EMODnet Preparatory Actions Hydrographic and Seabed Mapping and new EMODnet Bathymetry

By
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GEBCO Science Day, Venice – Italy, 8th October 2013

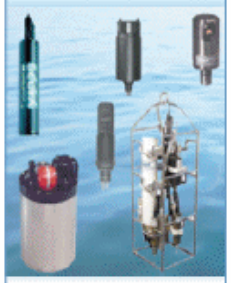
EMODNet

- EU has adopted the Marine Directive and Maritime Policy.
- The Commission proposed to take steps towards an overarching **European Marine Observation and Data Network (EMODNet)**
- The initial Roadmap for EMODNet was released in April 2009
- A cost – benefit analysis reveals that the cost of marine observation in Europe is circa 400 Million Euro per year for space data and another 1 Billion Euro per year for in-situ data => better availability and access can give benefits of at least 300 Million Euro per year for industry, research, government and public

EMODnet
European Marine Observation and Data Network

Essential Components of an Observation Network

Sensors to measure continuously and automously physical, chemical and biological parameters



- salinity, temperature
- turbidity, oxygen
- chlorophyll, nutrients
- pH, alkalinity
- bathymetry
- primary production

Platforms or structures anchored on the seabed, floating in the water column or drifting at the sea surface, and remote sensing from satellites.

- buoys, floats
- gliders
- mooring
- AUVs, lander
- FerryBox
- cabled networks
- remote sensing

Sampling and consecutive laboratory analyses from research ships, or shore, including water, sediments and biota (phytoplankton, bacteria, zooplankton, fish)

- inorganic trace compounds
- gases, e.g. CO2, CH4, DMS
- organic micropolluants
- abundance & function of biota

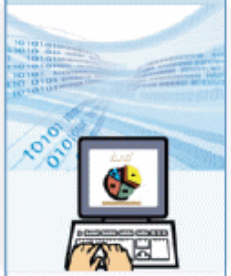
Communication systems to transfer in real-time data from sensors to the network and to the land stations

- satcom
- GSM, GPRS
- fibre optics
- acoustics

Data collection and management system for direct control of data quality, and data storage systems to enable data analysis and use for model applications

- data bases
- quality control
- data standards

Software and web based information tools to analyse data for trends, compliance to EU directives, to distribute and disseminate data to end users

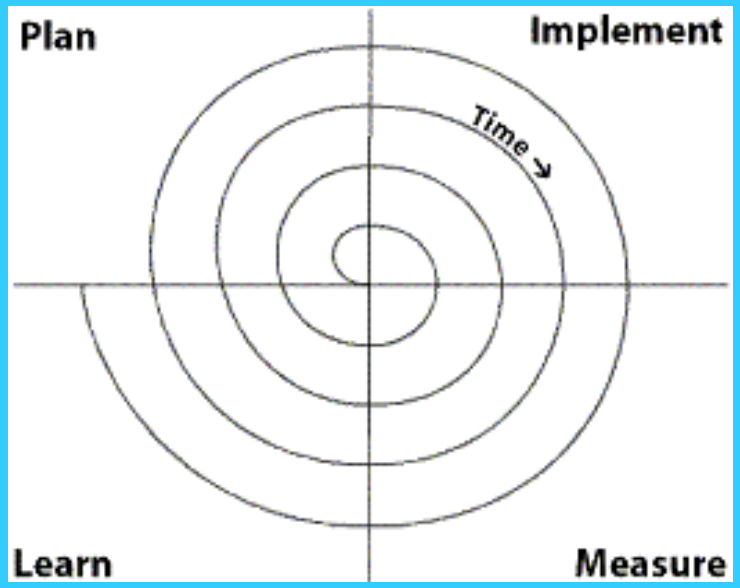


- analysis
- Presentation
- web
- GIS

a network of existing and developing European observation systems, linked by a data management structure covering all European coastal waters, shelf seas and surrounding ocean basins, accessible to everyone

EMODNet timeline

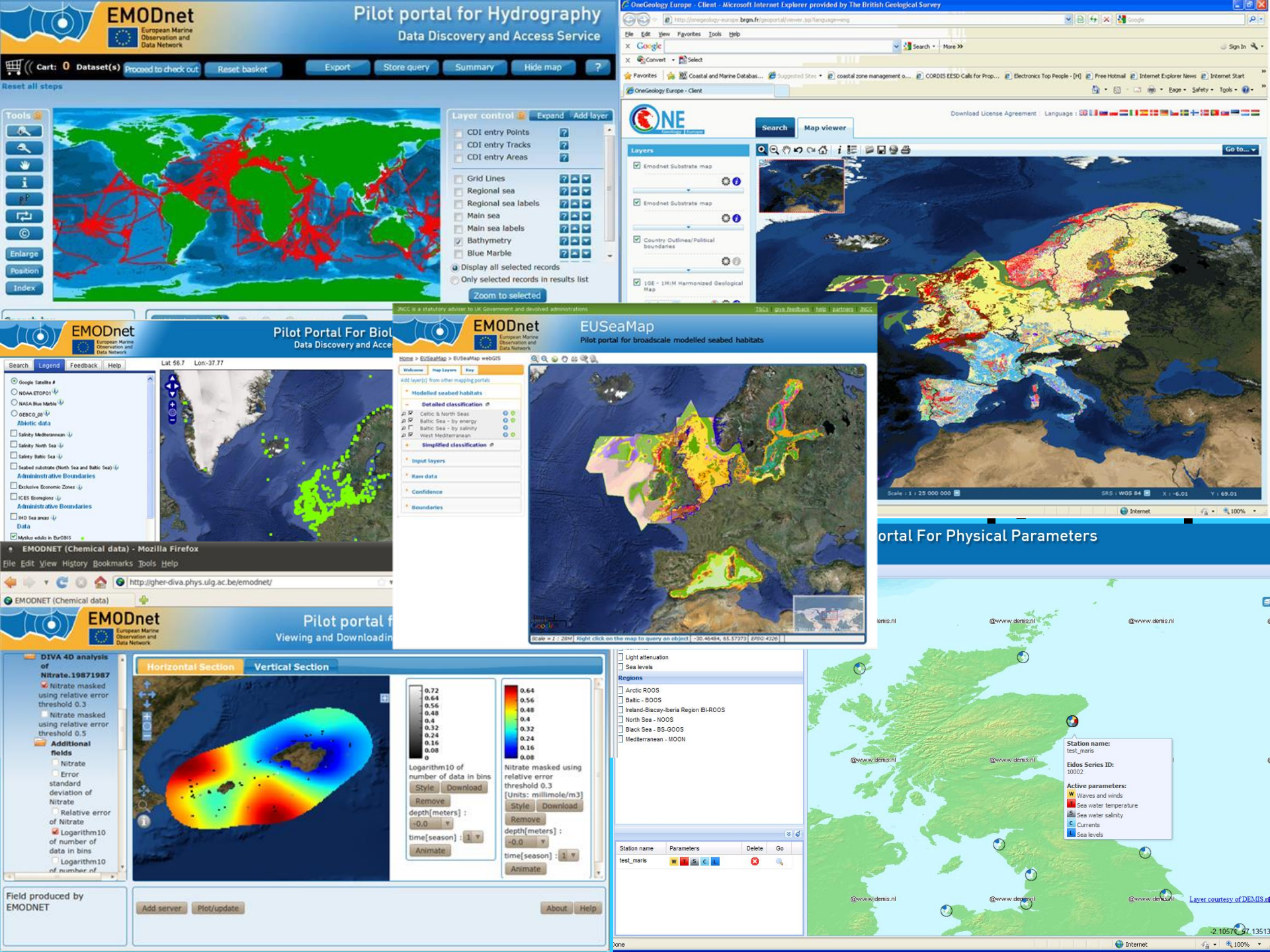
2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Phase 1 – limited sea basins (ca 6 MEuro)											
				Phase 2 - low resolution (ca 16 MEuro)							
						Phase 3 - multi-resolution (> 100 – 200 MEuro?)					



PROTOTYPING:

allows users to assess and improve product by trying it out

EMODnet
European Marine Observation and Data Network


EMODnet
European Marine Observation and Data Network
Pilot portal for Hydrography
Data Discovery and Access Service
Cart: 0 Dataset(s)
Proceed to check out
Reset basket
Export
Store query
Summary
Hide map
Reset all steps
Tools
Enlarge
Position
Index
Layer control
Expand
Add layer
CDI entry Points
CDI entry Tracks
CDI entry Areas
Grid Lines
Regional sea
Regional sea labels
Main sea
Main sea labels
Bathymetry
Blue Marble
Display all selected records
Only selected records in results list
Zoom to selected
OneGeology Europe - Client - Microsoft Internet Explorer provided by The British Geological Survey
OneGeology Europe - Client
Search
Map viewer
Layers
Emodnet Substrate map
Country Outlines/Political boundaries
1GE - 1M:M Harmonized Geological Map
Go to...
EMODnet
Pilot Portal For Biol
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Feedback
Help
Abiotic data
Administrative Boundaries
Data
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EUSeaMap
Pilot portal for broadscale modelled seabed habitats
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Simplified classification
Input layers
Raw data
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Boundaries
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EMODNET (Chemical data)
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depth[meters] :
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Animate
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Field produced by EMODNET
Add server
Plot/update
About
Help
Light attenuation
Sea levels
Regions
Arctic ROOS
Baltic - BOOS
Ireland-Biscay-Iberia Region IBI-ROOS
North Sea - NOOS
Black Sea - BS-GOOS
Mediterranean - MOON
Station name
Parameters
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Go
test_maris
Station name:
test_maris
Eidos Series ID:
10002
Active parameters:
Waves and winds
Sea water temperature
Sea water salinity
Currents
Sea levels
@www.demis.nl
Layer courtesy of DEMIS.nl

EMODNet Hydrography and Seabed Mapping

- Compiled an inventory of available bathymetric surveys (plummets, single and multibeam surveys), including links to associated survey data sets, adopting the SeaDataNet Common Data Index (CDI) Data Discovery and Access service

- Produced a higher resolution digital bathymetry of 0,25 minute by 0,25 minute, by processing data sets as input, for the following sea regions in Europe:
  - 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
  - Iberian Coast, Bay of Biscay (Atlantic Ocean) incl Madeira and Azores
  - Adriatic Sea (Mediterranean)
  - Aegean - Levantine Sea (Mediterranean).

- Compiled an overview of coverage of European waters by hydrographic surveys and assessed the costs for overall high resolution mapping

EMODnet

European Marine Observation and Data Network

Pilot portal for Hydrography

EMODNET | Pilot approach | Metadata & Data | Data products | Promotion | Partners

Tools

Contact | Extranet | Sitemap | Home

EMODnet demo

Home

Welcome to the Hydrography portal

The European Commission, represented for the purposes of this project by the Directorate-General for Maritime Affairs and Fisheries (DG MARE), has concluded service contracts for creating pilot components of the **European Marine Observation and Data Network** (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.

This **EMODnet-Hydrography portal** is one of the portals, that is being developed as part of the EMODnet preparatory actions for the European Marine Observation and Data Network (EMODnet).

The portal provides hydrographic data collated for a number of sea regions in Europe:

- 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
- Iberian Coast and Bay of Biscay (Atlantic Ocean)
- Adriatic Sea (Mediterranean)
- Aegean - Levantine Sea (Mediterranean).
- Madeira and Azores (Macaronesia)

News

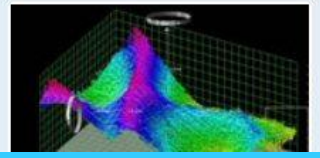
Now more than 9200 surveys gathered

New release of EMODNet digital bathymetry

EMODnet Bathymetry will be presented at the MARES2020 Conference in Bulgaria

EMODnet Bathymetry will be presented at the GEBCO Science Day 2013

More



www.emodnet-hydrography.eu

Hydrographic and Seabed Mapping – partnership

- Members of the **SeaDataNet** consortium together with other organisations from marine science, the hydrographic survey community, and industry:
  - **MARIS – NL** (Management, DM and IT expertise)
  - **IFREMER – FR** (Research institute)
  - **GGSGC – NL** (IT expertise, DM hydrography)
  - **IEO – ES** (Research institute)
  - **NERC-NOC – UK** (Research institute)
  - **GSI – IE** (HO – Ireland)
  - **SHOM – FR** (HO – France)
  - **UNEP-GRID Arendal – NO** (International Organisation)
  - **OGS – Oceanography department (IT)** (Research Institute)
  - **HCMR (GR)** (Research Institute)

  - Plus Data provider agreements with **HO's from Germany, Norway, Denmark, Netherlands and Belgium**

  - Plus Associate partners: **ISMAR-CNR –IT, OGS-RIMA – IT, LNEG – PT, UTM-CSIC – ES, NIOZ - NL** (Research Institutes) + **IHPT – PT** (HO) **+ OceanWise (UK) + Israeli Government, Ministry of National Infrastructures (Israel)**

Followed approach

- Involve research institutes, monitoring authorities, and HO's, in providing hydrographic data sets (both survey data sets and composite DTMs) to generate **Digital Terrain Models (DTM)** for each geographical region and load these into a spatial database at the Portal

- Develop and adopt a common methodology and tools for QA/QC and processing of the input data sets into regional DTMs

- Outfit the spatial database with a **dedicated data products viewing** that is complemented with DTM download services and WMS services (OGC) to serve users and to provide map layers for e.g. the other EMODnet portals

- Include in the portal a metadata discovery and access service by adopting the **SeaDataNet CDI data discovery and access service** that gives clear information about the hydrographic survey data used for the DTM, their access restrictions and distributors; this also ensures the connection of the portal with the SeaDataNet portal, which includes a shopping mechanism for requesting access to basic measurements data.

QA/QC and DTM specifications

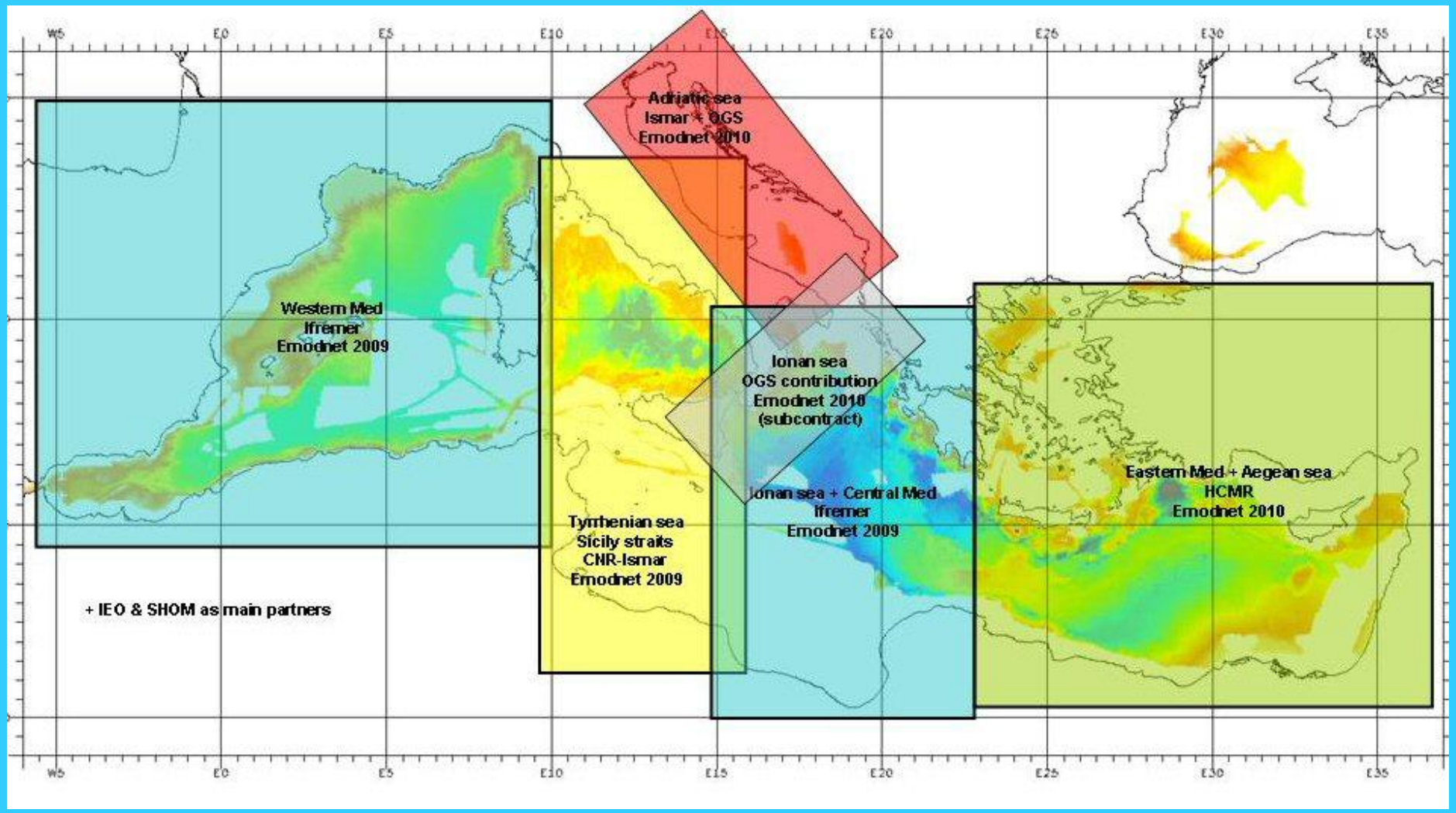
- **QA/QC specifications** have been prepared. It specifies the DTM to be produced and the QA / QC methodology to be applied. The specifications are finalized in the "Guideline for methodology, metadata and QC standards V1", that can be downloaded from the website.

- Each DTM grid cell has the following parameters:
  - Depth average in meters to LAT
  - Depth Min/Max in meters to LAT
  - Number of depth values used for interpolation
  - Depth standard deviation (as percentage of the water depth)
  - Smoothed depth average in meters to LAT
  - Number of elementary surfaces used to compute the average cell depth
  - An indicator of the offsets between the average and smoothed depth (as a % of the depth)
  - Source of data:
    - Surveys: link to Common Data Index (CDI) metadata sheet of most prevailing survey in the cell
    - Composite DTM: link to DTM metadata sheet
    - GEBCO: reference to GEBCO version

Data processing approach

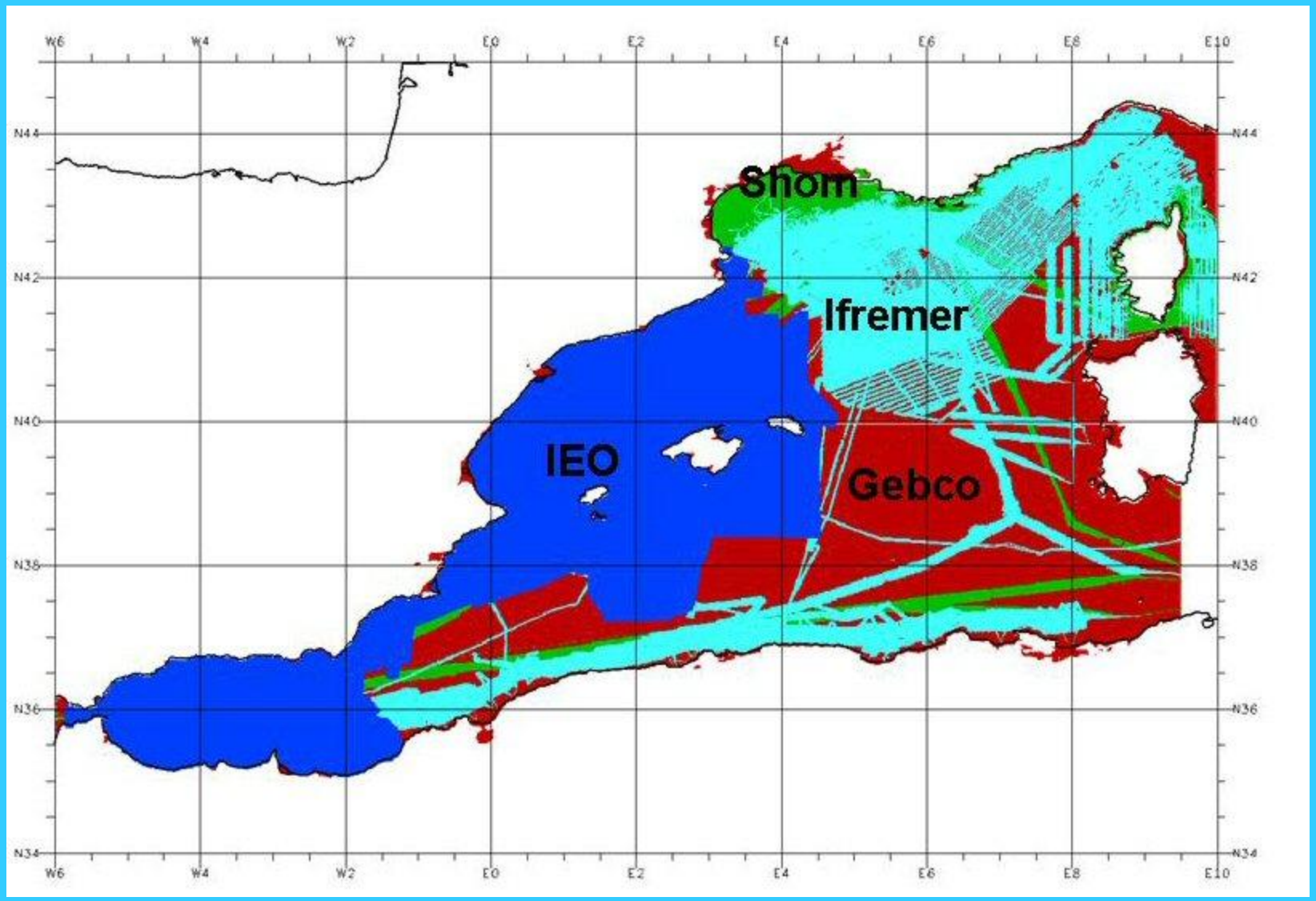
- The data sets are used internally for producing regional Digital Terrain Models (DTM).
- The DTMs are integrated into an overall DTM at the public portal for browsing and downloading
- The survey data sets themselves are not distributed but described in the CDI metadata, giving clear information about the background survey data used for the DTM, and facilitating requests by users to originators.
- The composite DTMs received from some Hydrographic Offices are also not distributed but described in a DTM metadata sheet, giving information about the background and originators of these products.

Hydrographic lot – Data processing coordination



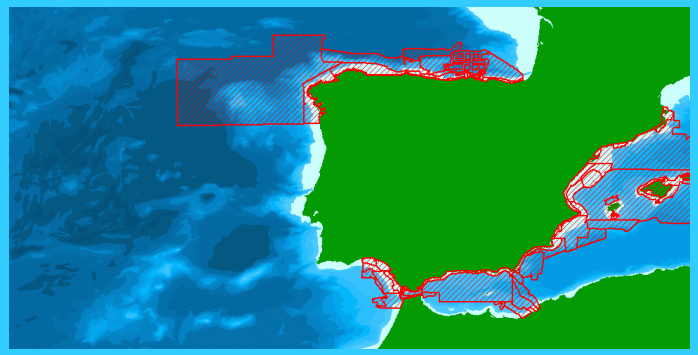
Example for the Mediterranean Sea

Hydrographic lot – Data contributing and coverage

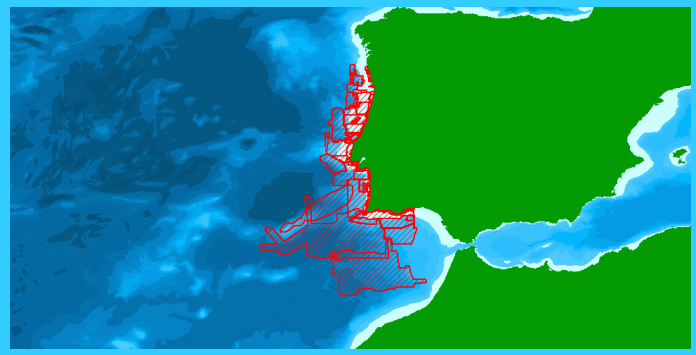


Example for the Western Mediterranean Sea

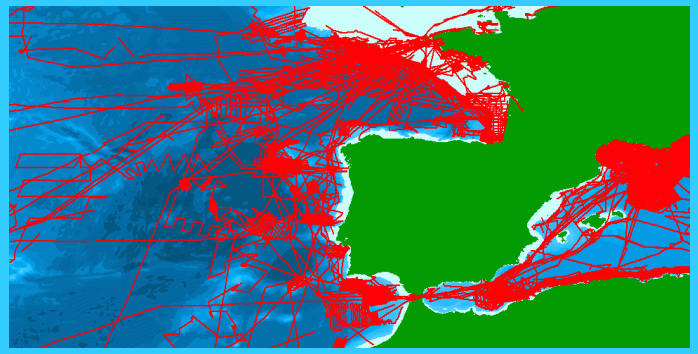
Data gathering – Iberian Coast and Bay of Biscay (Atlantic Ocean)



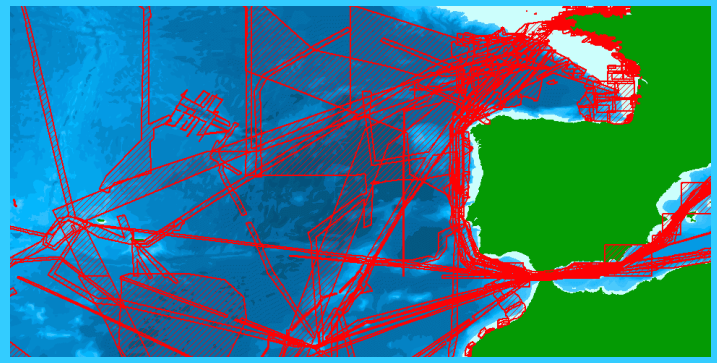
IEO data



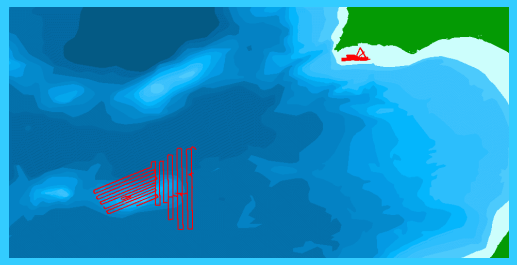
IHPT data



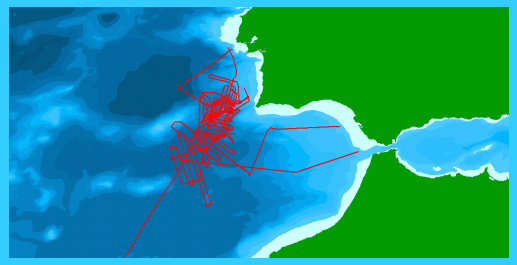
IFREMER data



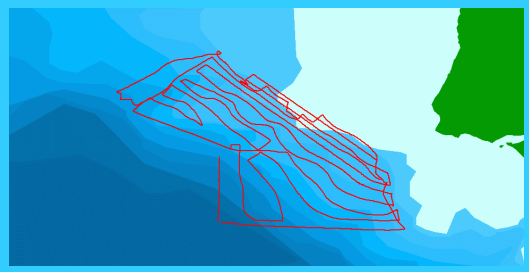
SHOM data



CNR – ISMAR data



UTM-CSIC data



LNEG data

Results

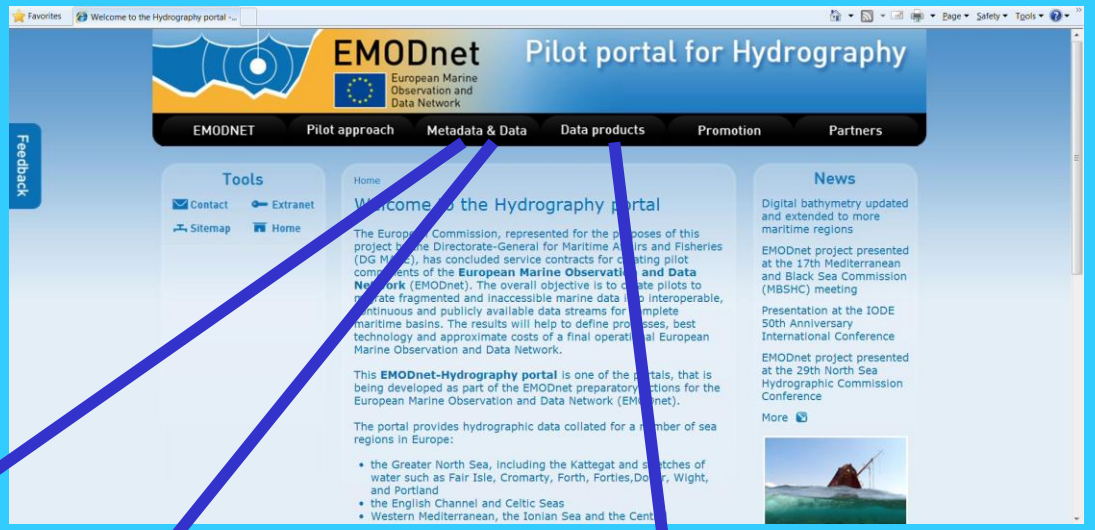
- Up till today, **9236** survey CDI metadata records from **15** data centres and **127** data originators from **1816 till 2013** have been collated and imported into a dedicated EMODnet Hydrography CDI data discovery and access service. This service was launched in May 2010 and has been upgraded over time with extra functionality and increasing number of entries

- These survey data and other gathered composite DTMs have been collated into regional EMODnet DTM's that are available for viewing and downloading in several formats via the Hydrography Products portal service.

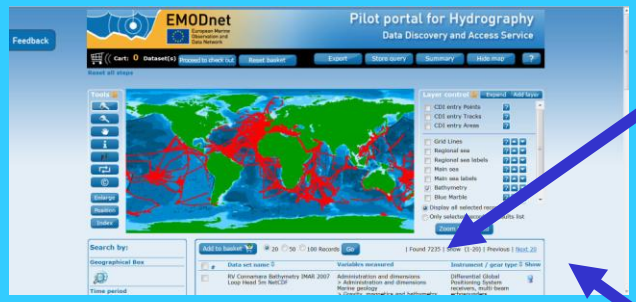
- The dedicated EMODnet Hydrography products portal has been launched in May 2010. It sits atop of the central DTM database and interacts with the CDI service and with OGC WMS services

- Later also the Sextant Data Products service has been added to give metadata about the composite DTMs that have been used next to survey data sets.

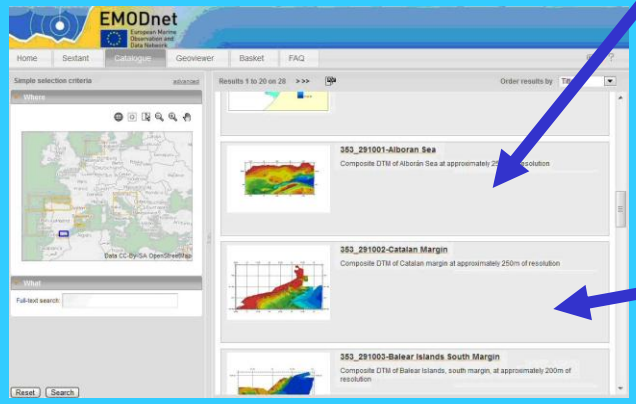
Hydrographic portal



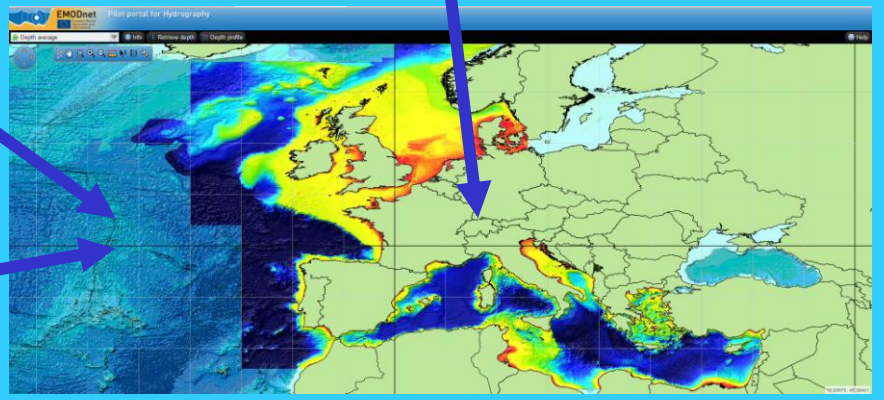
http://www.emodnet-hydrography.eu



CDI metadata service

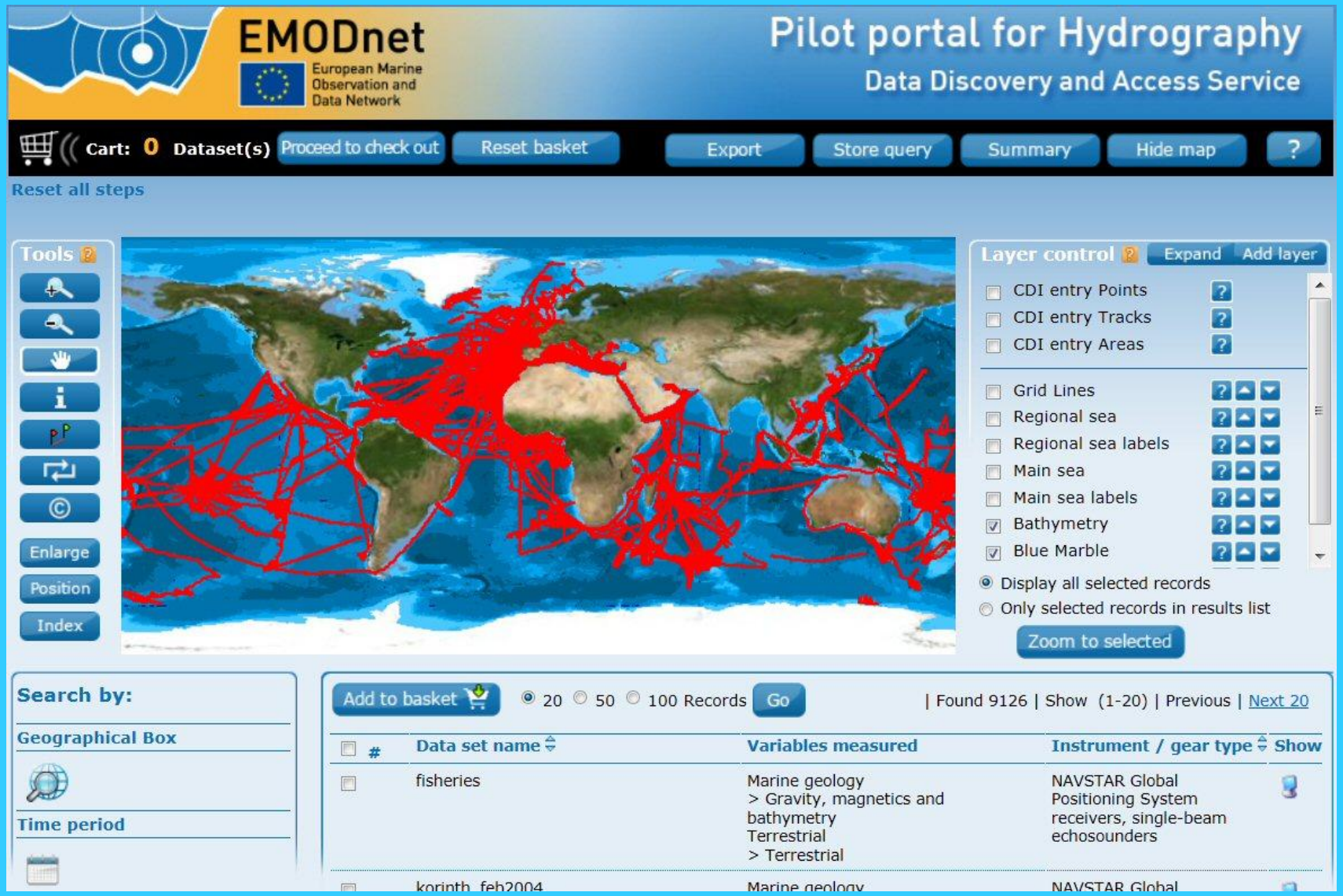


Sextant metadata service



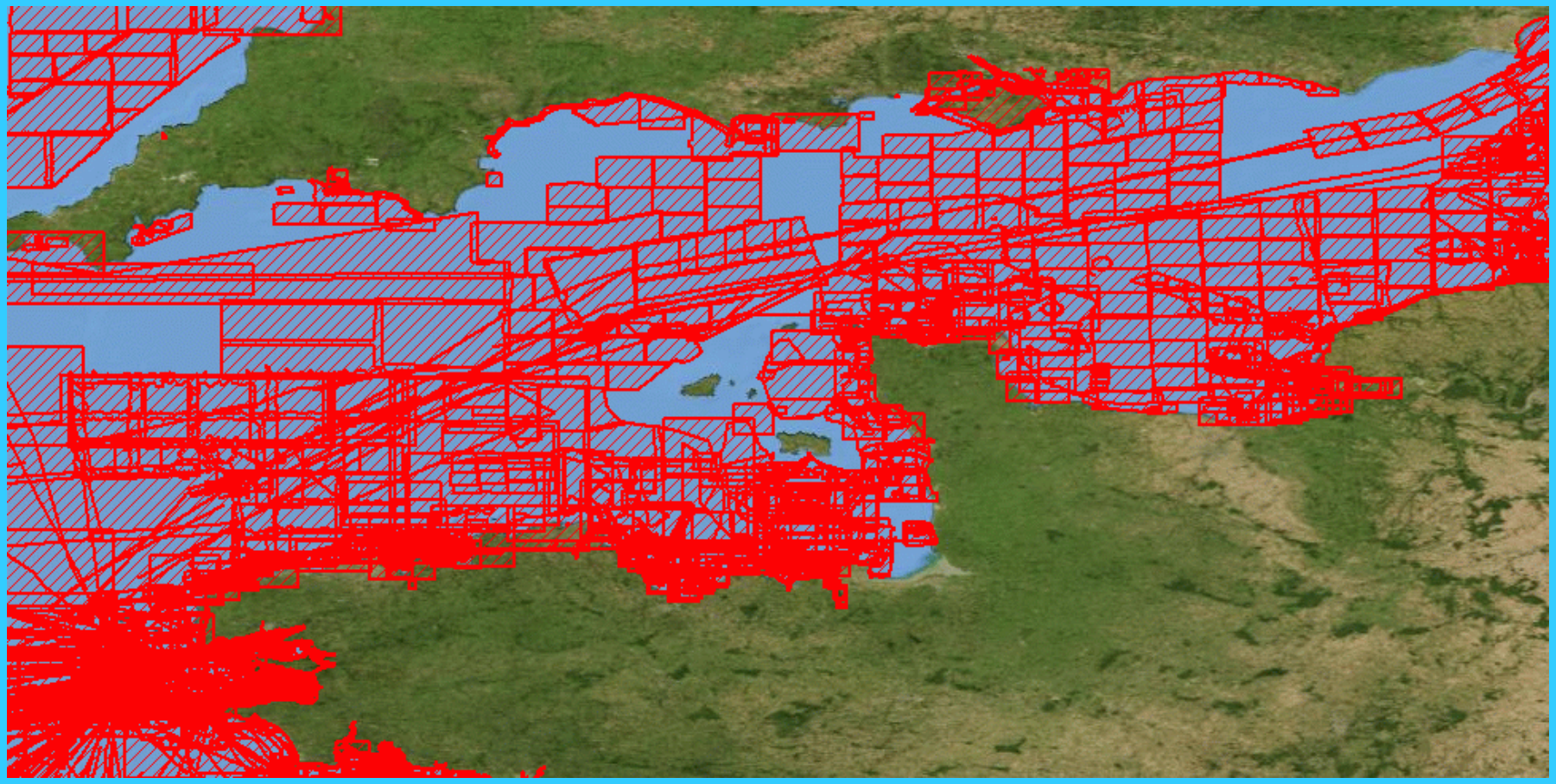
Data products service

CDI Data Discovery and Access Service



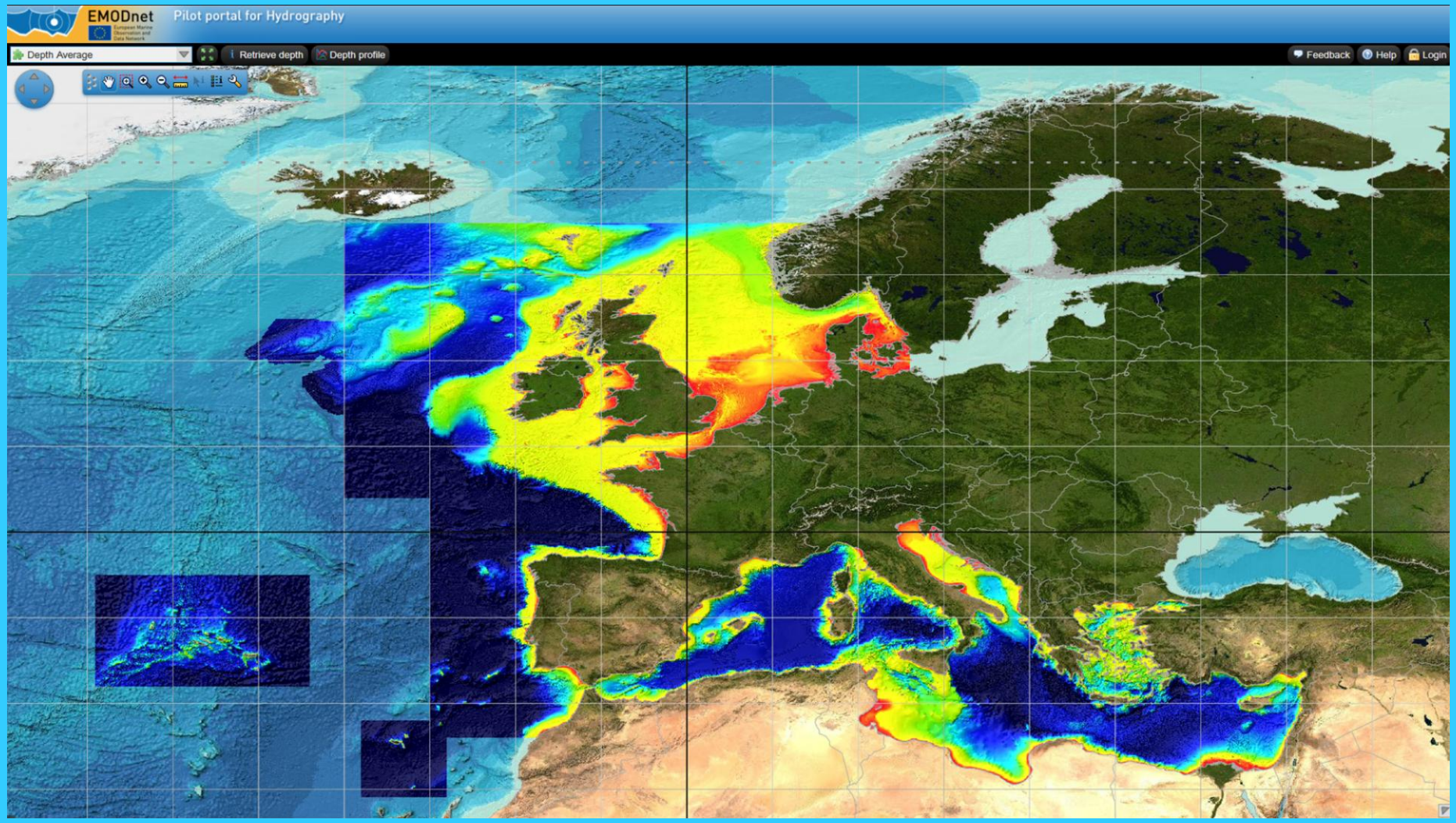
Discovering and requesting access to bathymetric survey data sets (single and multibeam) (9100+)

CDI Data Discovery and Access Service



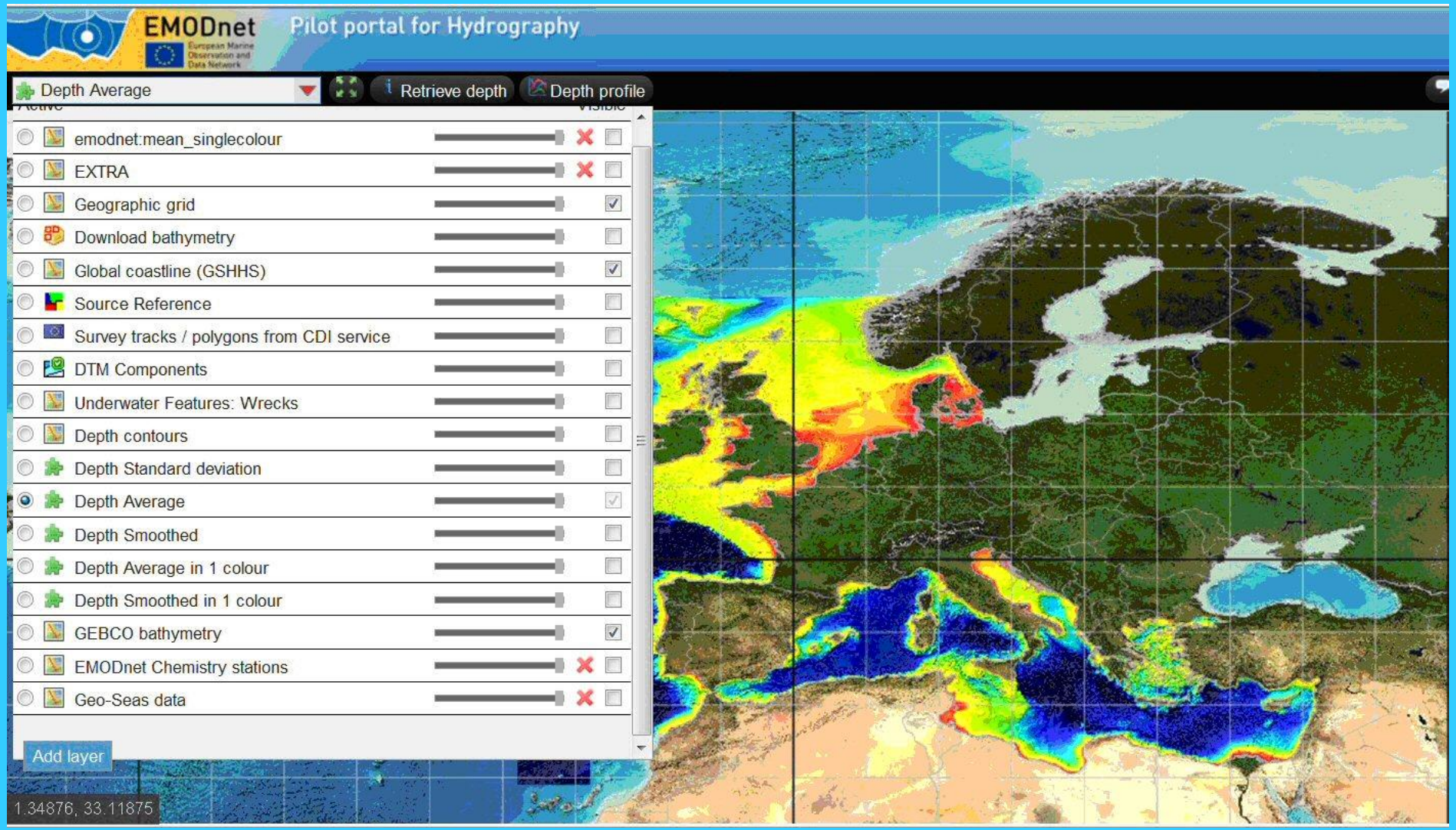
Discovering and requesting access to bathymetric survey data sets (single and multibeam) for the Channel

Hydrographic Data Products viewing service



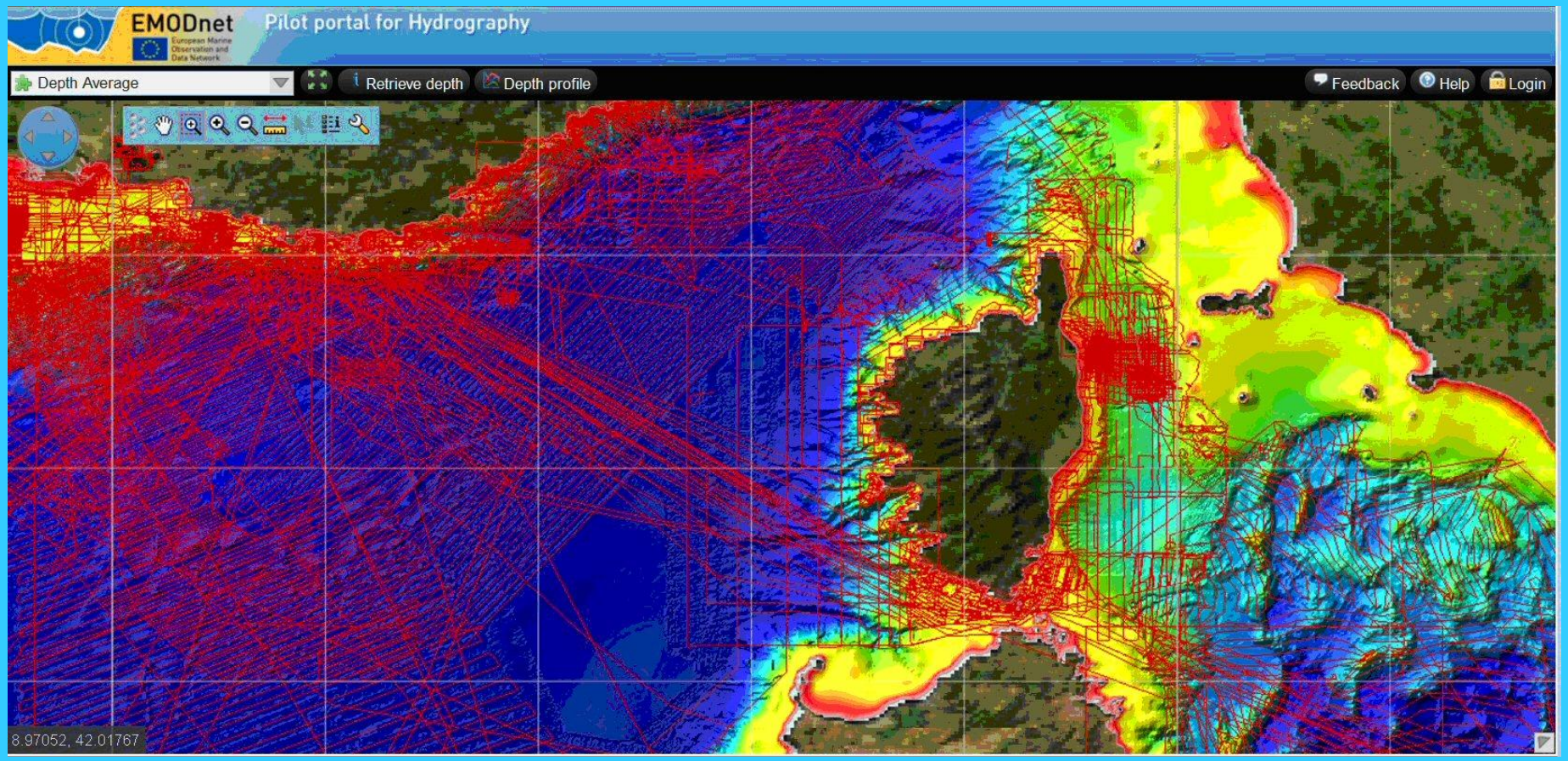
*DTM for European sea basins (0,25 * 0,25 minutes grid)*

Hydrographic Data Products viewing service



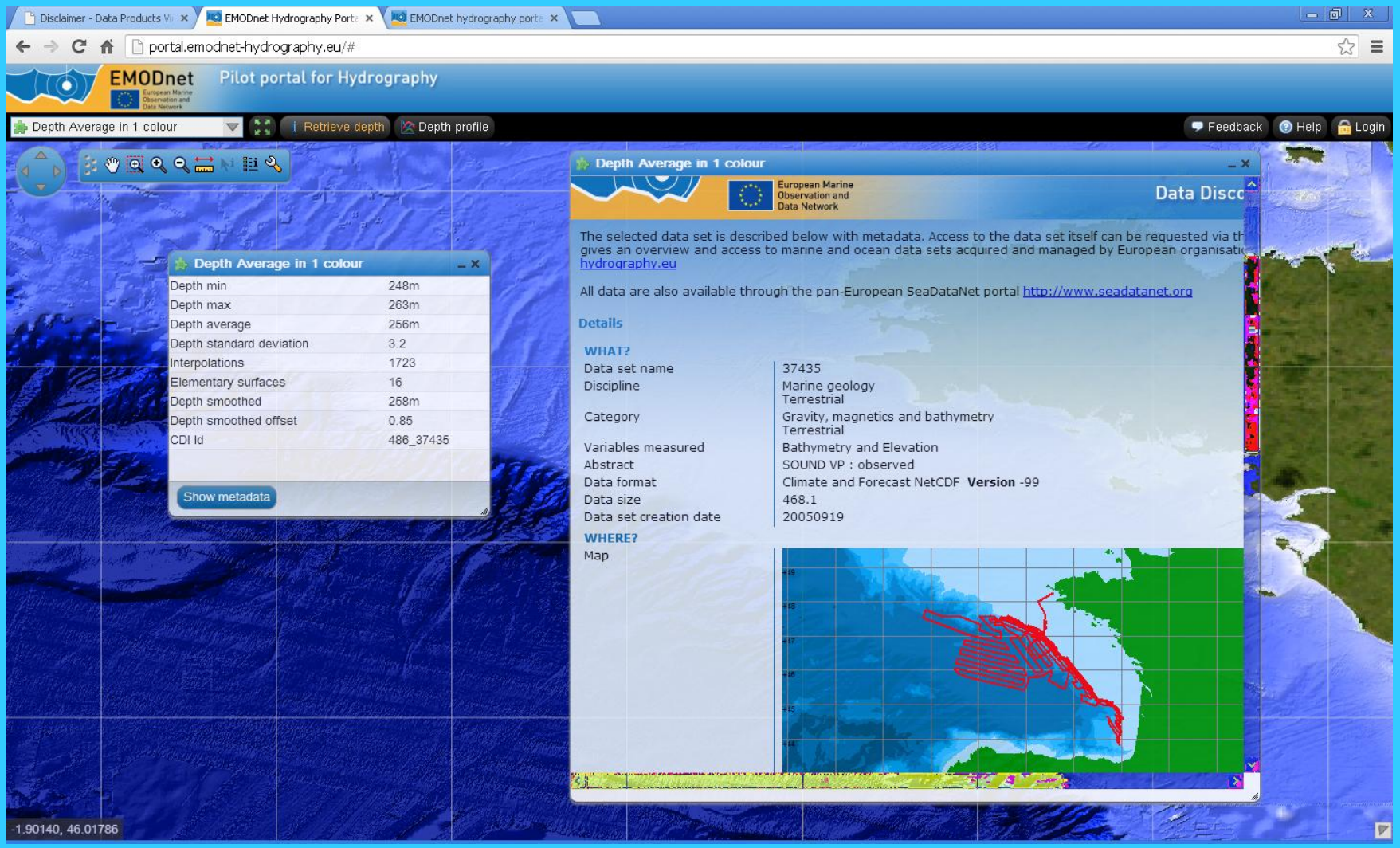
New DTM for European sea basins with layer menu

Hydrographic Data Products viewing service



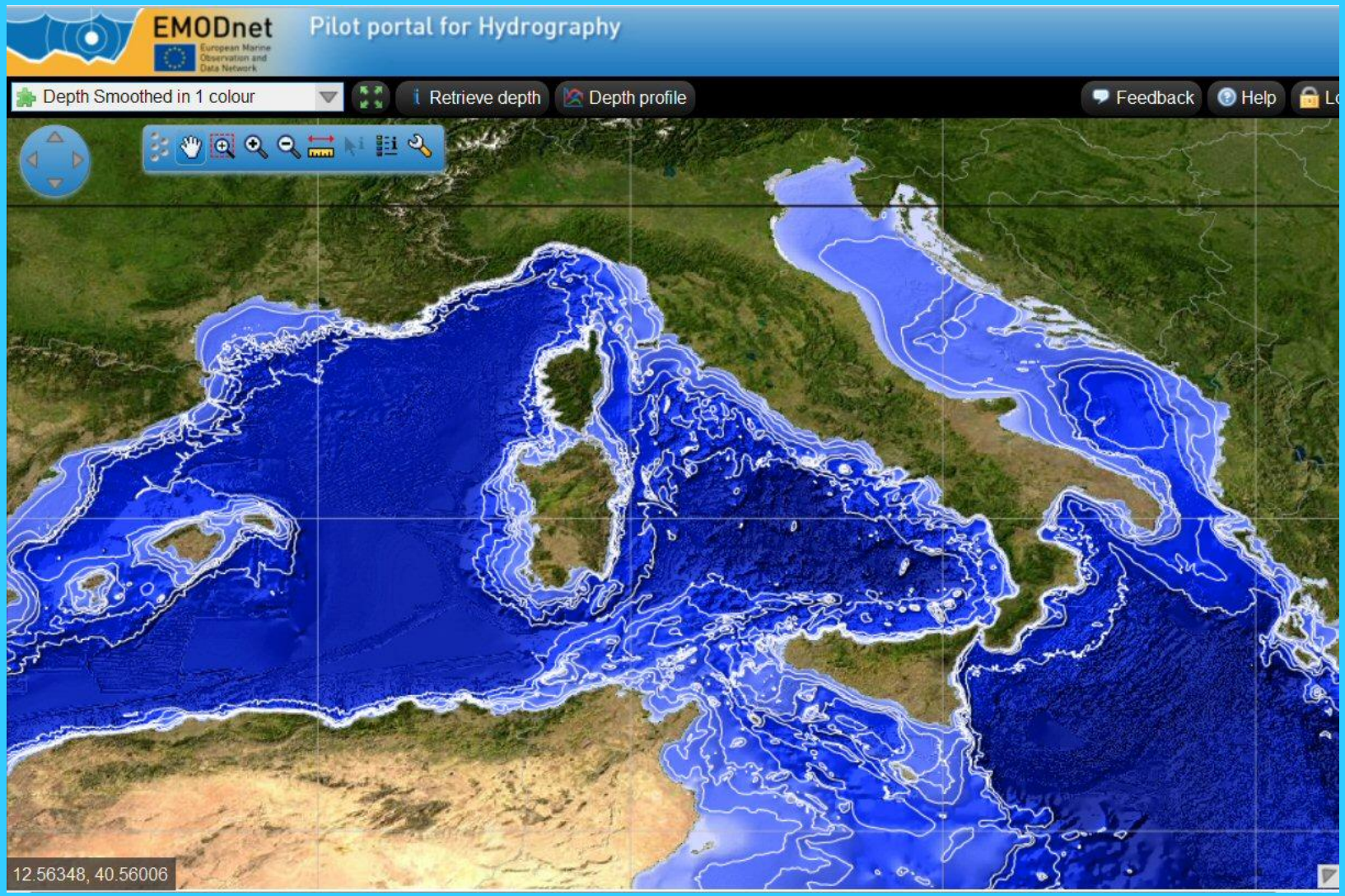
New DTM for European sea basins with CDI overlay to indicate surveys

Hydrographic Data Products viewing service



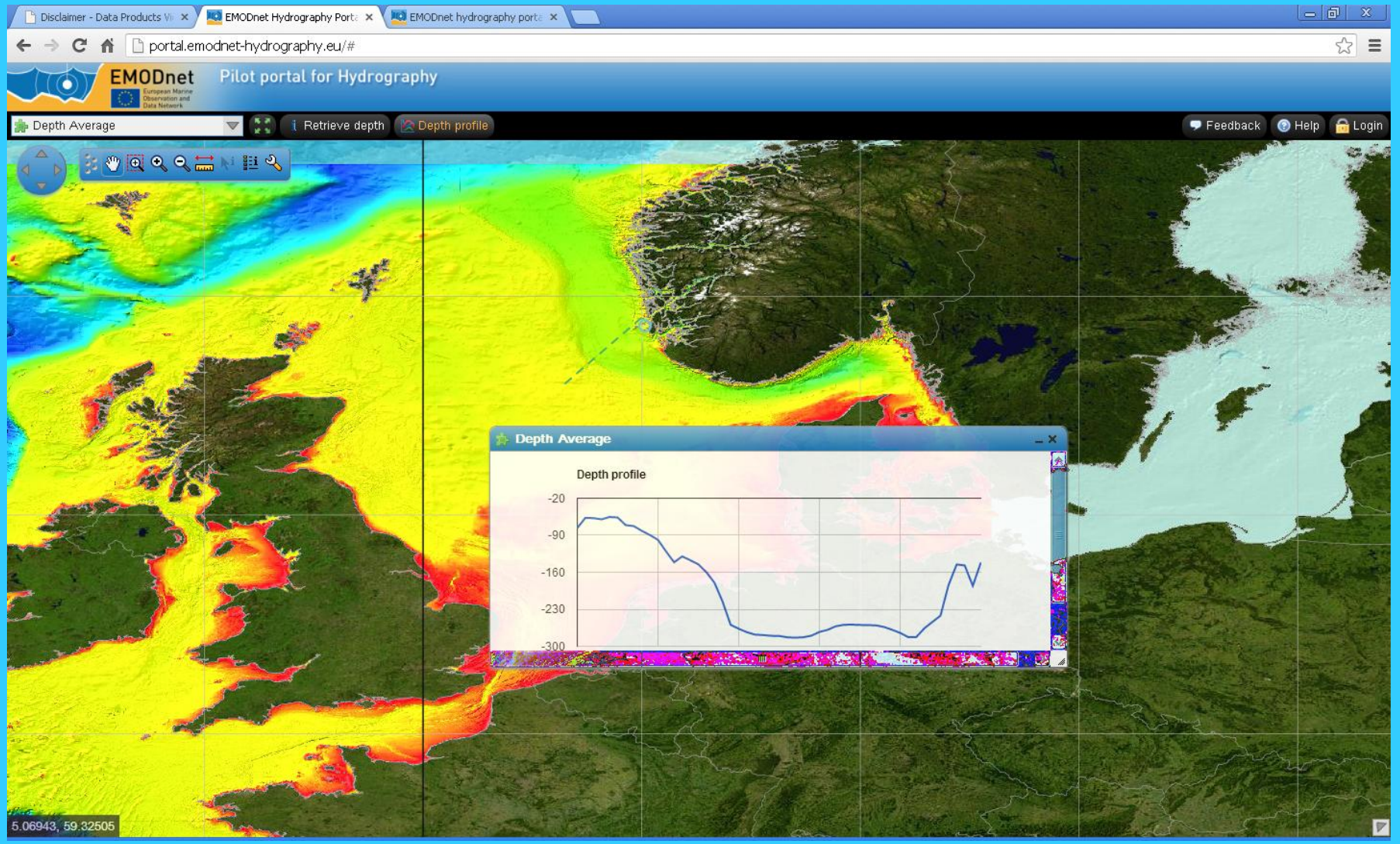
Retrieving parameters of an individual grid cell and retrieving CDI metadata of associated prevailing survey

Hydrographic Data Products viewing service



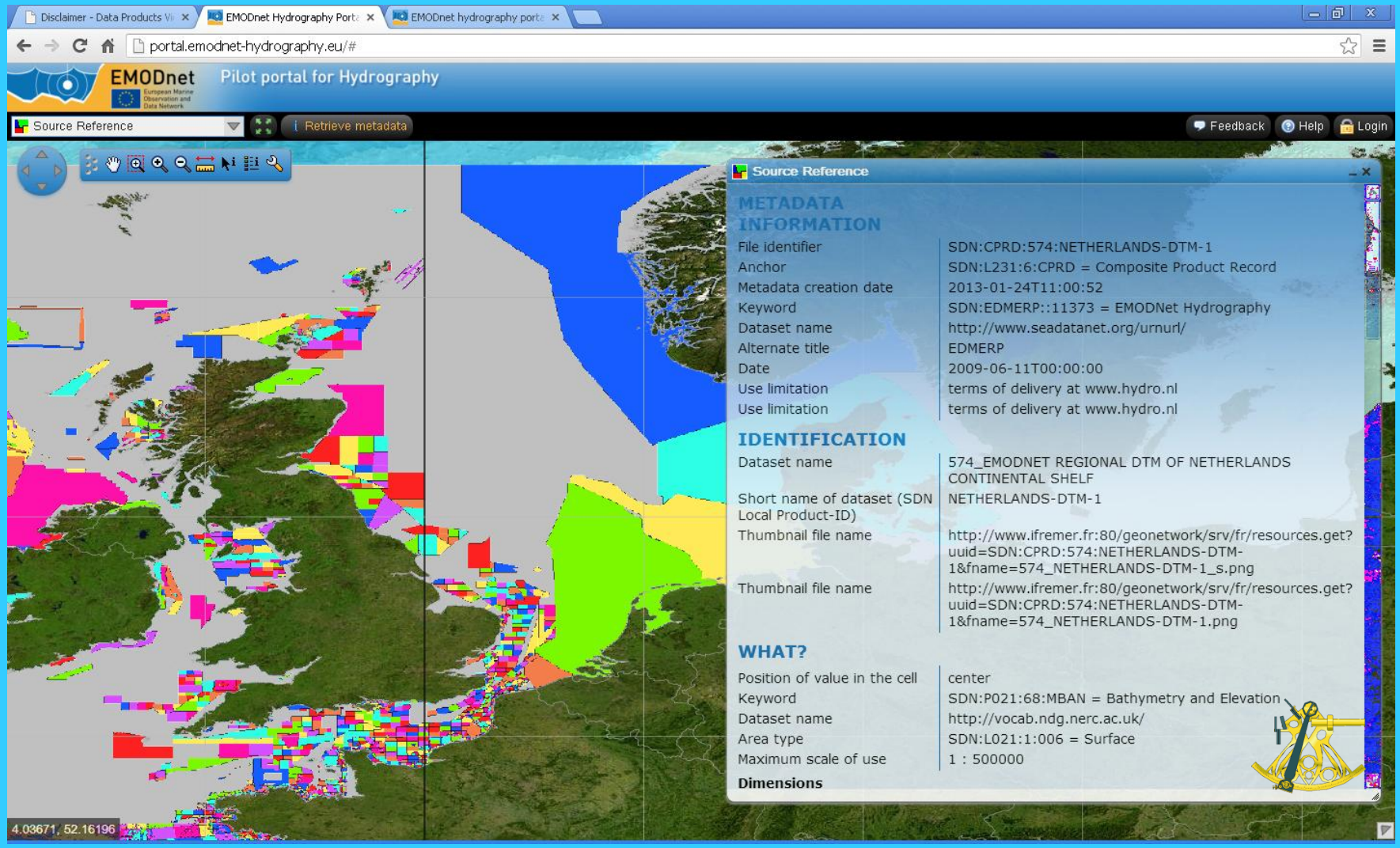
- *Contours*

Hydrographic Data Products viewing service



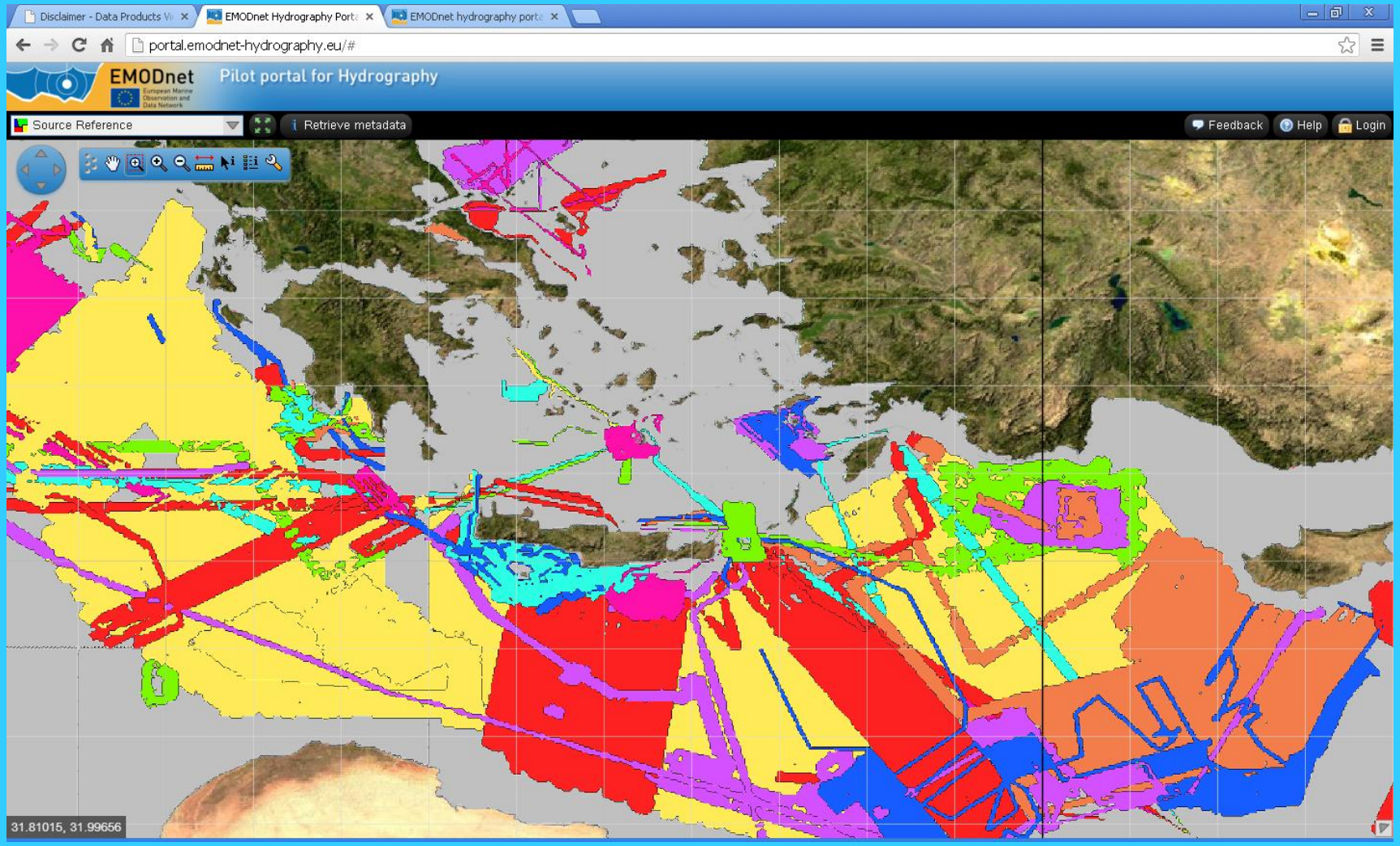
Retrieving depth profiles

Hydrographic Data Products viewing service



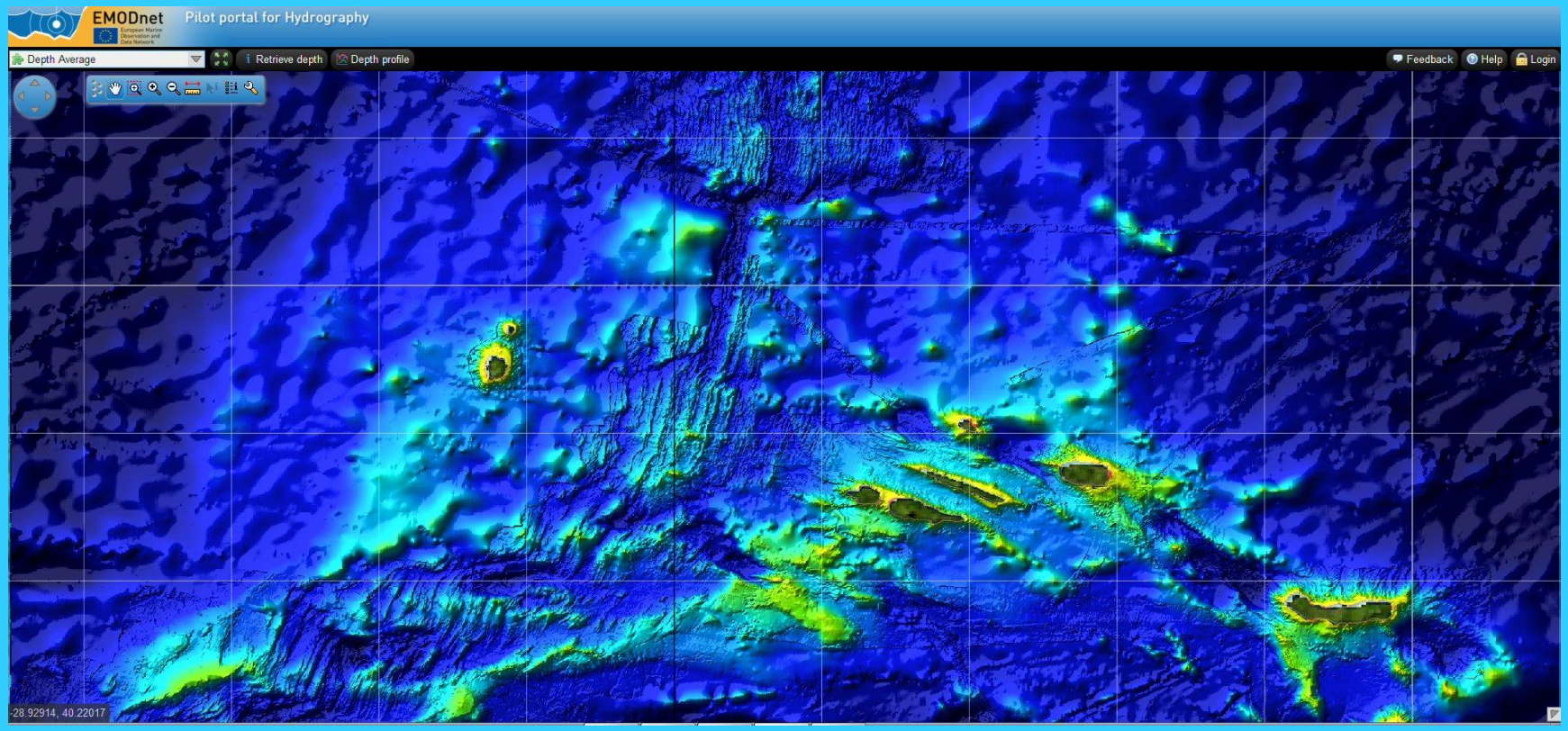
Retrieving Sextant metadata of associated composite DTM

Hydrographic Data Products viewing service



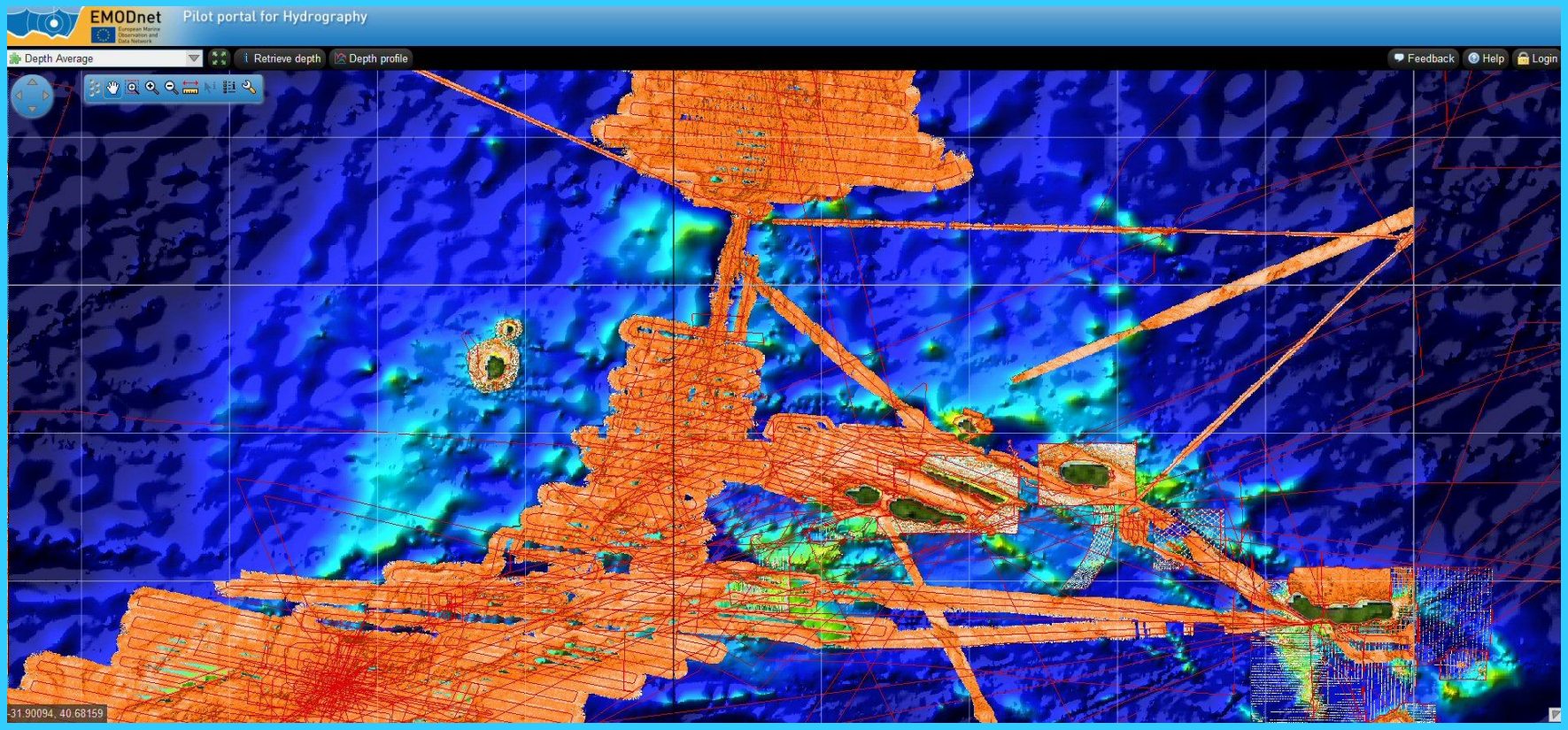
Sources reference layer, indicating which source data (surveys or composite DTMs) were used as prevailing for DTM grid cells. Including identification of related source and associated metadata.

Hydrographic Data Products viewing service



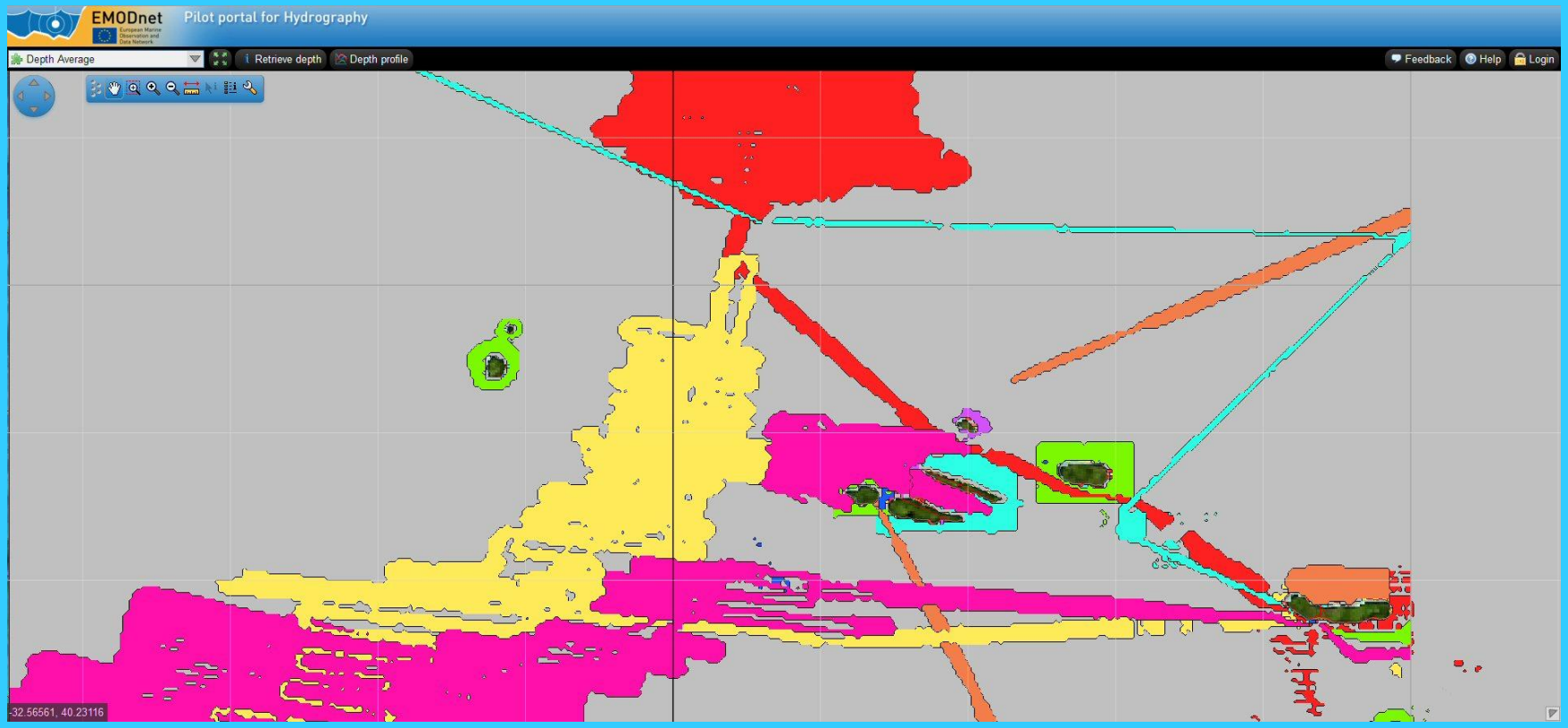
DTM for the Azores

Hydrographic Data Products viewing service



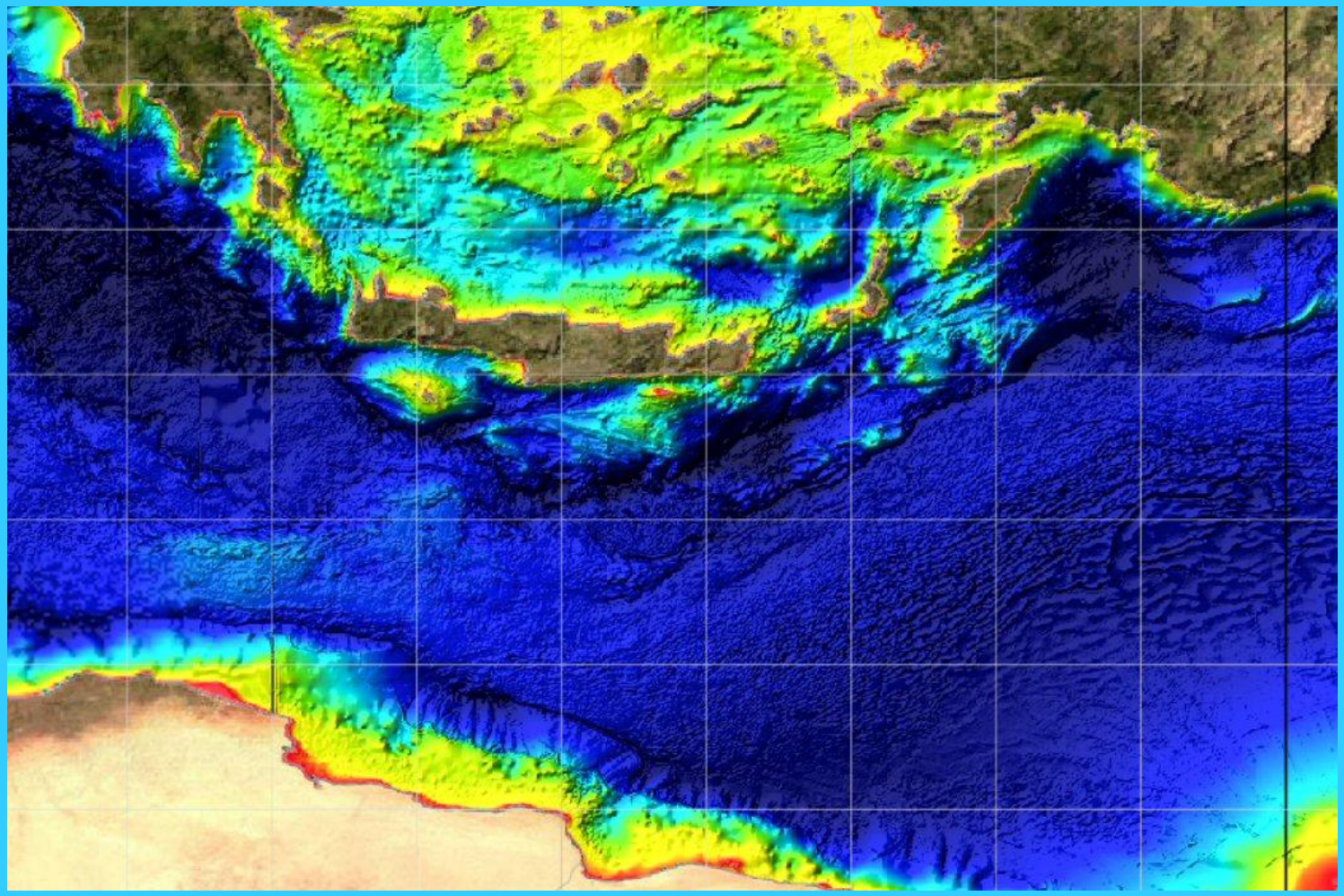
Azores: Depth standard deviation layer, also giving good insight in where surveys have been used to cover the area.

Hydrographic Data Products viewing service



Azores: Sources reference layer, indicating which source data (surveys or composite DTMs) were used as prevailing for DTM grid cells.

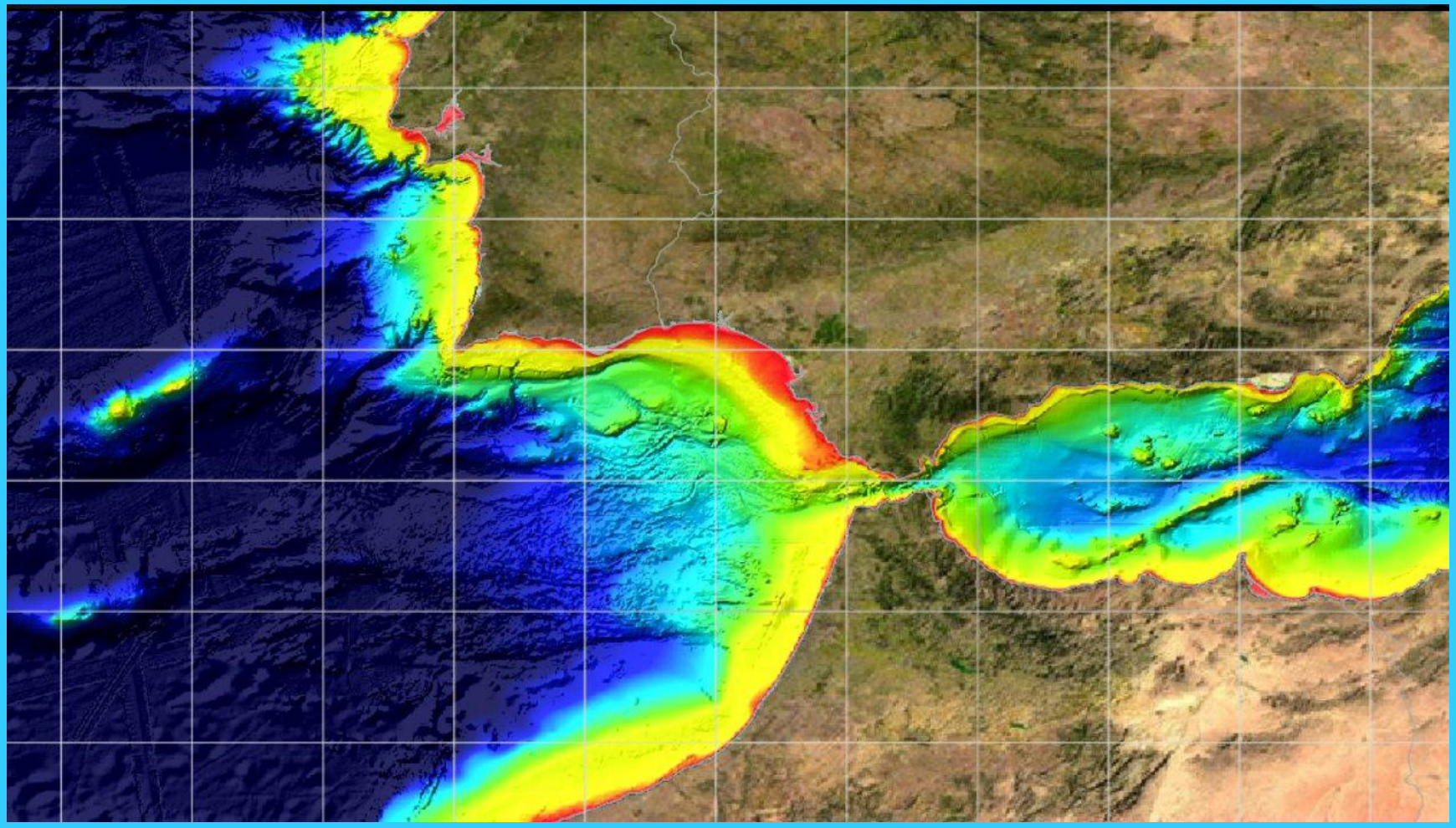
Hydrographic Data Products viewing service



Near Crete

- *Detailed zoom of digital bathymetry - examples*

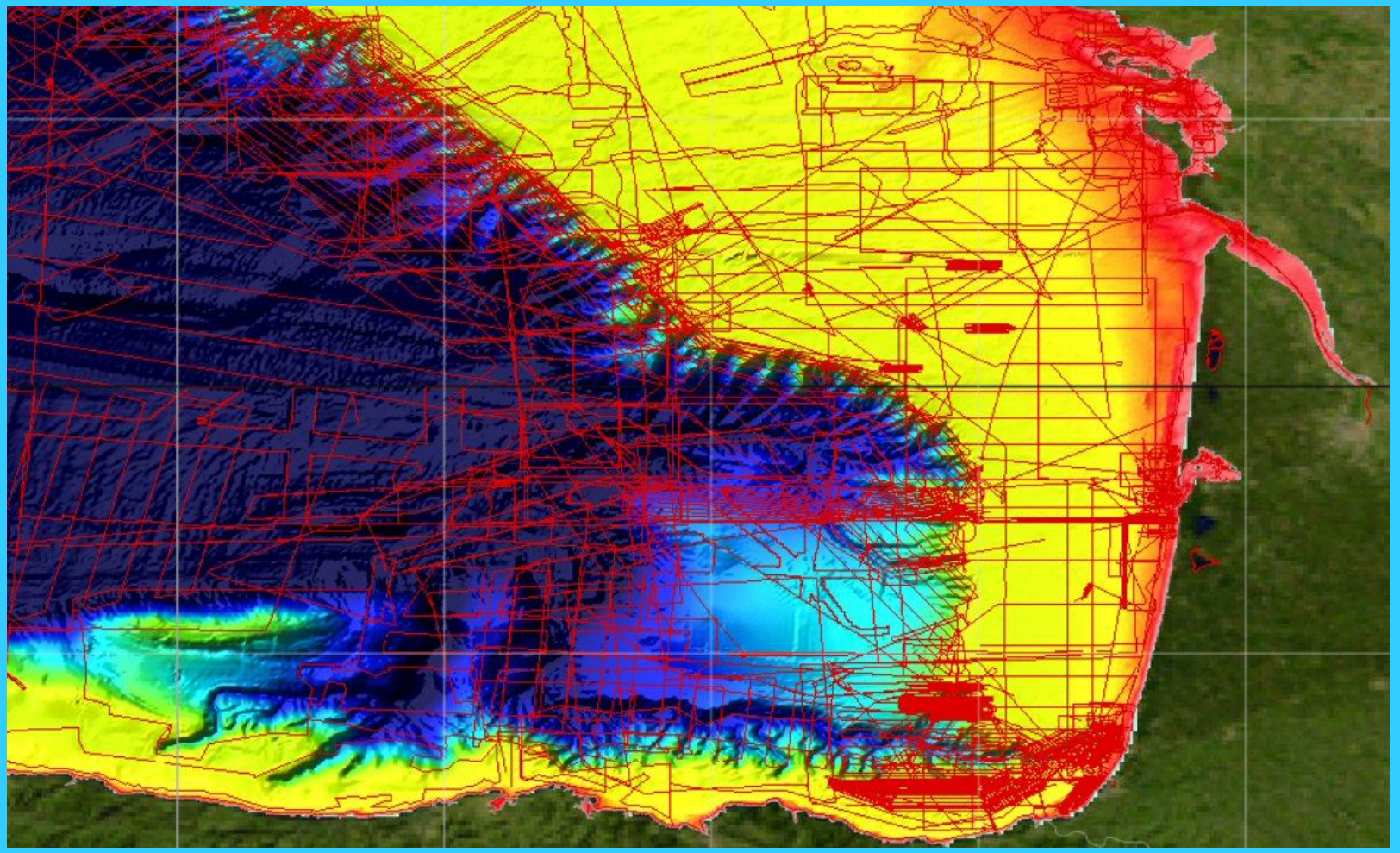
Hydrographic Data Products viewing service



Near Strait of Gibraltar

- *Detailed zoom of digital bathymetry - examples*

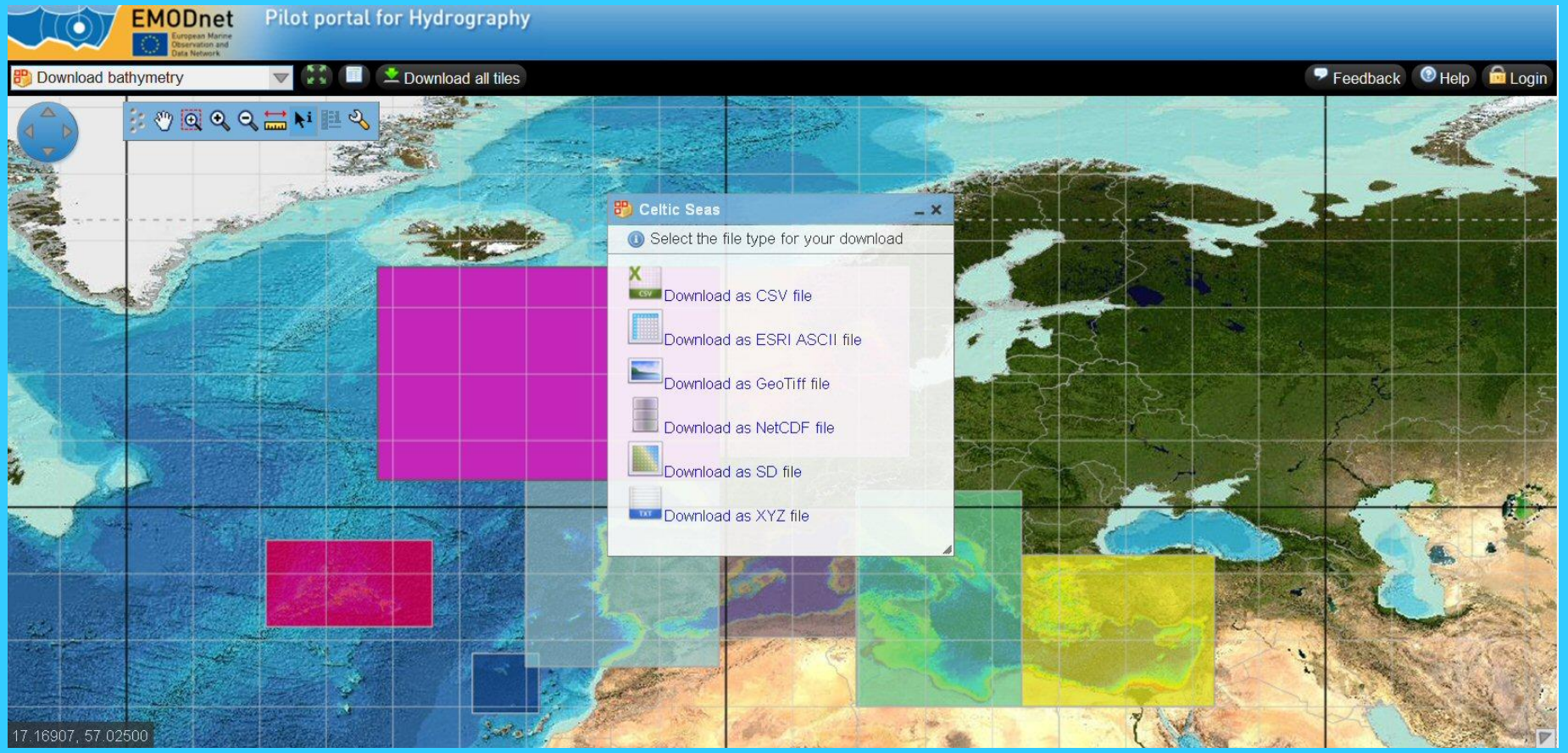
Hydrographic Data Products viewing service



Gulf of Biscay – North Atlantic

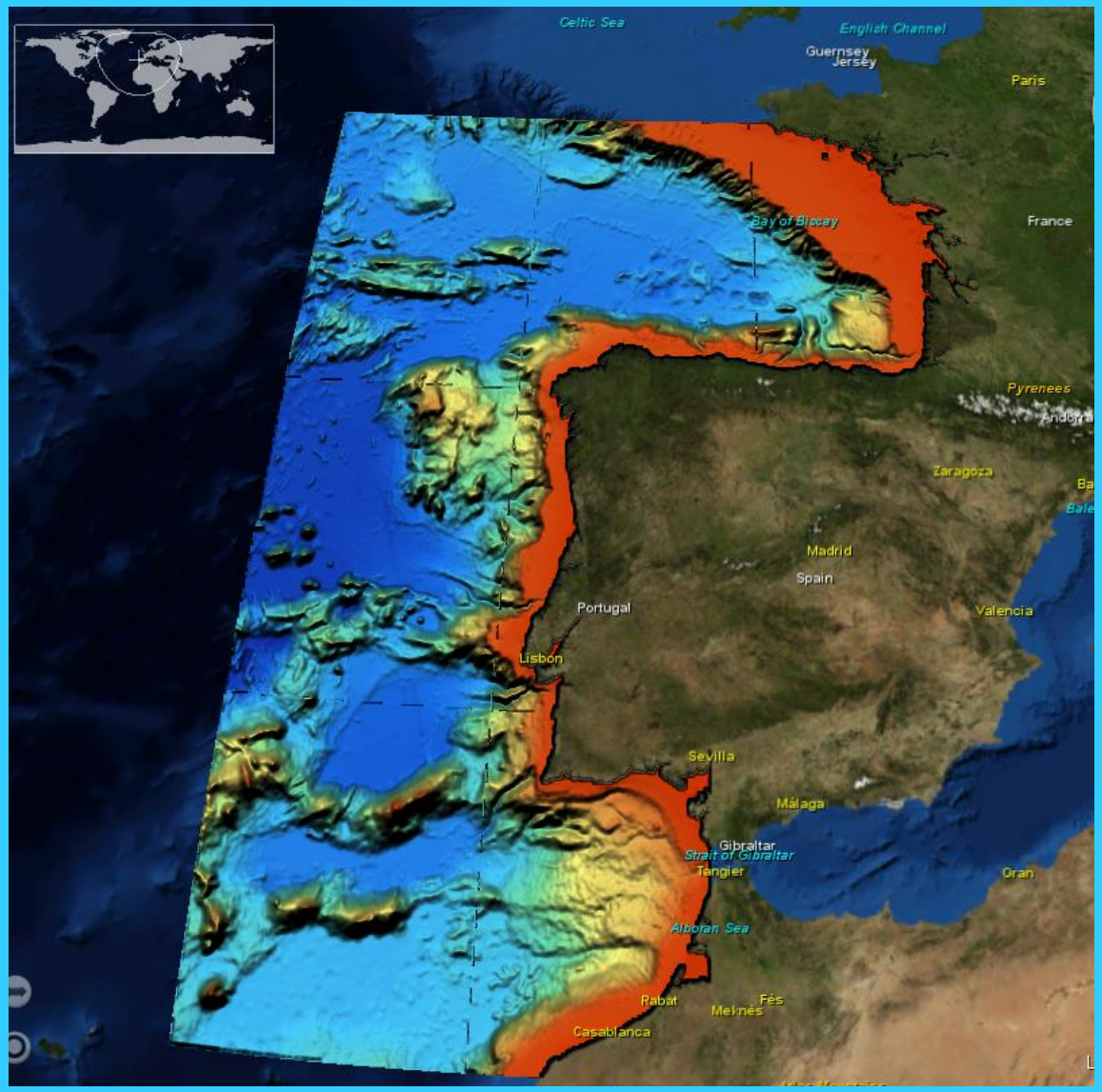
- *Detailed zoom of digital bathymetry – examples, incl CDI surveys*

Hydrographic Data Products viewing service



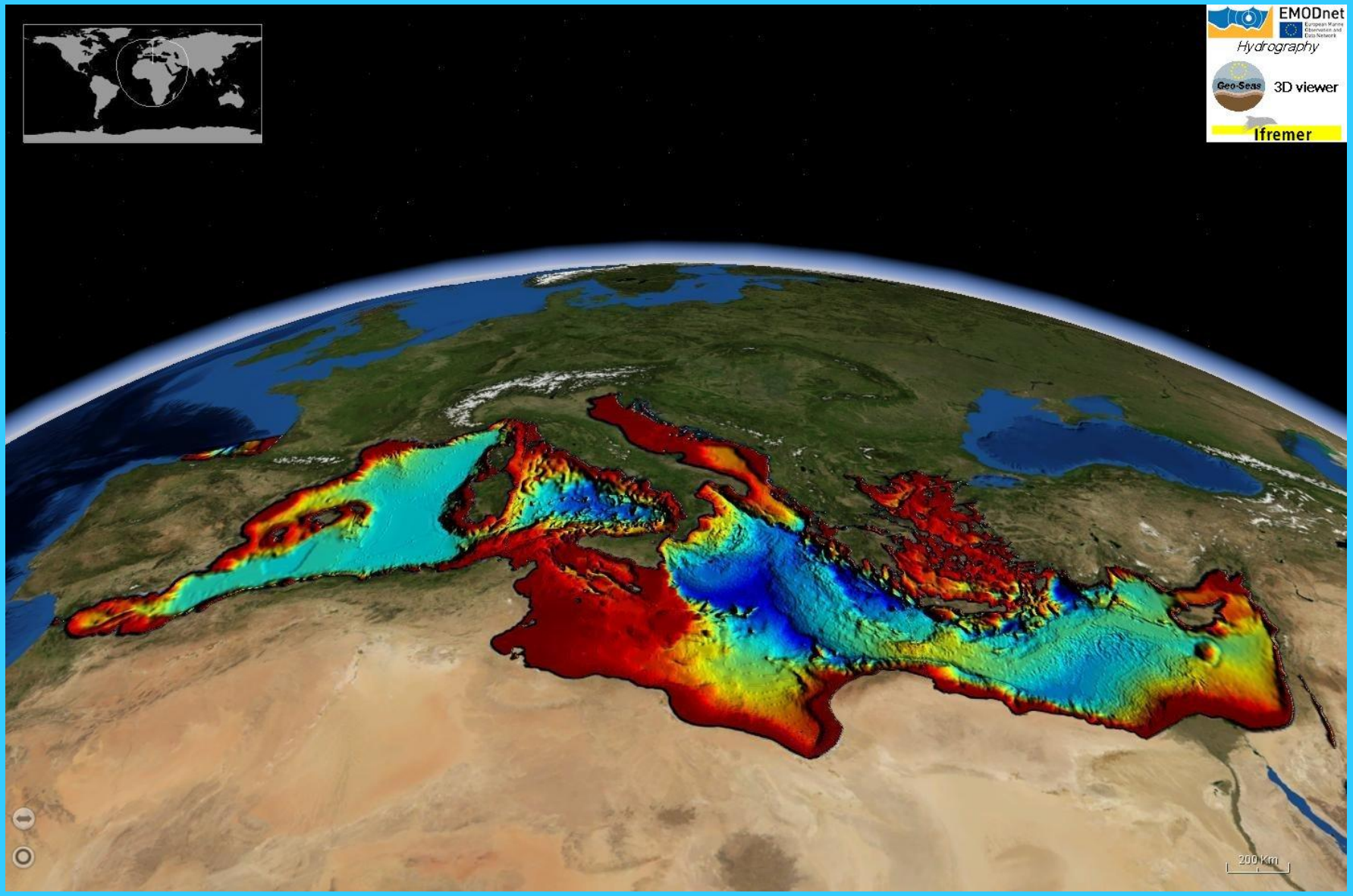
Selecting DTM tiles for downloading in various formats

Hydrographic DTM – 3D-Viewer



DTM loaded into 3D-Viewer as developed in Geo-Seas

Hydrographic DTM – 3D-Viewer



DTM loaded into 3D-Viewer as developed in Geo-Seas

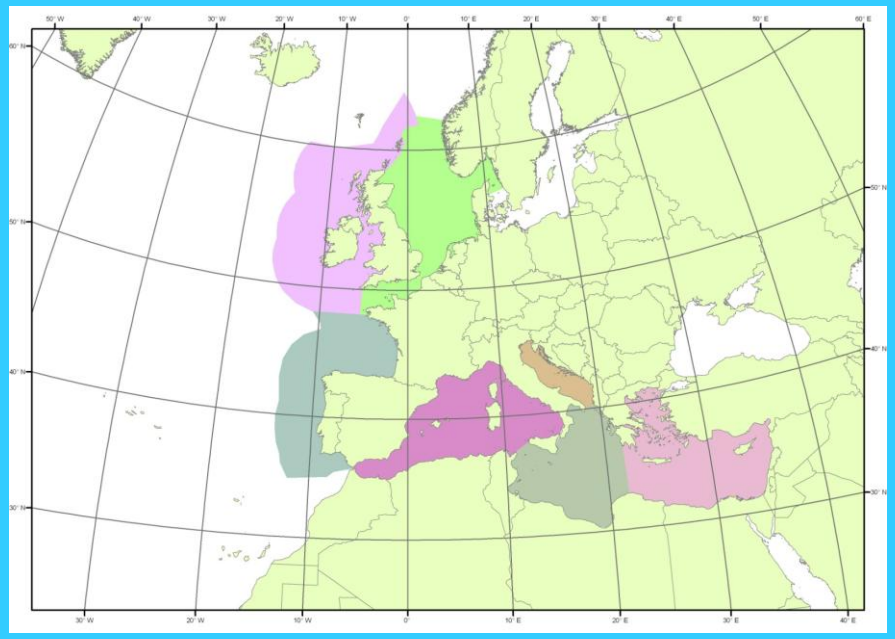
Successful approach

- Providers of bathymetric data sets understand and are welcoming the applied approach
- Data sets are gathered for internal use by regional consortium groups to compile the DTM product which can be downloaded without any registration
- Data sets are described and included in the CDI Data Discovery and Access Service and composite DTMs in the Sextant Data Products Service providing traceability of data
- Each cell in the DTM product gives information about the data sets used with CDI / Sextant references and gives statistical info
- This works as a shop window and results in more data providers coming forward

Analysis: Total area of sea basins

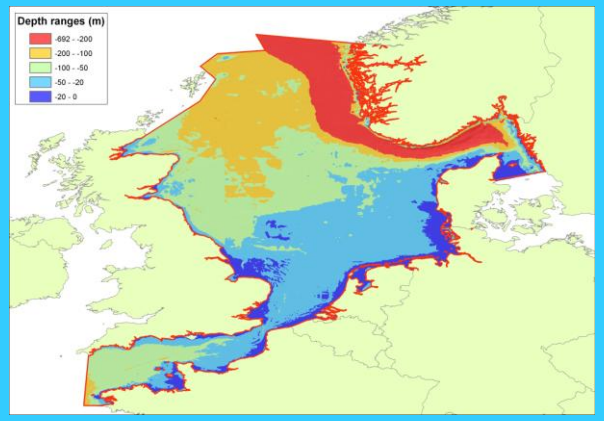
Basin	area (sq km)
GNS	678,250
Celtic	894,460
Bay of Biscay and Iberian	818,646
Western Med	844,828
Ionian and Central Med	717,683
Aegian-Levantine	815,870
Adriatic	133,943

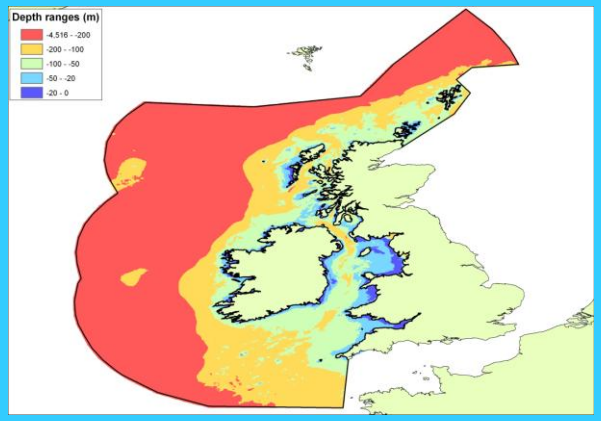
4,903,680

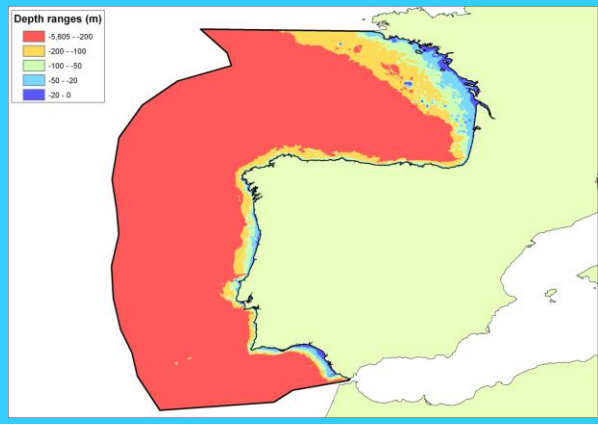


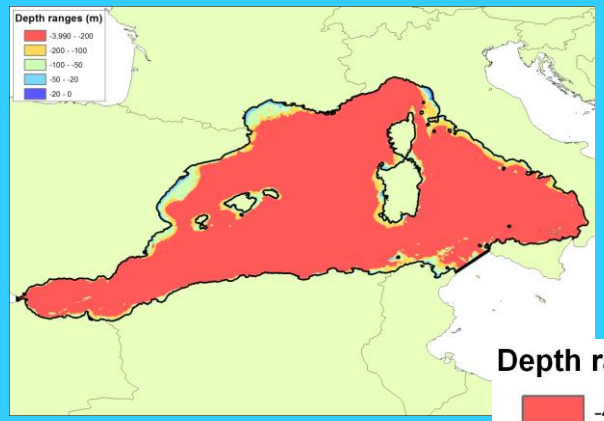
Sea basin areas as defined by the Marine Strategy Framework Directive Working Group on Data, Information and Knowledge Exchange (MSFD DIKE)

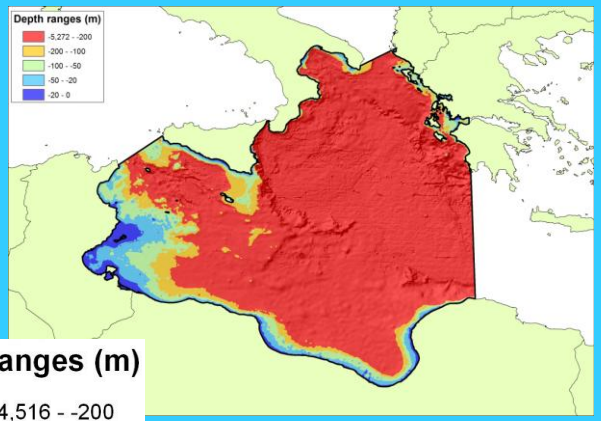
Analysis: Total area of deep water (> 200 m)

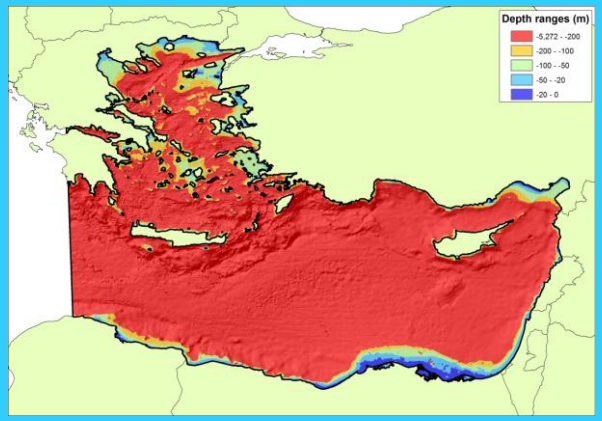


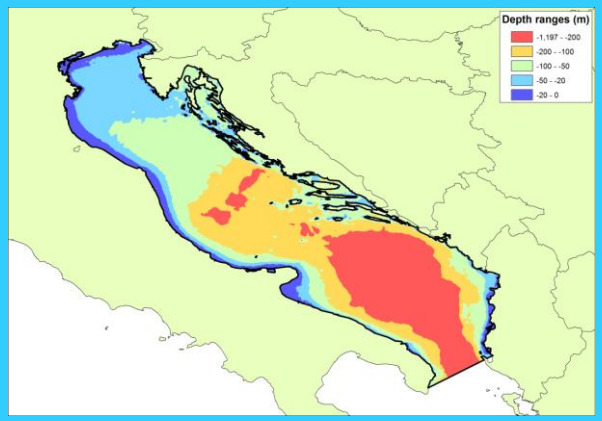










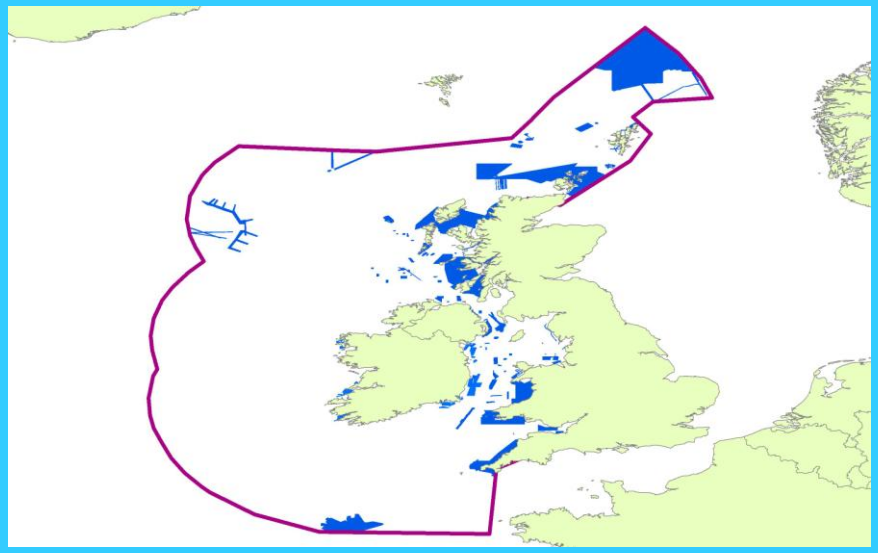


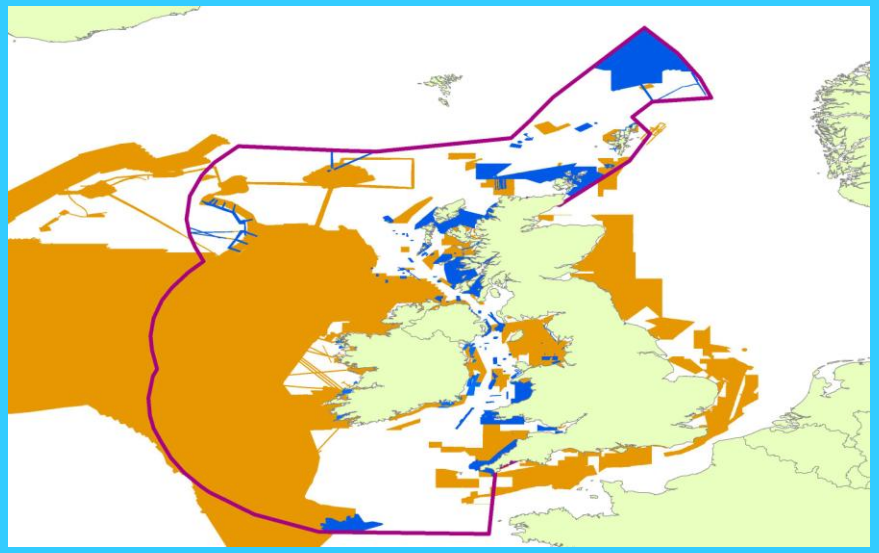
Depth ranges (m)

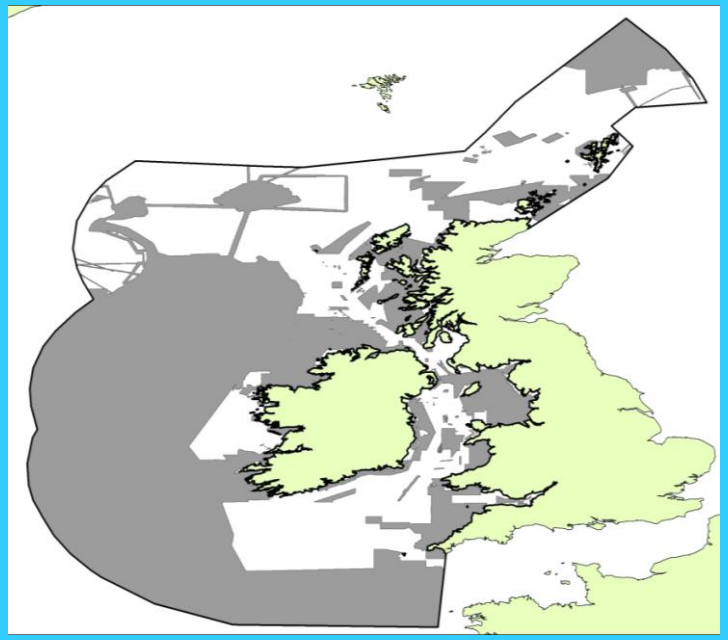
- -4,516 - -200
- -200 - -100
- -100 - -50
- -50 - -20
- -20 - 0

		% of basin areas
Total area >200m	**3,223,527**	65.73

Analysis: Areas surveyed versus to be surveyed







Total area of Celtic Basin area -
894,460 sq km

Area of basin with
available/identified data -
542,733Sq km

60.6% coverage

Analysis: Areas surveyed versus to be surveyed

Basin	Total basin area	Area surveyed	To be surveyed
GNS	678,250	400,700	277,550
Celtic	894,460	542,733	351,727
Bay of Biscay and Iberian	818,646	772,606	46,040
Western Med	844,828	722,220	122,608
Ionian and Central Med	717,683	389,232	328,451
Aegian-Levantine	815,870	461,577	354,293
Adriatic	133,943	109,865	24,078
	4,903,680	**3,398,933**	**1,504,747**

Analysis: Depth ranges of areas to be surveyed

Depth ranges to be surveyed	sq km	% of total
0-20	76,002	5.05
20-50	170,846	11.35
50-100	260,087	17.28
100-200	279,591	18.58
deeper than 200	718,210	47.72
total to survey	**1,504,736**	

Estimating costs of full survey coverage

Effort to survey	sq km	days	Euro	% of total cost
0-20	76,002	**7306**	**70,779,317**	14.05
20-50	170,846	**4469**	**101,722,494**	20.20
50-100	260,087	**3271**	**154,856,400**	30.75
100-200	279,591	**1971**	**166,469,767**	33.06
deeper than 200	718,210	**549**	**9,613,295**	1.90
Total estimate	**1,504,736**	**17500**	**500,000,000**	

EMODNet Bathymetry – scope of new project

- Started officially in July 2013
- Increasing the resolution of the DTM from ¼ to 1/8 of a minute of lat – lon (ca 225 m* 225 m) for all sea regions
- Including missing sea basins:
  - Black Sea
  - Baltic Sea
  - Norwegian + Icelandic Sea
  - Canary Islands as part of Macaronesia
- Including new data sets, also for existing regions and partners
- 3 coastal digital terrain models at higher resolution

Bathymetry – partnership

- **MARIS – NL** (Coordinator)
- **NERC – NOC – UK**
- **GGSGC – NL**
- **GSI – IE**
- **SHOM – FR**
- **OGS – IT**
- **HCMR – GR**
- **DdH - NL**
- **HO - Norway – NO**
- **OGS – IT**
- **IHPT – PT**
- **NIOZ – NL**
- **IO-BAS – BG**
- **EMEPC – PT**

- **IFREMER – FR**
- **NERC – BODC / GEBCO - UK**
- **IEO – ES**
- **IHM - ES**
- **UNEP-GRID Arendal – NO**
- **CNR – ISMAR - IT**
- **BSH - DE**
- **MOW - BE**
- **HO - Denmark – DK**
- **IPMA – PT**
- **ICM-CSIC – ES**
- **OceanWise - UK**
- **HO Faroes – FO**
- **NPD – NO (only data provider)**

- Consortium expanded with new partners and associate partners, including GEBCO editor

EMODNet Bathymetry – Workplan

- Continue with and refine the **methodology and use of dedicated software packages**; this also includes involving regional groups of experts;
- New challenge of producing DTMs with an even **higher resolution**, wider coverage and more regional data providers;
- Improve and expand the functionality of the EMODnet **CDI Data Discovery and Access service** for handling data requests in an efficient way and also for machine-to-machine interaction;
- Extend the **hydrographic viewing service** for handling also high resolution coastal DTMs and develop further the facilities for uploading data sets and DTMs posted by external providers;
- Develop further the **Sextant data products catalogue service,** used for documenting composite DTMs with product metadata, in functionality and coverage and establish further integration with the Hydrographic viewer.

EMODNet Bathymetry – special challenges

- **North Sea**: Improving the coherence of the integrated DTM for the North Sea area by adoption of common reference depths and separation models. Adding CDI metadata where possible

- **Black Sea**: approach possible Russian, Romanian, Ukrainian and Turkish data holders for the Black Sea; plus analyse research cruises in the Black Sea as part of EU RTD programmes

- **Baltic Sea**:
  - Swedish Maritime Administration (SMA) coordinates the **Mona Lisa project** which is 50% co-funded by the EU with 11.2 million Euro as part of Trans-European Transport Network (TEN-T) programme. A large budget is dedicated to acquiring new multibeam surveys for major navigation routes in the Baltic Sea.
  - SMA is chairing the Baltic Sea Hydrographic Commission (BSHC), and also the Sea Bathymetry Database Working Group of BSHC (BSHC-BSBDWG). This group is working on a harmonised DTM for the Baltic Sea with a resolution of 500 * 500 meters => seeking synergy

- **Cooperation with GEBCO**, striving for uptake of EMODnet DTM as European coverage in GEBCO

- Further deploying facilities for direct uploading and DTM processing of survey data sets by potential data holders, such as harbour authorities, coastal managers, industry

www.emodnet-hydrography.eu