Harmonization of DTM production in EU distributed infrastructures

Eric Moussat, Ifremer, eric.moussat@ifremer.fr
Benoît Loubrieu, Ifremer, benoit.loubrieu@ifremer.fr
Thierry Schmitt, SHOM, thierry.schmitt@shom.fr

ABSTRACT

Bathymetric products result of measurements carried out by various organizations whose responsibilities and objectives differ significantly from one to another: oceanographic institutions, universities, hydrographic offices and private companies.
Collecting soundings by these organizations to make bathymetric products is time consuming and expensive. Many of their data sets are not indexed in public catalogues. Policies of data providers might restrict their access especially in cross border areas or require long, and not always successful, negotiations. Lack of common approaches (metadata and data content made available, geometry, vocabularies and format) to generate bathymetric products makes processing complex and sometimes impossible.

A general mechanism to create DTM (Digital Terrain Model) has been developed to provide bathymetric data from multiple data providers.
This has been done in the framwork of the European Emodnet hydrography, Geo-Seas and SeaDataNet (SDN) initiatives and distributed marine data infrastructures.

1. GENERAL REQUIREMENTS

Community of users	Scale/ Resolution	Horizontal datum and horizontal coordinates	Interpolation characteristics	Depth value	Special requests
Geology Sedimentology Morphology	50 to 1000 m	WGS84 projected coordinates	Smoothing should be limited	mean	Seamless sea-land
Oceanography Hydrodynamic Climate change	50 to 1000 m	WGS84 geographic coordinates	Smoothing and hole filling allowed	mean	Nested models
Ecology Habitat mapping Fisheries	1 to 100 m	WGS84 projected coordinates	Smoothing must be limited	mean	Geomorphology (slope, aspect, ...) and dependant physical variables
Engineering	Several meters	WGS84- no preference	Holes permitted Minimal residual		Availability of times series for comparison

USER NEEDS (from survey of end-users carried out by the Geo-Seas partners).

Systems of reference :
CRS (WGS 84)
Vertical datum (LAT),
Metadata :
SeaDataNet ISO 19115/19139 profile
Data content and format :
NetCDF CF transport format
Convergence with INSPIRE

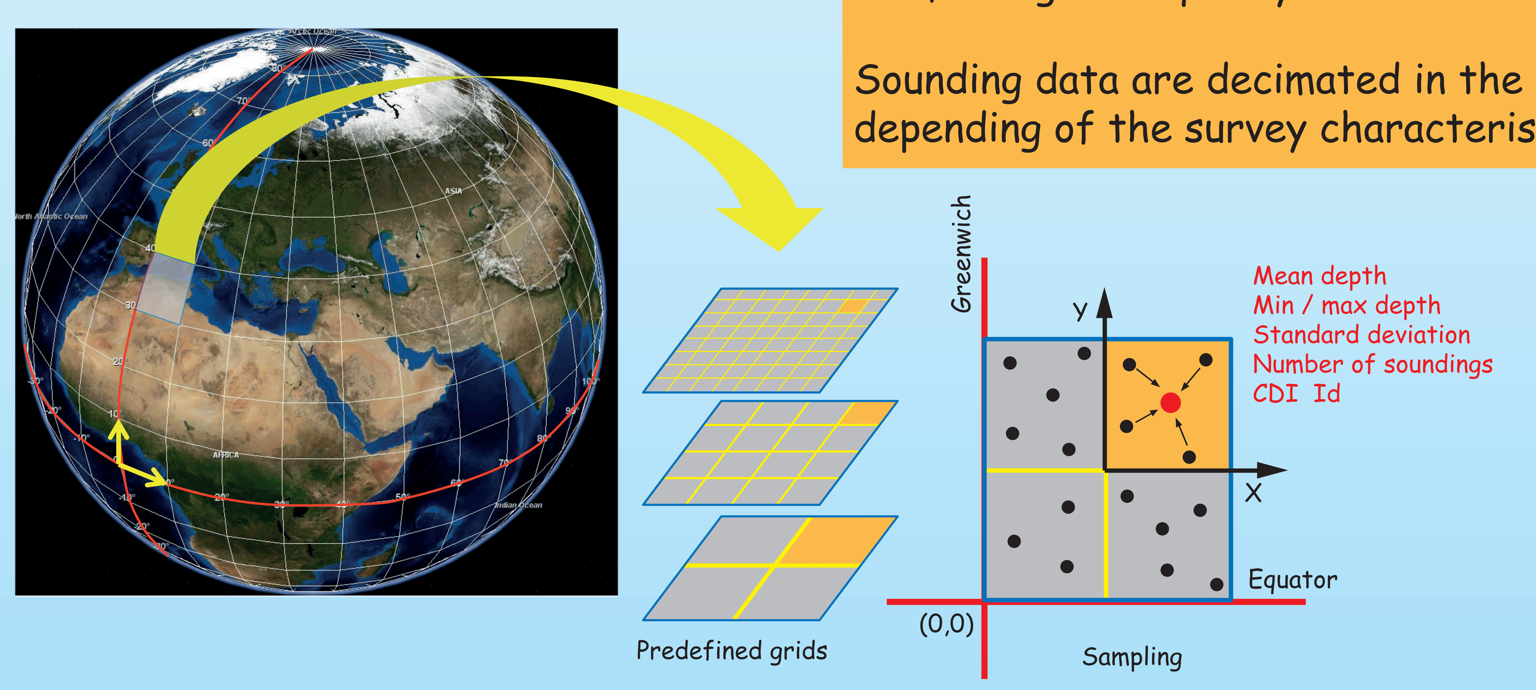
Characteristics	Hydrographic Office	Research institutes
Level of processing	- Validated data (correction and compliance to IHO orders) - Generally shoal biased	- Variable quality - Raw datasets to integrated
Availability	- Variable from free to access to the licence at a cost - Some HO are related to the defence sector - Generaly decimated - Convergence towards an unified format (S-100)	- Dictated by the nature of the data (restrictions related to research or ownership by commissioner or IP holder) - Generally voluminous - Multiple type of format

DATA PROVIDERS CONSTRAINTS (by the Geo-Seas partners).

2. SOURCE DATA SAMPLING

Predefined regular rectangular grids with common origin
Unique hierarchy of resolution
Use of SDN Common Data Index (CDI) to identify source datasets (DS)
Multi layer grids to transport information for DS aggregation, lineage and quality assessment

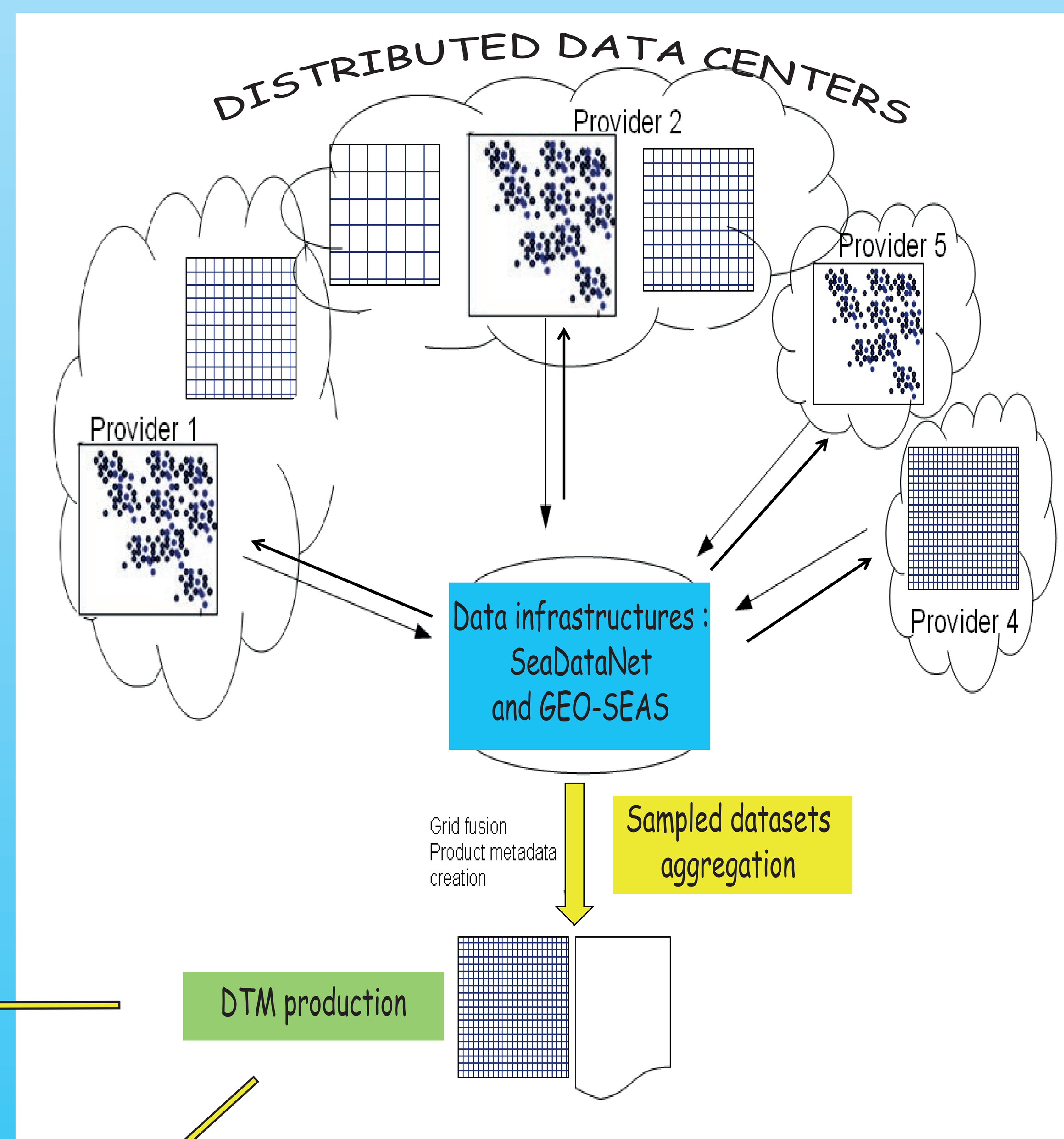
Sounding data are decimated in the most appropriate grid, depending of the survey characteristics



Sampling level	Mesh size
1	4
2	16
3	64
4 ...	.....

Hierarchy of resolution in fraction of minute of arc

3. AGGREGATION MECHANISM

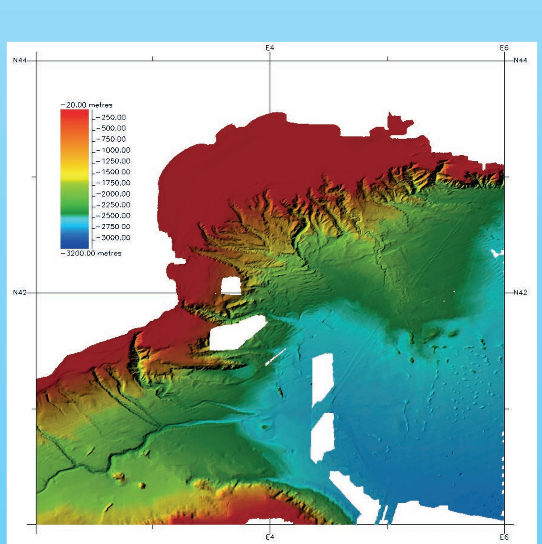


	Source 1	Source 2	Merged grid cell
Soundings number	N_1	N_2	$N = N_1 + N_2$
Average depth	$M_1 = \frac{\sum X_1}{N_1}$	$M_2 = \frac{\sum X_2}{N_2}$	$M = \frac{N_1.M_1 + N_2.M_2}{N_1 + N_2}$
Standard deviation	$\sigma_1^2 = \frac{\sum X_1^2}{N_1} - M_1^2$	$\sigma_2^2 = \frac{\sum X_2^2}{N_2} - M_2^2$	$\sigma^2 = \frac{\sigma_1^2.N_1 + M_1^2 + \sigma_2^2.N_2 + M_2^2}{N} - M^2$
Maximum depth	$\max(X_1)$	$\max(X_2)$	$\max(\max(X_1), \max(X_2))$
Minimum depth	$\min(X_1)$	$\min(X_2)$	$\min(\min(X_1), \min(X_2))$

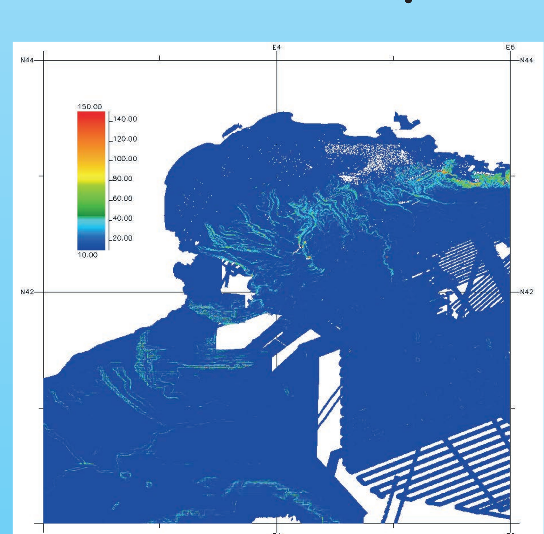
Data providers :
Mechanism easy to implement
Data distribution more flexible
Preservation of the data providers policies
Promotion of their datasets indexed in SDN/-Geo-Seas CDI catalogue

Data users :
Faster and simplified data access (depending on selected resolution)
Easier quality assessment and lineage control
Harmonized data content and format
Reusability
Access to metadata of source datasets using CDI Id

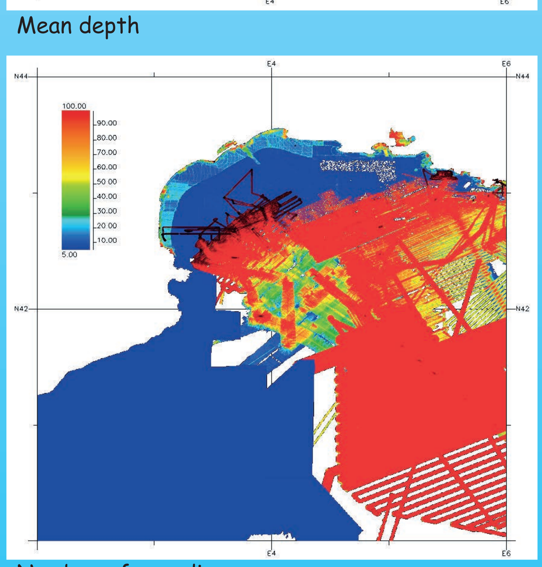
4. MULTI LAYER PRODUCT GRID (product)



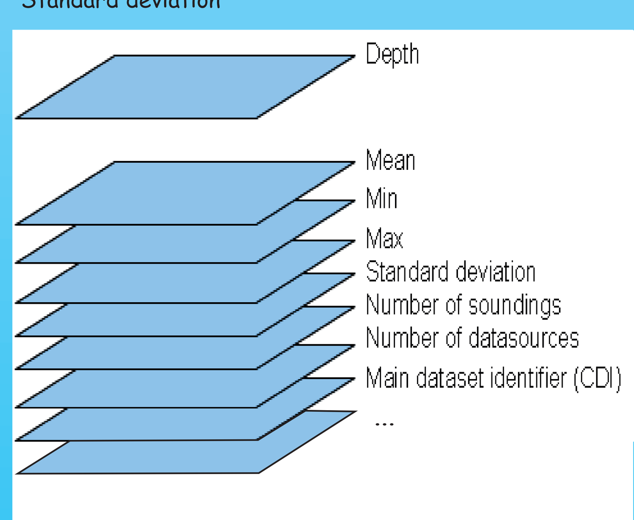
Mean depth



Standard deviation



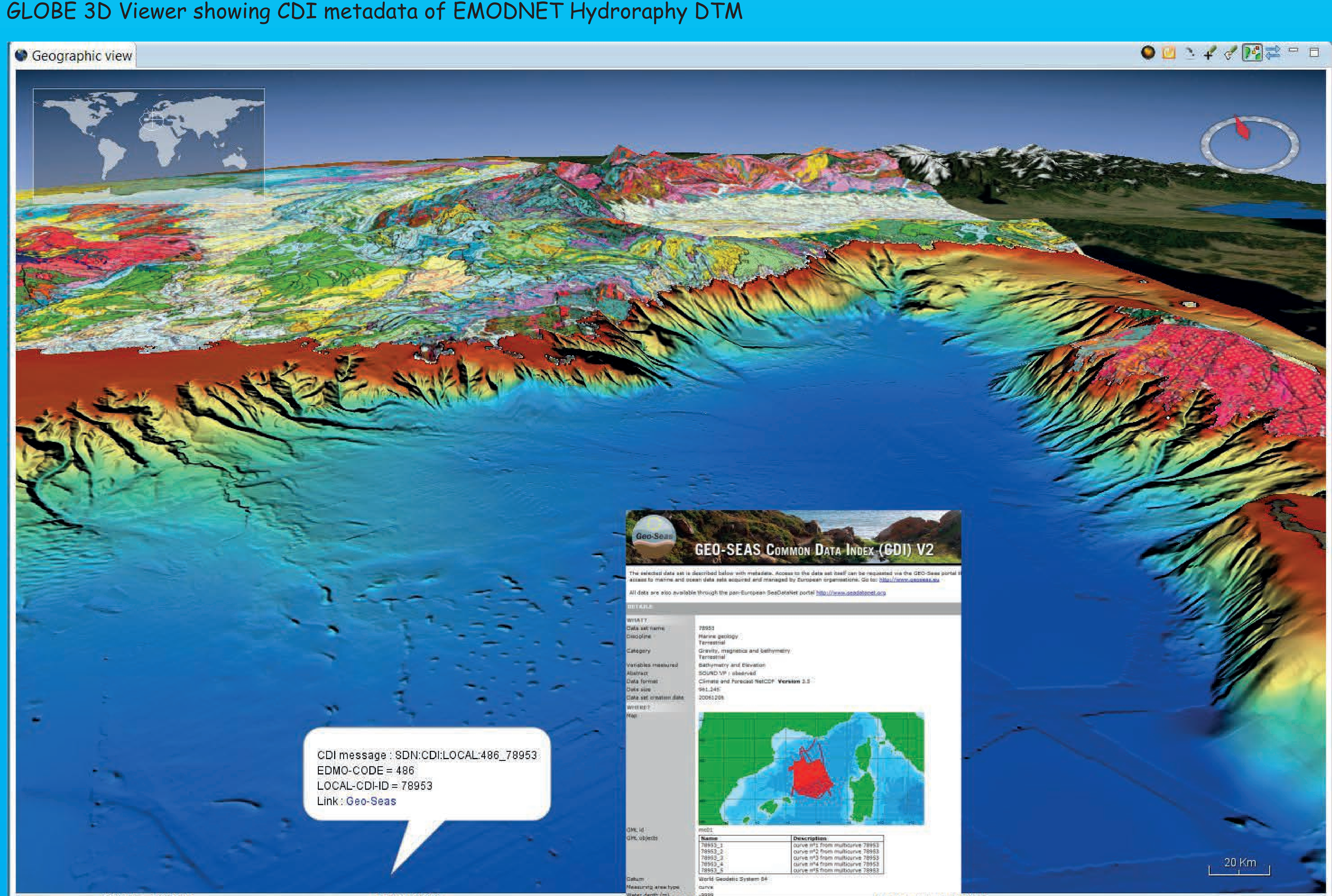
Number of soundings

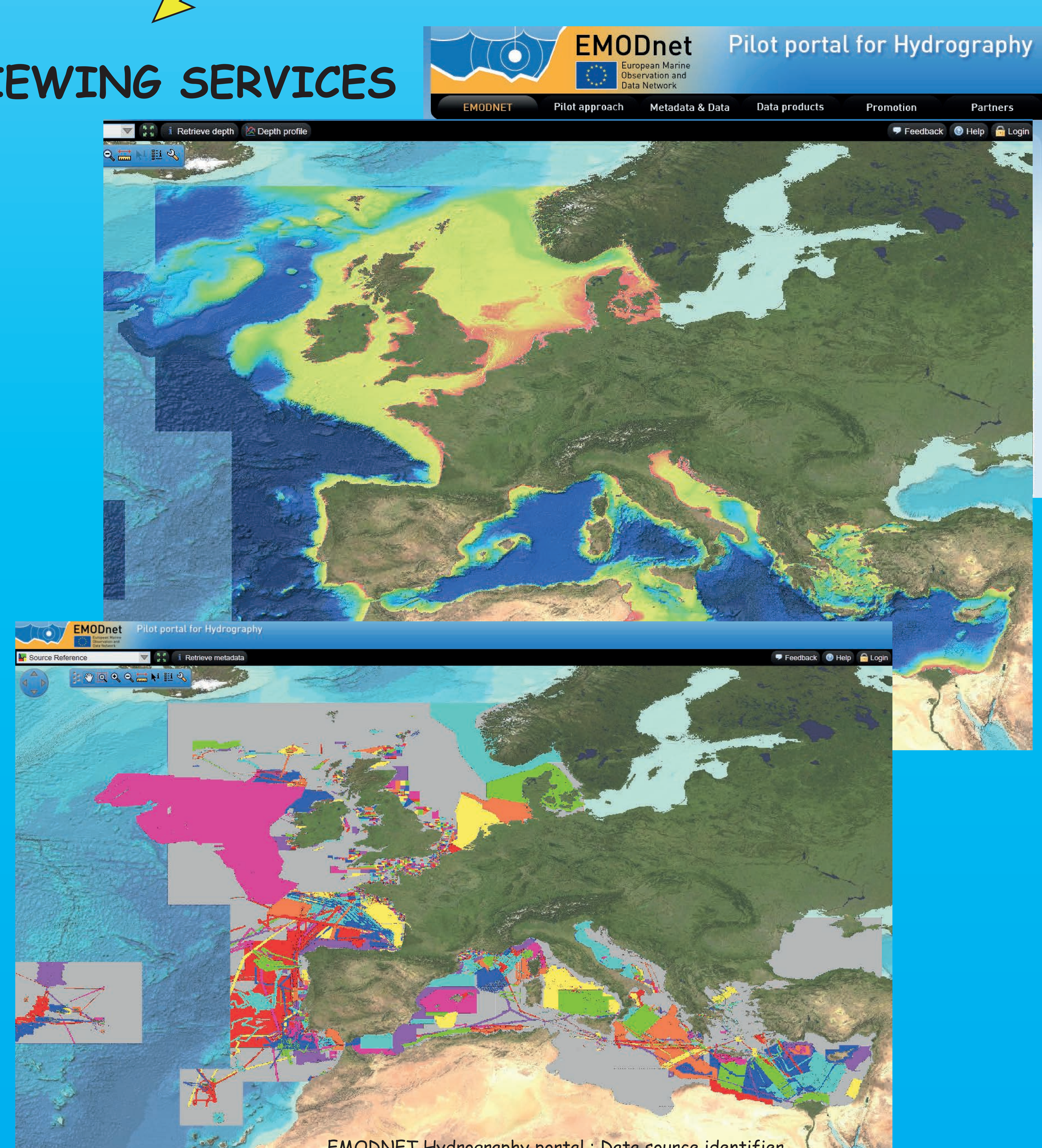


5. PRODUCT AND VIEWING SERVICES

New services can be offered such as 3D viewing using tools such as the Globe 3D viewer (Ifremer), a freeware adapted to the Geo-Seas purposes. Both the DTM products and the corresponding services are designed to help end-users to access bathymetric products, metadata and other qualitative attributes and to assess the quality of the source data sets and their fitness of use.

GLOBE 3D Viewer showing CDI metadata of EMODNET Hydrophy DTM





EMODNET Hydrography portal : Data source identifier

6. CONCLUSION

The success of the european projects using similar principles and procedure shows that the proposed mechanism to provide data has been well accepted by many partners as it preserves their interest while giving more visibility on their activities.
This mechanism allowed a decentralized cooperation for the production of large coverage synthesis, using decimated grid and leaving source datasets (at the highest resolution) held and managed by the data provider. This decentralization allowed also a closer interaction with local actors. Overall the mechanism contributed to create the EMODNET 15" DTM of the European Seas in a remarkable short time.

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

http://www.geo-seas.eu/

http://www.seadatanet.org/