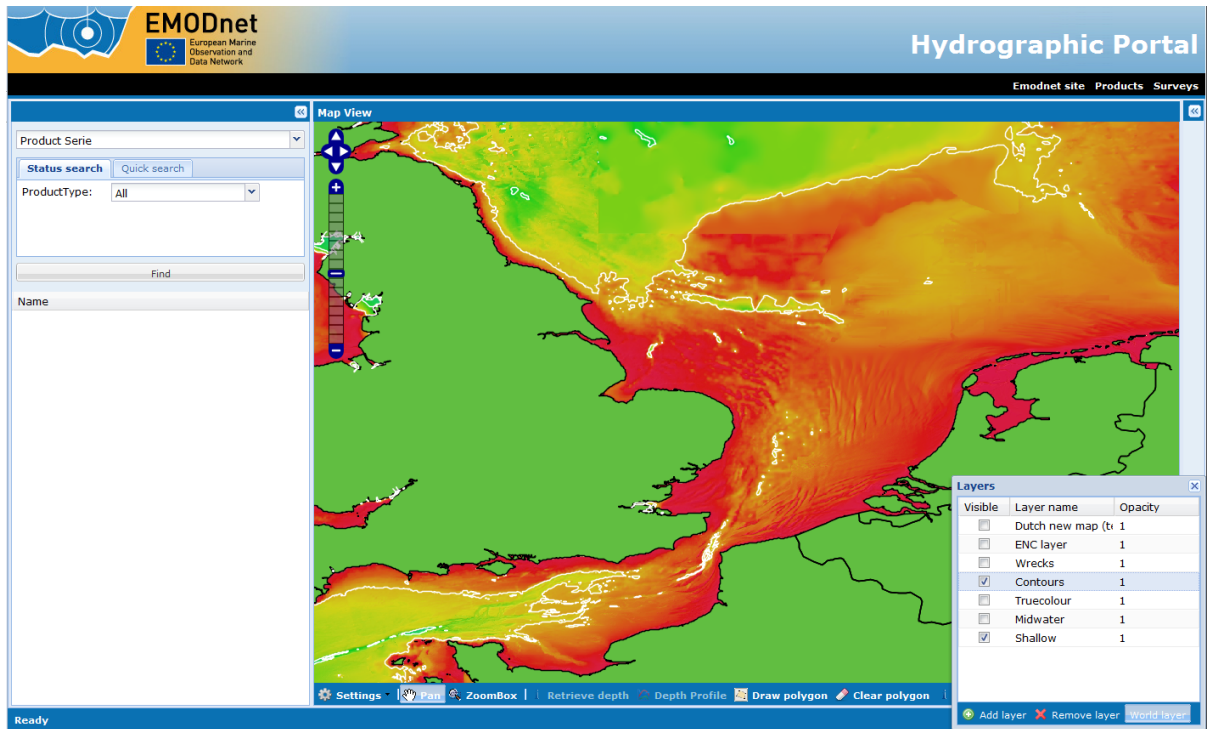

Image: Retrieving a depth profile along a user defined cross section

Image: Layers menu with bathymetry in shallow colouring and contours activated
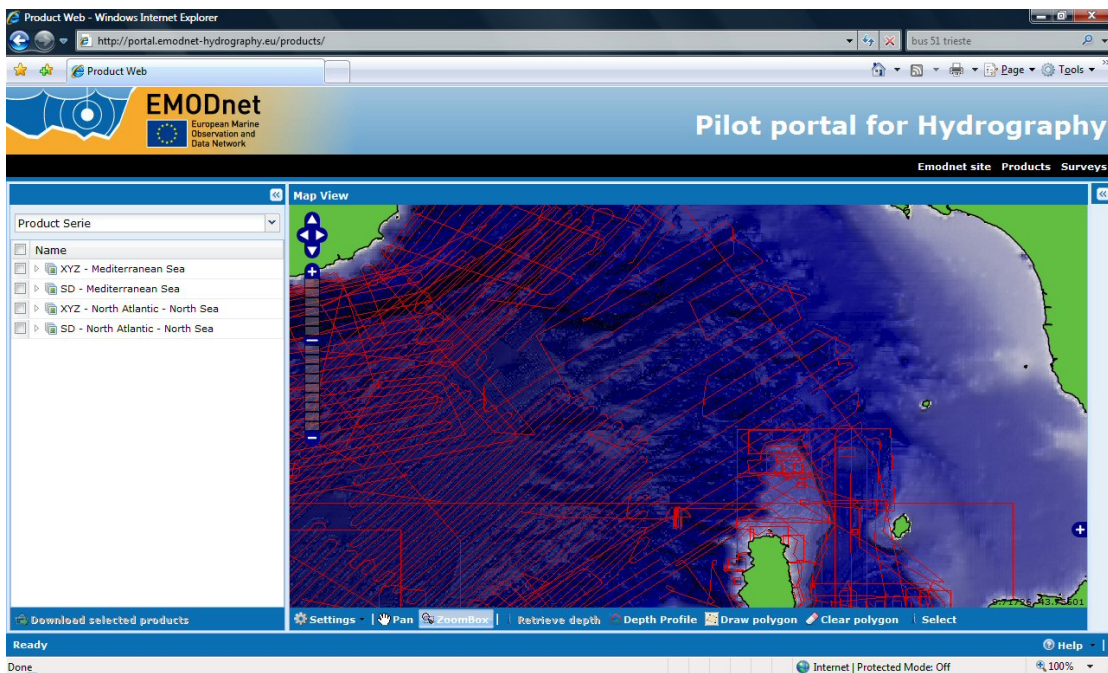
Image: Digital bathymetry with overlay of CDI metadata of multibeam surveys

The next image gives an illustration of a 3D visualisation of a downloaded Fledermaus SD data tile with the freely downloadable Fledermaus software tool.
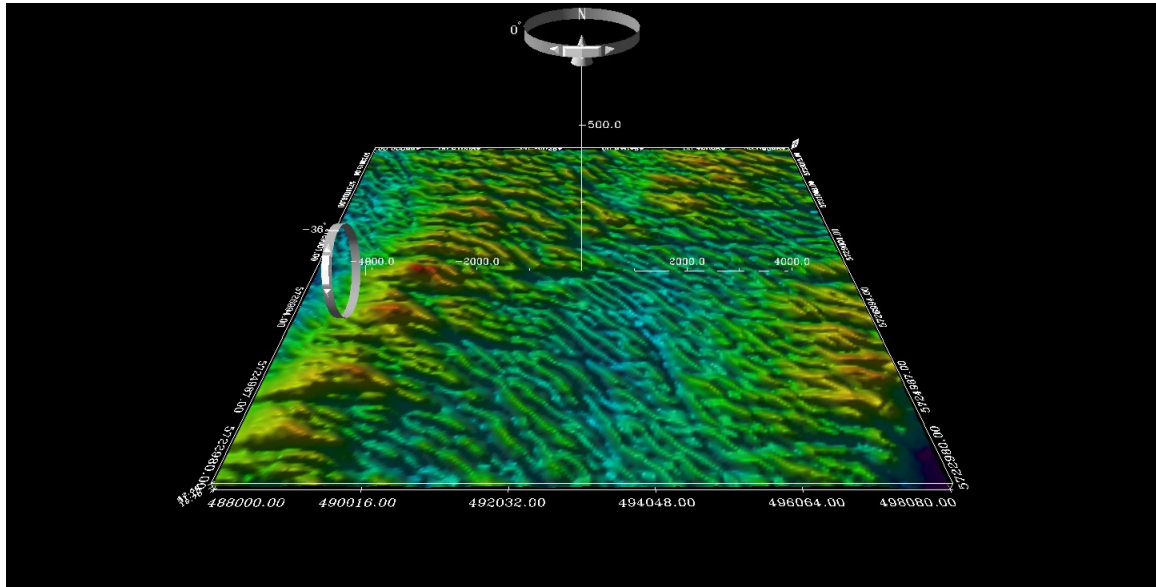
Image: Fledermaus 3D visualisation

CDI metadata discovery service:

Also the CDI discovery service has been made operational as a dedicated service of the SeaDataNet CDI service. It allows a user to query and retrieve the CDI metadata records of the background data sets used, with the option to request access to these underlying survey data sets via a shopping mechanism. For the moment the CDI service and database covers CDI entries from SHOM and IFREMER surveys. It will be extended on a regular basis with new CDI entries for other data sets that have been gathered and used in the EMODNET DTM production. The following images give some illustration of the CDI discovery and data access mechanism and the EMODNET CDI interfaces.
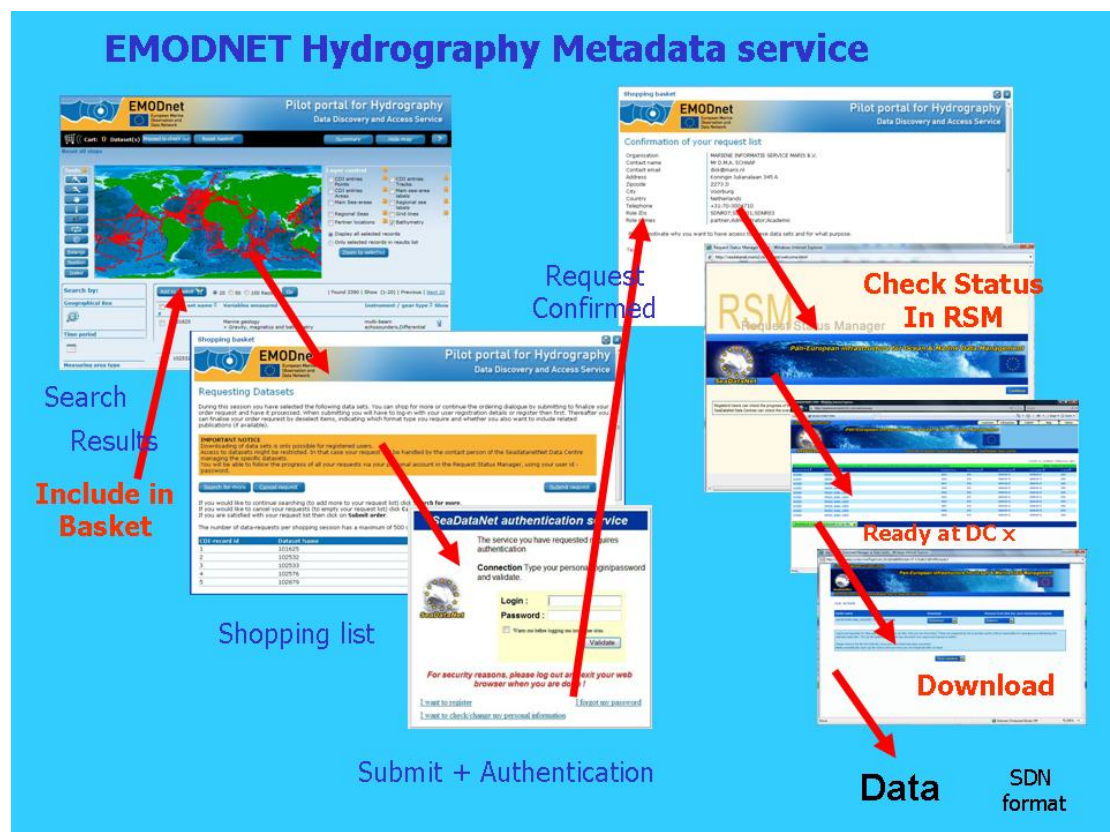
Image: EMODNET CDI discovery and data access mechanism

The CDI metadata of the bathymetric survey data sets are public domain and freely available for all users. The SeaDataNet CDI search, shopping and tracking mechanism is applied for identifying and requesting access to these background data sets from data providers. This gives users a unique and harmonised access to the increasing number of background survey data sets, that have been used to prepare the bathymetric Digital Terrain Models. Furthermore, the data sets are delivered in standard data transport formats (NetCDF (CF)).

How does it work?
The process from search to getting access to requested data sets allows users to retrieve data sets from the distributed data centres in a common way via one unique portal.

The CDI query interface enables to search by a set of criteria. The selected data sets are listed. Geographical locations are indicated on a map. Clicking on the display icon retrieves the full metadata of the data set. This gives information on the what, where, when, how, and who of the data set. It also gives standardised information on the data access restrictions, that apply. The interface features a shopping mechanism, by which selected data sets can be included in a shopping basket.

All users can freely query and browse in the CDI directory; however submitting requests for data access via the shopping basket requires that users are registered in the SeaDataNet central user register, thereby agreeing with the overall SeaDataNet User Licence.

All data requests are forwarded automatically from the EMODNET Hydrography portal to the relevant data centres. This process is controlled via the Request Status Manager (RSM) service at the portal, that communicates with the data centres. Users receive a confirmation e-mail of their data set requests and a link to the RSM service. By log-in to the RSM service users can check regularly the status of their requests and download data sets from the associated data centres, after access has been granted. On their turn, data centres can follow via the RSM service all transactions for their data sets online and can handle requests which might require their mediation.

Each CDI metadata record includes a data access restriction tag. It indicates under which conditions the data set is accessable to users. Its values can vary from 'unrestricted' to 'no access' with a number of values in between. During registration every user will be qualified by its national NODC / Marine Data Centre with one or more SeaDataNet roles. The RSM service combines for each data set request the given data access restriction with the role(s) of the user as registered in the SeaDataNet central user register. This determines per data set request, whether a user gets direct access automatically, whether it first has to be considered by the data centre, that therefore might contact the user, or that no access is given.

Image: Homepage of the EMODNET CDI discovery service

Interoperability:

The GIS layers in the Hydrographic viewing service can be shared as OGC WMS services with other EMODNET portals and beyond (e.g. WISE-Marine, European Atlas of the Seas, SeaDataNet). Also WMS layers from other EMODNET portals can be added to the Hydrography viewer.

To facilitate the adding of WMS layers by users between the different EMODNET portals SeaDataNet is establishing a WMS Registry: a CSW registry of WMS services including additional descriptions of layers via the CAMIOON catalogue service.

The Common Data Index (CDI) services have been integrated into the portal, including its services for requesting background data sets from their distributors. CDI can also deliver a WMS layer.

Statistics:

The use of the Hydrography website and services is monitored by web statistics since May 2010. These will be used to produce an overview of use in the next interim report.

Also the actual access requests to background data sets are registered in the Request Status Manager and will be used to report in an later stage.

6. PLANNED ACTIVITIES SECOND YEAR

For the second year a number of activities are planned which are summarized below:

- Gather more data sets (surveys and composite data sets)

- Seek to get hold of surveys for the composite data sets used

- Produce a new release of the regional DTM's and central EMODNET DTM

- Gather more metadata of both surveys and composite data sets

- Further develop the Product Portal with additional functions:

    - Additional output formats (ESRI ASCII and NetCDF (CF))

    - Conversion between LAT to MSL

    - Inclusion of a confidence GIS layer based upon the standard deviation

- Provide a Help Desk by which users can give suggestions and comments

- Collect user feedback

- Activate the SeaDataNet WMS Registry

7. REFERENCES:

- Documentation: 5.00; Common Data Index (CDI); Version 1.6; Metadata Format; 10 June 2010 with XML Schema, XLS description of all XML tags and XML examples (see http://www.seadatanet.org/standards_software)

- MyOcean Product Catalogue, based upon CAMIOON (see http://www.myocean.eu.org/products-services/catalogue.html)

- Guidelines for metadata, data and DTM QA/QC, Version 1.4, April 2010, produced by IFREMER, SHOM, NOC and ATLIS for EMODNET Hydrography

- Wessel,P. and Smith, W.H.F. (1996), 'A global self-consistent, hierarchical, high-resolution shoreline database', Journal of Geophysical Research, Vol.101, No B4, p8741-8743, April 10, 1996

- The General Bathymetric Chart of the Oceans (GEBCO) (see http://www.gebco.net)