EMODnet Thematic Lot n°0 – *Bathymetry – High Resolution Seabed Mapping (HRSM2)*

EASME/EMFF/2017/1.3.1.2/01/SI2.791269

Start date of the project: 20/12/2018 - (24 months)

EMODnet Phase III – 1st Annual Progress Report

Reporting Period: 20/12/2018 – 31/12/2019

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1. Executive summary

This report gives the progress in the 1st year of the **EMODnet Bathymetry - High Resolution Seabed Mapping contract (HRSM2)** which runs for 2 years from 20th December 2018. It is a follow-up of the earlier developments in EMODnet Hydrography, Seabed Mapping, Bathymetry and High Resolution Seabed Mapping projects which took place since June 2009 and that resulted in the portal: https://www.emodnet-bathymetry.eu.

EMODNet HRSM2 aims at a continuation of services, at an expansion of the collection gathered of bathymetry survey data sets, composite DTMs and high resolution DTMs, and at a refinement of the quality and precision of the overall EMODnet DTM of 1/16 minute * 1/16 minute, inter alia by optimizing the production methodology and associated tools next to filling gaps and less accurate data with new data, where possible, and further expanding the functionality of the portal for users, e.g. with additional and upgrading services for discovery, access, and visualization. In addition, updates will be produced for i) the existing best-estimate European digital coastlines for a range of vertical levels and ii) existing inventory of national legal baselines for European countries.

In the first year one plenary meeting was organized with all consortium members, including training sessions in HRSM2 tools and services. And two technical meetings took place dedicated to planning technical and methodological improvements.

A major upgrade has taken place of the CDI Data Discovery & Access service which gives overview and access to the gathered bathymetric surveys. As part of the EU SeaDataCloud project, the CDI service has been improved in functionality and performance by adopting the cloud and completely renewing the user interface and the data shopping experience.

The total number of CDI records decreased in the first quarter of the project from **27168 to 26223** records under influence of a review of CDI submissions provided and managed by Shom. Thereafter, the number of CDIs has made an increase again under influence of the data gathering activities by multiple data providers from **26223 to 26447** CDIs, while the number of Composite DTM entries has increased from **147 to 181**. Overall, the number of data providers stabilised at **51** organisations.

The generation of Regional DTMs will be undertaken by Regional Coordinators, who each are responsible for a quality assessment and selection of the data contributions and the compilation of the Regional DTM using the GLOBE software. This process will start end February 2020 and the new Regional DTMs are planned to be ready by July 2020, while in April 2020 a meeting is planned to monitor and discuss progress and experiences.

Following the Data Protection Regulation (EU) 2018/17725 and the ePrivacy Directive, activities were deployed to improve the compliance of the EMODnet Bathymetry website (https://www.emodnet-bathymetry.eu) and related services accordingly. Final review and acceptance by EU are awaited.

The EMODnet portal and services continue to be very popular among researchers and industry users and the statistics are great with circa **38.000 DTM tiles** downloaded by users from circa **2100 unique organisations.** Also the OGC web services (machine-to-machine) are very popular with more than **20 million WMS views.**

2. Introduction

This report gives the progress in the 1st year of the **EMODnet Bathymetry - High Resolution Seabed Mapping contract (HRSM2)** which runs for 2 years from 20th December 2018. It is a follow-up of the earlier developments in EMODnet Hydrography, Seabed Mapping, Bathymetry and High Resolution Seabed Mapping projects which took place since June 2009 and that resulted in the portal: https://www.emodnet-bathymetry.eu.

3. Highlights of the reporting period

- The contract was awarded by EASME to the EMODnet Bathymetry - High Resolution Seabed Mapping (HRSM2) Consortium and signed by both parties on 18/12/2018, with a contractual start on the 20/12/2018.
- The Consortium Agreement between Shom as coordinator and all full partners of the EMODnet High Resolution Seabed Mapping (HRSM) Consortium has been agreed and signed by all parties early April 2019. Also all bilateral Subcontracts between Shom and subcontractors in the Consortium have been agreed and signed.
- The EMODnet Bathymetry portal has been upgraded to comply with the new GDPR Directive. The domain has been upgraded to https: https://www.emodnet-bathymetry.eu.
- At the kick-off meeting a training was given to all data providers, followed by sorting and circulating a set of current guidelines and manuals concerning how to pre-process survey data sets and composite DTMs using the GLOBE software.
- The data providers have made great progress with adopting the amended methodology for populating the upgraded CDI service and with producing and populating their expected contribution (new metadata and formatted datasets). The total number of CDI records firstly decreased from **27.168 to 26.223** records, due to a change of policy at Shom. Thereafter, the number of CDIs increased again by multiple data providers from **26.223 to 26.447** CDIs, while the number of Composite DTM entries has increased from **147 to 181**. Overall, the number of data providers stabilised at **51** organisations.
- Partner EOMAP generated composite DTMs from Sentinel-2 satellite data for coastal and near shore zones, covering Cyprus, Northern Denmark, Croatia and Southern Sicily and Puglia, Italy.
- The EMODnet portal and services continue to be very popular among researchers and industry users and the statistics are great. In the reporting period circa **38.000 DTM tiles** were downloaded in circa by circa **4.000 unique users** from circa **2100 unique organisations** and more than **115 countries** during more than **11.000 transactions.** Also the OGC web services (machine-to-machine) are very popular with more than **20 million WMS views** in the reporting period by circa **170.000 visitors**.
- Using Google Scholar more than **150 references** to EMODnet Bathymetry can be found for accepted papers and edited books during the reporting period.

4. Summary of the work done

The EMODnet HRSM2 project is a seamless continuation of the earlier EMODnet High Resolution Seabed Mapping (HRSM) project with the same consortium and an almost comparable work plan, whereby the focus is on improving and optimizing existing services and products and expanding data collections. This seamless continuation meant that the consortium could keep their earlier momentum and that not too much extra education activities were needed. Consequently, in the first year one plenary meeting was organized with all consortium members, including training to give all hands-on instructions with the EMODnet HRSM2 methodology, tools and services. And two technical meetings took place dedicated to planning and monitoring progress of activities for improving the methodology, and software tools for processing bathymetric survey data sets and Composite DTM data sets from data providers into Regional DTMs. Existing Guidelines were reviewed and the most current ones were sorted and made available to all project partners via a dedicated folder in the Extranet. Moreover, progress is made with upgrading the GLOBE software for pre-processing and pre-gridding of input data sets and generation of the Regional DTMs. Adaptations are made for supporting the NetCDF V4 data format as an international standard, which also will facilitate data providers and regional coordinators to import and process much larger data files efficiently instead of having to split these in smaller parts. In the HRSM project not only regional coordinators but also data providers are advised to use GLOBE for preparing their data input. This way there is a harmonized process in all steps from data input to Regional DTMs.

The overall methodology is a continuation from the earlier approach in HRSM1, although refinements are made, for instance in the GLOBE tool, and interpolation techniques. Moreover, it is planned that for producing the 3 regional DTMs for the Mediterranean Sea use will be made of the Collaborative Virtual Environment (CVE) for which IFREMER had developed and tested a prototype in the previous project and for which some extra developments are undertaken.

The generation of Regional DTMs is again divided over regional sea basin subgroups, each with a Regional Coordinator and a number of contributing data providers. Each Regional Coordinator will be responsible for a quality assessment and selection of the data contributions and the compilation of the Regional DTM using the GLOBE software. This process will start end February 2020 when all data providers have finalized their data gathering and population activities for the CDI and CPRD catalogues and will have undertaken pre-processing and gridding of their data sets for delivery as DTMs to the regional coordinators. The regional DTMs are planned to be ready by end July 2020, after which the central integrator (GGSgc) will start it's work of validating and merging all regional DTMs into the new release of the EMODnet DTM. The step from Regional DTM to overall EMODnet DTM is not only an integration but also a final QA – QC to achieve a high-quality bathymetry product that can be made public by the Bathymetry Viewing service at the portal for viewing and for downloading.

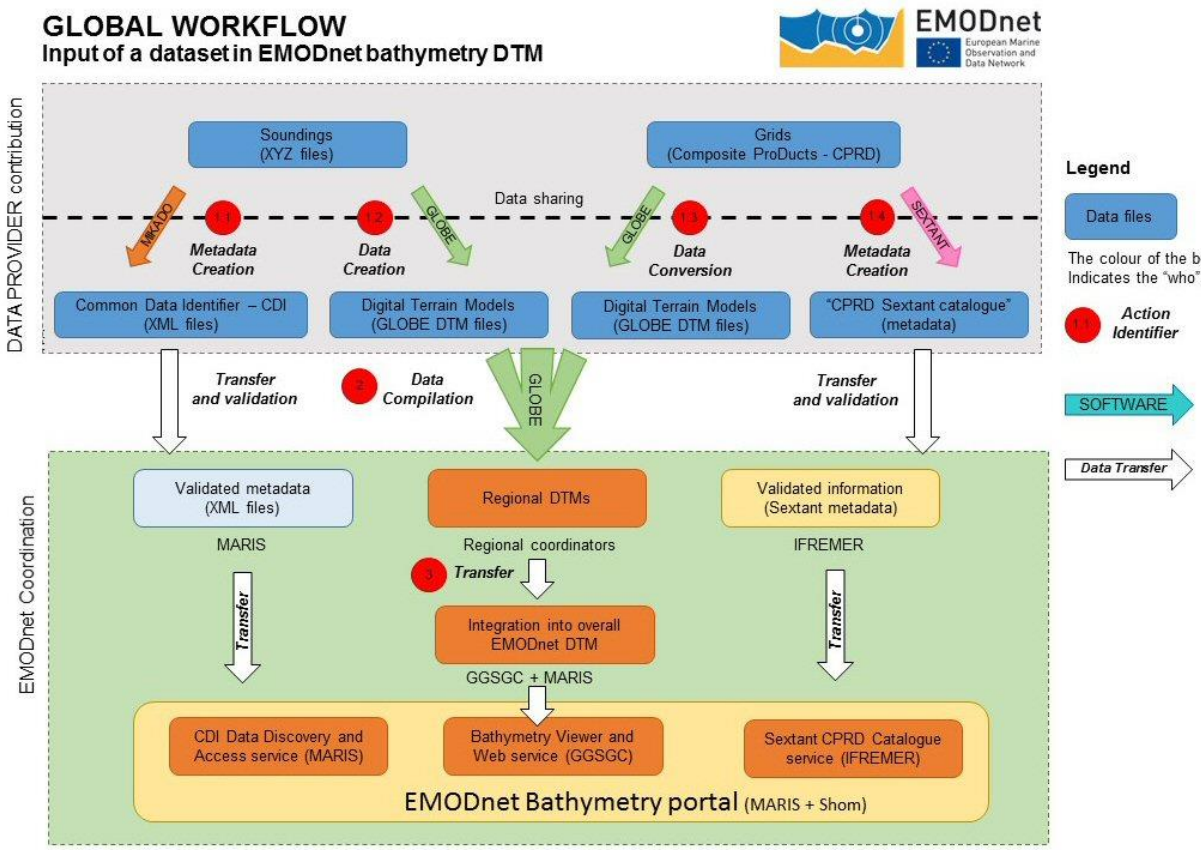


Image: Workflow for EMODnet HRSM2

Awaiting the integration task, GGSgc has made great progress in the meantime with developing a worldwide elevation base layer in the EMODnet ATLAS style. All EMODnet portals will benefit from having such a common worldwide base layer in a common EMODnet look & feel. Moreover, it will further promote the EMODnet brand as it can also be shared with external users. During preparing the EMODnet worldwide elevation base layer, GGSgc had to overcome a number of challenges such as 'big data volume' and several applied solutions will also be useful in the production of the new EMODnet DTM for European seas. The release of the EMODnet worldwide elevation base layer is expected by end February 2020.

A major upgrade has taken place of the CDI Data Discovery & Access service which gives overview and access to the gathered bathymetric surveys. As part of the EU SeaDataCloud project, the CDI service has been improved in functionality and performance by adopting the cloud and completely renewing the user interface and the data shopping experience. Following the upgrade of the SeaDataNet CDI user interface, also efforts were undertaken for upgrading the CDI service user interface of EMODnet Bathymetry. And upgrading took place of the CDI OGC WMS – WFS services, which are integrated in the Bathymetry Viewing and Download service. The upgrading demanded also replacing the existing CDI

Download Manager (DM) software component at several data providers with the new CDI Replication Manager (RM) component. The planning is that the deployment of the RMs at the relevant data providers of EMODnet Bathymetry will be completed in January 2020 as it directly influences progress of the data population.

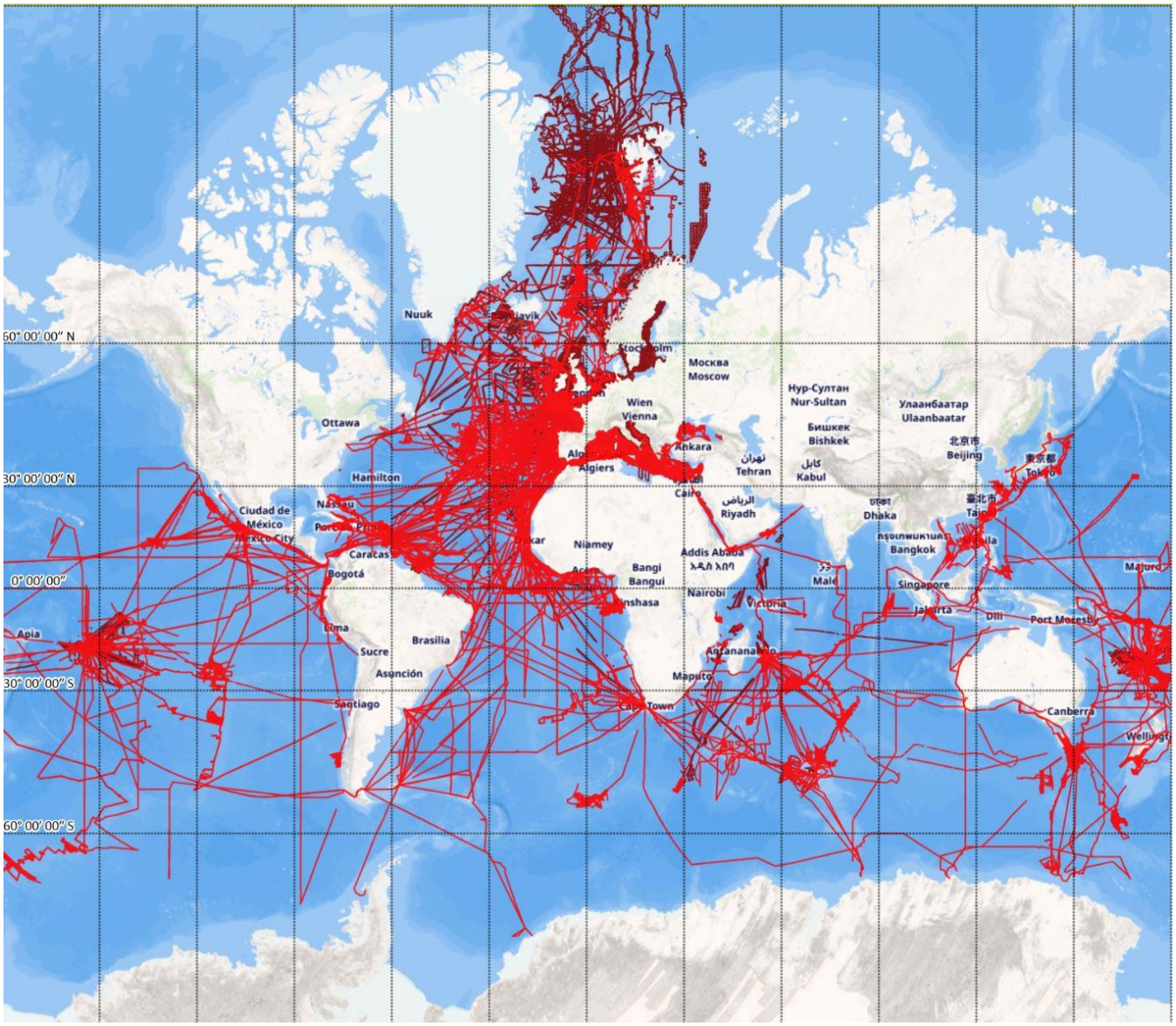


Image: Map of all entries in the CDI catalogue service

The total number of CDI records decreased in the first quarter of the project from **27168 to 26223** records under influence of a review of CDI submissions provided and managed by Shom. Thereafter, the number of CDIs has made an increase again under influence of the data gathering activities by multiple data providers from **26223 to 26447** CDIs, while the number of Composite DTM entries has increased from **147 to 181**. The latter also include Satellite Derived Bathymetry (SDB) DTMs for five sites, covering

Cyprus, Northern Denmark, Croatia and Southern Sicily and Puglia, Italy. A total of 8,759 sq km was mapped by partner EOMAP using Sentinel – 2 data covering shallow waters. Overall, the number of data providers has stabilised at **51** organisations.

The new EMODnet DTM will have again a common resolution of 1/16 minute * 1/16 minute overall. This will be published at the portal in the Bathymetry Viewing and Downloading service as one layer and users can download tiles from this layer in a range of formats. In addition, like in the current situation, additional higher resolution DTMs will be produced as hotspots and for the near coastal areas and coastal zones, where possible. These HR-DTMs with different resolutions will be published as another layer and users will be able to download each individual DTM at its highest resolution. Also, users viewing the common DTM layer will be able to drill down to higher resolutions, where available, in a dynamic way, without having to activate the high-resolution layer.

Following the GDPR Directive, activities were undertaken together with the EMODnet Secretariate and EU services to improve the GDPR compliance of the EMODnet Bathymetry website (https://www.emodnet-bathymetry.eu) and related services. For instance, https:// certificates were acquired and implemented for all domains, a privacy policy and cookies statement were prepared and published, and several other items were resolved. Final review and acceptance by EU are awaited.

The existing coastline and legal baselines products are being updated. First of all, partner Deltares has identified and analysed the difficulties that were earlier experienced. And they have worked on improving the digital coastline method estimated from satellite views. While all partners have been requested to look for any updates and new entries for the existing inventory of legal baselines.

Finally, The CDI scheme had been made INSPIRE compliant again, which required amendments by the SeaDataNet technical task group and the INSPIRE team at EU-JRC. The new INSPIRE compliance can be validated using the latest version of the new ETF validator of INSPIRE: http://inspire.ec.europa.eu/validator/. More details on this achievement are given in the separate Report on International Interoperability.

The EMODnet portal and services continue to be very popular among researchers and industry users and the statistics are great. In the reporting period circa **38.000 DTM tiles** were downloaded in circa by circa **4.000 unique users** from circa **2100 unique organisations** and more than **115 countries** during more than **11.000 transactions.** Also the OGC web services (machine-to-machine) are very popular with more than **20 million WMS views** in the reporting period by circa **170.000 visitors**. More than **600** of these user organisations are companies, while more than **300** are research institutes and more than **750** are universities.

Also there are many feedbacks and questions received through the Helpdesk which all demonstrate a great interest and appreciation by users from research and industry sectors. There is also international interest and cooperation.

More details about the project progress per work package will be given in Chapter 7.

5. Challenges encountered during the reporting period

A major challenge has been the uptake of the upgraded CDI service and its new methodology for populating the CDI service by data providers. For multiple EMODnet Bathymetry data providers it includes deploying the new Replication Manager (RM) software, while all data providers have to adapt to the new CDI Import Manager service steps which give each data provider more self-control for submitting and checking updated and new CDI entries.

The challenge was overcome by informing the data providers about the CDI service upgrading development, while also several joined the Training Workshops in summer 2019 which were organised and funded by the EU SeaDataCloud project for transfer and hands-on training with the new methodologies and associated software and services. This was followed by releasing the new RM software and sending new manuals and instructions to all data providers. As follow-up, bilateral guidance and support was given to each data provider for deploying software, where applicable, testing it's functioning, and adopting the new approach to population of the CDI service. This was an intensive process between the data providers and MARIS as cdi-support helpdesk and is still not fully completed, but very good progress is made whereby the upgraded CDI services function as planned. The full deployment at the EMODnet Bathymetry partners will be completed by end January 2020, in time for finalising the HRSM2 CDI population by end February 2020.

6. Allocation of project resources

The following table gives an indication of the efforts in % of the total project efforts for the various work packages in the first year:

- WP0: Project Management
- WP1: Bathymetric data collection and metadata compilation for all maritime basins
- WP2: QC/QA, data processing and producing Digital Terrain Models for the basins
- WP3: Integration and inclusion of the DTM's into the portal
- WP4: Technical Development & Operation of portal, tools and services
- WP5: Coastlines, legal baselines and vertical reference levels
- WP6: Helpdesk, cooperation and outreach

Partner	WP0	WP1	WP2	WP3	WP4	WP5	WP6	TOTAL %
SHOM	1.00	0.80	0.60	0.00	0.20	0.10	0.50	**3.20**
MARIS	0.40	0.60	0.10	0.00	0.60	0.00	0.30	**2.00**
IFREMER	0.00	0.30	1.00	0.00	2.00	0.00	0.10	**3.40**
NERC-NOC	0.00	0.15	0.40	0.00	0.00	0.00	0.00	**0.55**
NERC-BODC	0.00	0.18	0.05	0.00	0.00	0.00	0.00	**0.23**
NERC-BGS	0.00	0.19	0.05	0.00	0.00	0.00	0.00	**0.24**
CNR-ISMAR	0.00	1.00	0.60	0.00	0.00	0.00	0.20	**1.80**
CNR-IAMC	0.00	0.80	0.05	0.00	0.00	0.00	0.00	**0.85**
CNR-IGAG	0.00	0.70	0.05	0.00	0.00	0.00	0.00	**0.75**
OGS	0.00	0.80	0.05	0.00	0.00	0.00	0.00	**0.85**
IEO	0.00	1.90	0.10	0.00	0.00	0.00	0.00	**2.00**
GSI	0.00	0.90	0.10	0.00	0.00	0.00	0.00	**1.00**
IHPT	0.00	1.80	0.10	0.00	0.00	0.00	0.00	**1.90**
IPMA	0.00	1.80	0.40	0.00	0.00	0.00	0.00	**2.20**
HCMR	0.00	1.90	0.40	0.00	0.00	0.00	0.00	**2.30**
IO-BAS	0.00	1.00	0.05	0.00	0.00	0.00	0.00	**1.05**

Partner	WP0	WP1	WP2	WP3	WP4	WP5	WP6	TOTAL %
BSH	0.00	1.00	0.50	0.00	0.00	0.00	0.00	**1.50**
GRID	0.00	1.00	0.40	0.00	0.00	0.00	0.00	**1.40**
MDK	0.00	0.90	0.15	0.00	0.00	0.00	0.00	**1.05**
GGSGC	0.00	0.00	0.20	0.40	0.60	0.10	0.20	**1.50**
OceanWise	0.00	0.50	0.10	0.00	0.00	0.00	0.00	**0.60**
CSIC	0.00	2.00	0.10	0.00	0.00	0.00	0.00	**2.10**
NHS	0.00	0.40	0.00	0.00	0.00	0.00	0.00	**0.40**
NIOZ	0.00	0.20	0.10	0.00	0.00	0.00	0.00	**0.30**
SMA	0.00	0.60	0.50	0.00	0.00	0.00	0.00	**1.10**
IIM	0.00	1.20	0.10	0.00	0.00	0.00	0.00	**1.30**
MAL	0.00	0.80	0.10	0.00	0.00	0.00	0.00	**0.90**
MARUM	0.00	1.00	0.00	0.00	0.00	0.00	0.00	**1.00**
DDNI	0.00	0.40	0.10	0.00	0.00	0.00	0.00	**0.50**
GIS	0.00	0.80	0.10	0.00	0.00	0.00	0.00	**0.90**
EOMAP	0.00	1.00	0.20	0.00	0.00	0.00	0.20	**1.40**
SU	0.00	0.25	0.40	0.00	0.00	0.00	0.00	**0.65**
Deltares	0.00	0.00	0.00	0.00	0.21	1.00	0.00	**1.21**
RNLN	0.00	0.35	0.10	0.00	0.00	0.00	0.00	**0.45**
Jardfeingi	0.00	0.05	0.00	0.00	0.00	0.00	0.00	**0.05**
GeoEcoMar	0.00	1.00	0.10	0.00	0.00	0.00	0.00	**1.10**
CORONIS	0.00	0.00	0.00	0.00	1.00	0.00	0.20	**1.20**
MR	0.00	0.20	0.00	0.00	0.00	0.00	0.00	**0.20**

Partner	WP0	WP1	WP2	WP3	WP4	WP5	WP6	TOTAL %
UoM	0.00	0.10	0.00	0.00	0.00	0.00	0.00	**0.10**
CONISMA	0.00	0.70	0.10	0.00	0.00	0.00	0.00	**0.80**
NIMRD	0.00	0.40	0.10	0.00	0.00	0.00	0.00	**0.50**
HHI	0.00	1.80	0.10	0.00	0.00	0.00	0.00	**1.90**
IGME	0.00	1.00	0.10	0.00	0.00	0.00	0.00	**1.10**
IOLR	0.00	0.40	0.10	0.00	0.00	0.00	0.00	**0.50**
GST	0.00	0.40	0.10	0.00	0.00	0.00	0.00	**0.50**
TOTALS PER WP (%)	**1.40**	**33.27**	**7.95**	**0.40**	**4.61**	**1.20**	**1.70**	**50.53**

7. Work package updates

WP0 – Project Management

The EMODnet Bathymetry – High Resolution Seabed Mapping project, internally known as HRSM2, is successor to the EMODnet High Resolution Seabed Mapping Bathymetry project, and has been awarded by EASME on 22 November 2018 to the consortium, led by Shom. The contract was signed by both parties on the 18th December 2018 after arranging requested evidences, with a start on the 20th of December 2018. A consortium agreement (for full partners) and subcontractor agreements (for subcontractors) were drafted, introduced and following feedback amended. The Consortium Agreement has been finalized and signed by all partners in the Consortium in the 2nd project quarter; this also concerns the subcontracts which have been agreed and signed by all subcontractors. The Technical Core Group, composed of Coordinators and Work package leaders, have met 5 April 2019 in Paris – France, hosted by Shom, to prepare the project kick-off meeting and to discuss updating, where needed, of the methodology, technology and production processes as used in the predecessor EMODnet HRSM project. The work plan has the same composition as the previous contract as it is a continuation. However content wise there are some differences as the new activities will build upon the previous results and make further progress, including further innovations.

Concise minutes and action list of the meeting have been prepared and included in the extranet for sharing with all project members. The HRSM2 kick-off meeting including all consortium members took place 11-12 June 2019, in Brest, France, hosted by Shom. All the partners were invited in order to discuss further the implementation of the future update of data sources, the generation of the new EMODnet Digital Terrain Model (DTM) and other targeted products and services. Presentations were given by Coordinators, WP leaders, and specific experts to introduce and discuss the workplan and expected actions. Also, instructions were given relevant for implementation of the project methodology for generating a new release of the DTM took place, highlighting and giving guidance concerning use of the preferred software tools (Mikado, Sextant, Globe). All presentations have been included in the extranet together with minutes and list of actions. The minutes give a planning of activities, deadlines, and targeted results of the two-year project. A technical sub group met 29 November 2019 in Brest – France, hosted by IFREMER, to discuss progress on upgrading the Globe software, reviewing the overall planning, and discussing organisation of a meeting with core partners and regional coordinators in April 2020 to monitor project progress and in particular, finetune the activities for generating updated regional DTMs, applying the upgraded Globe software and its new features. Minutes were made and included in the extranet about which all consortium members were informed. The coordinatior (Shom) and technical coordinator (MARIS) have participated in the EMODnet Steering Committee meeting on 2 – 3 September 2019, presenting the project progress and contributing to discussions. They also participated and contributed to the EMODnet Technical Working Group on 3 – 4 September 2019. Both meetings took place in Ghent – Belgium. Shom and MARIS together prepared 4 quarterly progress reports of which the

first 3 have been accepted by the EU (EASME and DG MARE), while the last one is under review as it concerns the 4th quarter of 2019. Shom and MARIS have also together drafted this 1st Annual Report and the separate report on Interoperability and International Cooperation.

WP0 concerns Task 10 [1]- Project management. It also contributes to Task 9 - Monitoring of performance. For the latter also activities in WP4 and WP6 are relevant. Overall, both tasks have progressed well as described in the progress of WP0, WP4 and WP6.

WP1 – Bathymetric data collection and metadata compilation for all maritime basins

At the project kick-off meeting, all data providers have been informed about the proven approach and software tools and services that are used in EMODnet HRSM2 for gathering source data sets such as bathymetric survey data sets and composite DTMs and populating these into the two major catalogues: the CDI Data Discovery and Access service for describing survey data sets and the Sextant data products catalogue service for describing composite DTMs. Where needed, data providers were encouraged to familiarize themselves again with the software tools and services and to start the process of preparing their datasets and related metadata entries for the CDI and Sextant catalogue services. As part of the proposal submission an inventory was prepared with indication of new data sets that would be populated by the data providers in the consortium. In practice, this inventory is used to progress the data gathering and population. Also, data providers have been asked to review their existing entries in both catalogues for improving and completing the Quality Index information. Next to populating the two catalogues, data providers have also been instructed to pre-process and grid their data input using the Globe software and following the EMODnet Bathymetry method and grid. This way their data input is made fit for the Regional Coordinators and their planned WP2 activities for updating and upgrading the existing regional DTMs with new and improved data contributions. A review took place of the various guidelines that have been produced and made available over the years for giving guidance on the methodologies for populating the catalogues and pre-processing the data sources. This has resulted in a set of up-to-date guidelines in a dedicated folder on the extranet. Where needed, support was given by MARIS for the CDI population and by IFREMER for the Sextant population and consecutive pre-processing with the Globe software. During the population, there has been a major upgrading of the CDI service as part of the EU SeaDataCloud project. This had some implications for data providers with a direct connection, because they have been asked to replace the existing local Download Manager component with the new Replication Manager component. As part of this migration to the upgraded CDI service, data providers have been informed by the CDI support desk at MARIS and also, they have

[1] Task 10 refers to an extra task defined in the technical propoposition (Annex II) associated to the technical tender (Annex I) of the present contract

been invited to participate in the SeaDataCloud Training Workshop which was held in June 2019 in Ostend – Belgium. This was followed up by several data providers. However, the migration has delayed somewhat the progress of CDI population and therefore, the original deadline of finalising CDI and Sextant population has been extended from end January 2020 to end February 2020. As can be seen in the chapter 11 on indicators, progress in the first year has been good and several data providers have completed their assignment while others are underway. The total number of CDIs has initially decreased from **27168 to 26223** records, largely caused by a review of CDI submissions provided and managed by Shom. In addition, as part of the CDI upgrading process, existing CDI data sets have been validated for their formats which has led to some data sets that needed correction. This contributed to the CDI decrease. However, an increasing number of new and updated CDI entries has been populated in the 4th quarter of 2019. The total number of CDIs at the end of the first reporting year is 26447 CDI entries, while the number of Composite DTM entries from 147 to 181. The latter also include Satellite Derived Bathymetry (SDB) DTMs for five sites, covering Cyprus, Northern Denmark, Croatia and Southern Sicily and Puglia, Italy, which have been generated by partner EOMAP. A total of 8,759 sq km was mapped using Sentinel – 2 data covering shallow waters down to approx. 10-13m (Denmark) and 17-20m (Mediterranean Sea areas). In the following, this process for deriving bathymetry from satellite images is further explained.

EOMAP made use of optical satellite data from European Space Agency's (ESA) Sentinel-2 sensors. Those satellites have a free & open data policy and have a revisit time of 5 days average. Sentinel-2 has three bands in the visible spectral range which are recorded in a spatial resolution of 10m, and a further high-resolution band in the near infrared region. Out of all the archived satellite recordings, EOMAP selected datasets with the following priorities

- cloud and haze free conditions,
- water clarity as good as possible,
- little or no impact on sunglint (mirror-like reflectance of the water surface),
- little or no impact of waves and wave-breaking.

In total 274 Sentinel-2 records were processed by EOMAP to derive bathymetric data for shallow waters following its own physics-based inversion methods. Quantitative information of the shallow water bathymetry can be derived using the reflected sunlight energy in different wavelength of the visible and near infrared region. The core algorithm of this retrieval is embedded in a processing workflow (EWS) which includes the following steps:

(a) correct the satellite data for effects of **adjacency** of the land (Kisilev et al. 2015[2]);

[2] Kiselev, V., Bulgarelli, B. and Heege, T., 2015. Sensor independent adjacency correction algorithm for coastal and inland water systems. Remote Sensing of Environment, 157: 85-95. ISSN 0034-4257, http://dx.doi.org/10.1016/j.rse.2014.07.025.

(b) correct for **atmospheric** and sea surface impacts using a coupled retrieval of in water optical properties (IOP's) and atmosphere (Heege et al. 2014[3]);
(c) minimize further effects of **sunglint** of the water surface;
(d) retrieve spatial resolved information on spectral **absorption** and **scattering** (in physical units) of water constituents in the water column;
(e) retrieve spatially resolved information on **water depth** and **seafloor albedo**.

Following this the water depth will be corrected for further effects:

(f) water level heights using predicted **tidal information** of nearby stations were used to refer to Mean Sea Level Datum (MSL);
(g) finally, a **QA/QC** procedure was applied, combining uncertainty products from the error propagation and manual checks for biased pixels (e.g. ships, deep waters, cloud shadow). Furthermore, extreme outliers were removed and data were checked for all logical inconsistencies;
(h) The final step included the creation of the EMODnet specific **delivery format** using the Sextant catalogue for metadata and Globe software to generate the 1/32 and 1/64 minute DTMs.

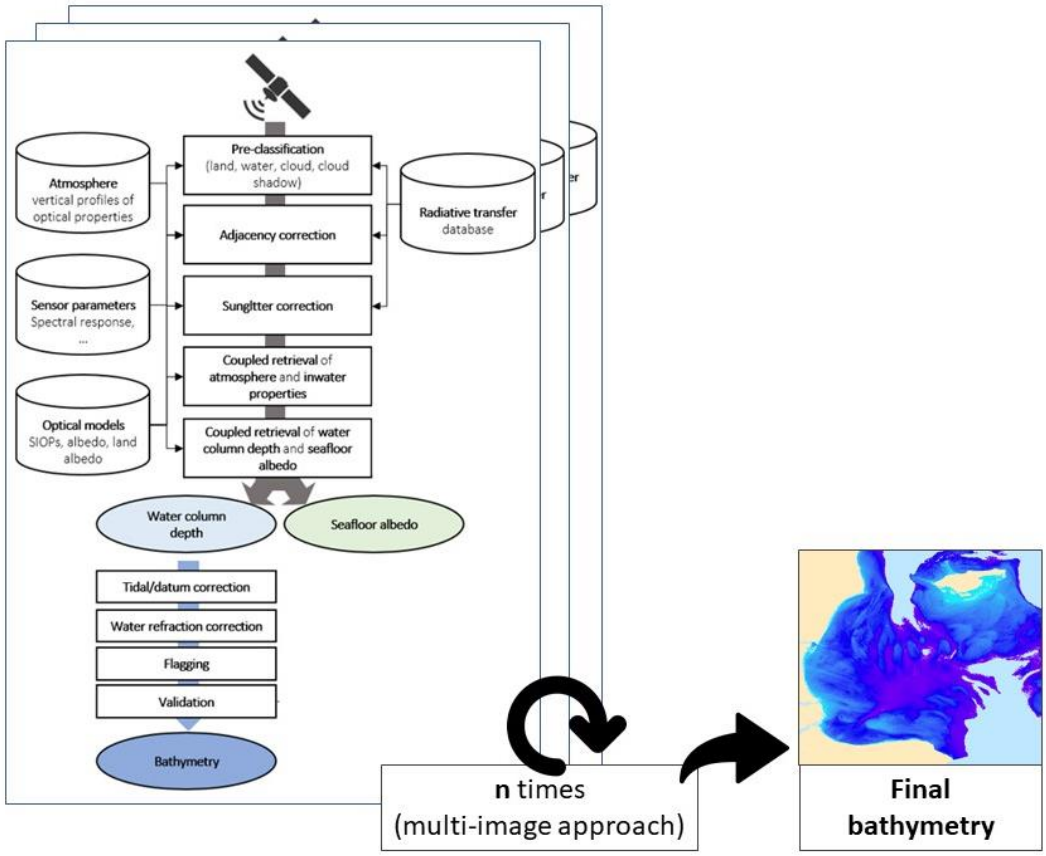


Image: Schema of EOMAP's workflow for creating Satellite Derived bathymetry using optical satellite image data.

[3] Heege, T., Kiselev, V., Wettle, M, Hung, N.N. (2014): Operational multi-sensor monitoring of turbidity for the entire Mekong Delta, International Journal of Remote Sensing, Vol. 35, Issue 8, 2014, p. 2910-2926

The applied method and its workflow are described in more detail in scientific articles and publications and is known as Modular Inversion Program (MIP, Cerdeira Estrada et al. 2012[4], Siermann et al. 2014[5], Heege et al. 2014[6]). It allows mapping bathymetry and benthic habitats up to approx. 1 to 1.2 times Secchi Disk depth at time of satellite image recording. The current version includes further enhanced cutting-edge processes with improved corrections of atmospheric, adjacency and sunglitter impacts. The system can process also multiple satellite records where available, taking advantage of a patented approach (US Patent 2017[7]) to reduce the uncertainties and indeterminacies of the various environmental variables through simultaneous retrievals. For all sites EOMAP has applied this patented multiple image processing to result in cloud-gap free bathymetric surfaces and lowest vertical uncertainties.

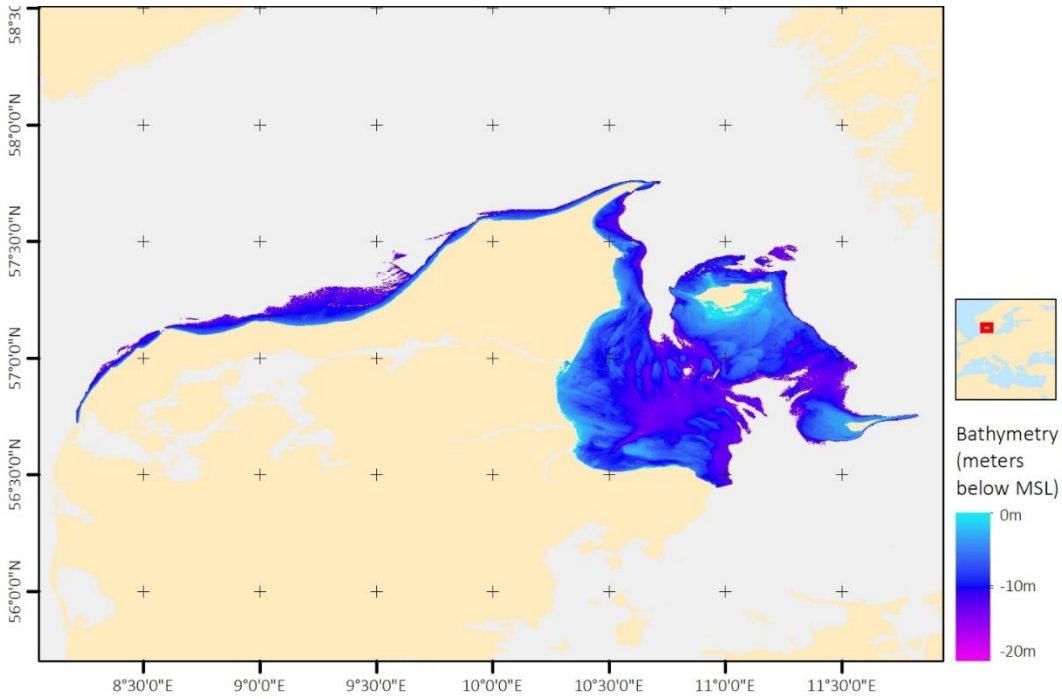


Image: Satellite-Derived Bathymetry results for Northern Denmark

[4] Cerdeira-Estrada S., Heege, T., Kolb M., Ohlendorf S., Uribe A., Müller A., Garza R., Ressl R., Aguirre R., Marino I., Silva R., Martell, R. (2012): Benthic habitat and bathymetrry mapping of shallow waters in Puerto Morelos reefs using remote sensing with a physics based data processing, Proc. IGARSS, p. 1-4

[5] Siermann, J., Harvey, C., Morgan, G., & Heege, T. (2014, January 19). Satellite derived Bathymetry and Digital Elevation Models (DEM). International Petroleum Technology Conference. doi:10.2523/17346-MS

[6] Heege, T., Kiselev, V., Wettle, M, Hung, N.N. (2014): Operational multi-sensor monitoring of turbidity for the entire Mekong Delta, International Journal of Remote Sensing, Vol. 35, Issue 8, 2014, p. 2910-2926

[7] US Patent No 9613422 (2017): Using multispectral satellite data to determine littoral water depths despite varying water turbidity. Patent Publication Number 20150310618. Assignee: EOMAP GmbH & Co.KG. Inventor: Thomas Heege

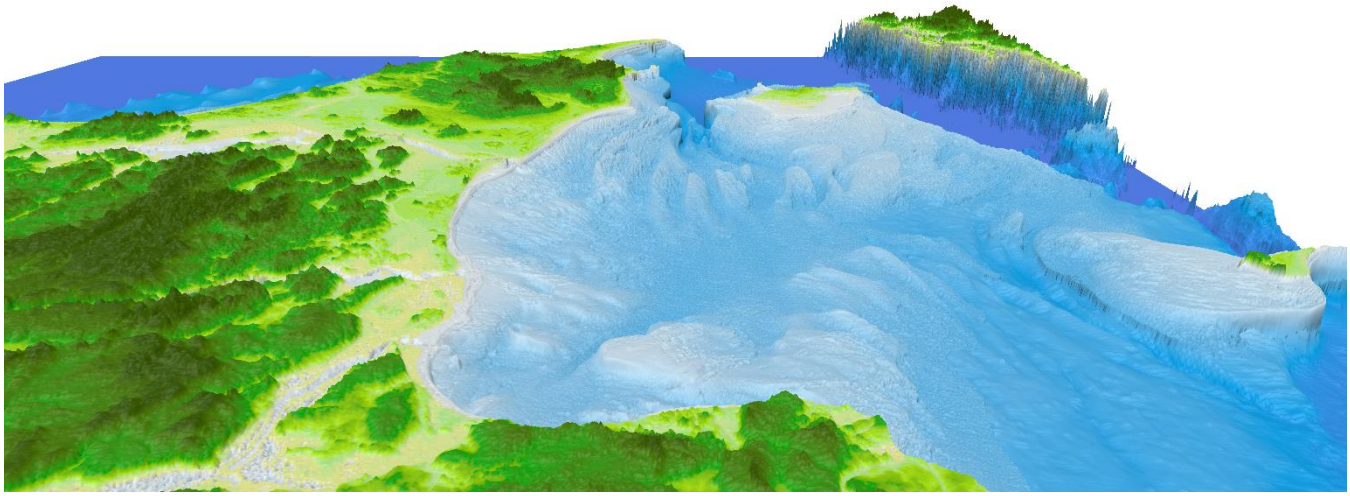


Image: Satellite-Derived Bathymetry results for Northern Denmark

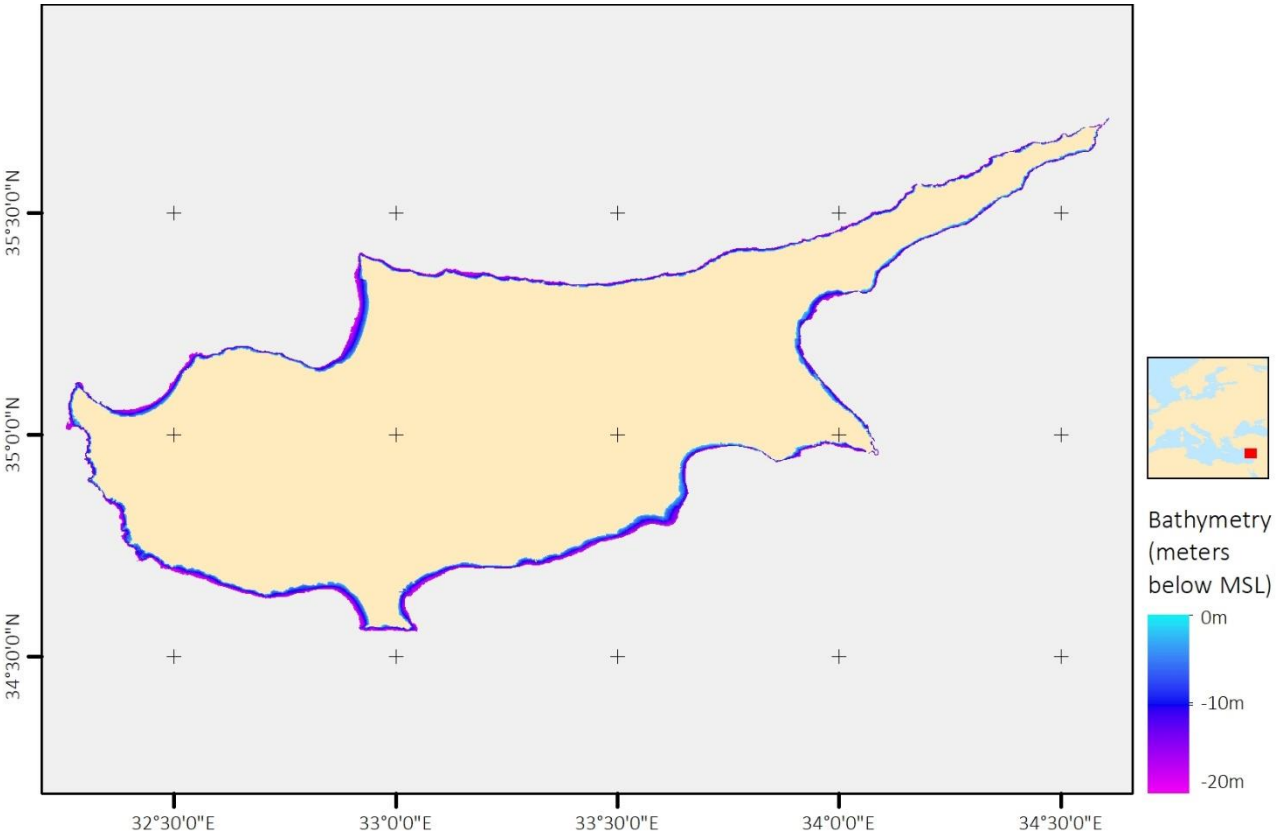


Image: Satellite-Derived Bathymetry results for Cyprus

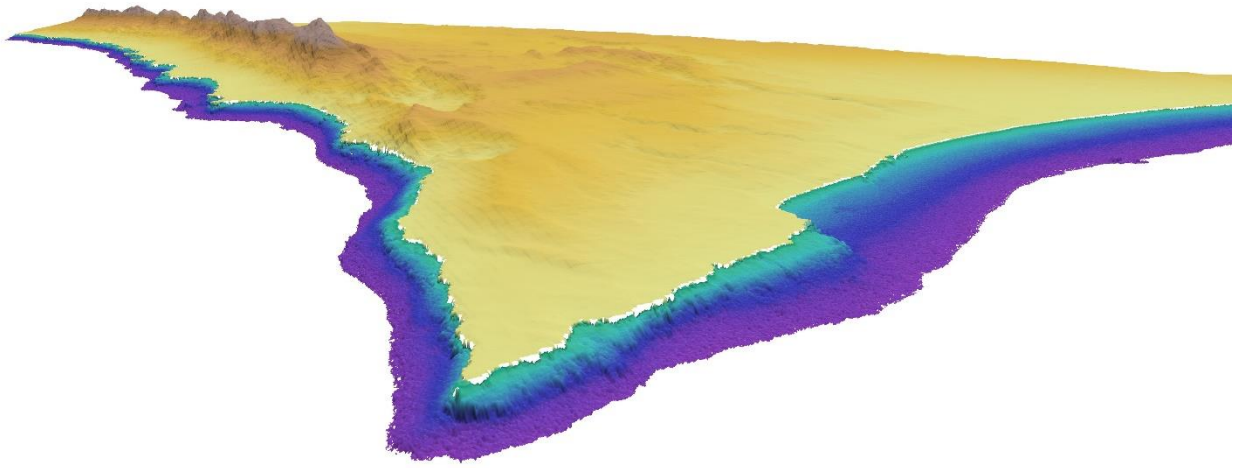


Image: Satellite-Derived Bathymetry results for North-Cyprus

The generated Satellite Derived Bathymetry DTMs have been compared to nautical charts of various scales and dates, which covered limited areas of all study sites. It is of high importance to understand the characteristics of the nautical charts before reviewing the comparison

1. **Date and methods of the charts**: The charts have been collected at various dates starting in the last decades, parts of those data collections were done prior to GPS era and bathymetric survey methods were often not done with the accurate multibeam sonar systems, which we have today. Thus,
    a. the horizontal accuracy of the depth soundings will have uncertainties of several meters to 10th of meters in extreme cases
    b. A full seafloor coverage (equivalent to modern MBES surveys) was often not done. Data gaps in between the lead line survey points will exist
    c. Vertical uncertainties will be present in all areas where the seabed has changed in the last decades. Those areas are more likely to be sandy bottom and hardbottom/rocky features are less likely to have changed
2. **Scale of the charts:** The scale of the charts is not ideal and much coarser than the native resolution of the Satellite-Derived Bathymetry. Thus, the data have a lower level of details and also focus on the most-shallow features (see next item).
3. **Shoal bias of nautical charts:** Nautical charts are shoal biased, which describes the fact, that charts represent the shallowest depth sounding of the surrounding. Satellite-Derived Bathymetry data however, represent the mean depth. Depending on the seafloor heterogeneities this can cause issues when comparing the data.

The direct comparison of the charting points with the SDB data set shows an almost ideal 1:1 fit of the data, with the vast majority of the data (81%) being within CAT ZOC C vertical uncertainty category (2m absolute and 5% depth uncertainty). Further statistical measures are: Mean square error = 1.55m, R^2 of

the linear regression = 0.76, gain of the linear regression = 0.97, offset of the linear regression = 0.16m, number of charting points = 11,313

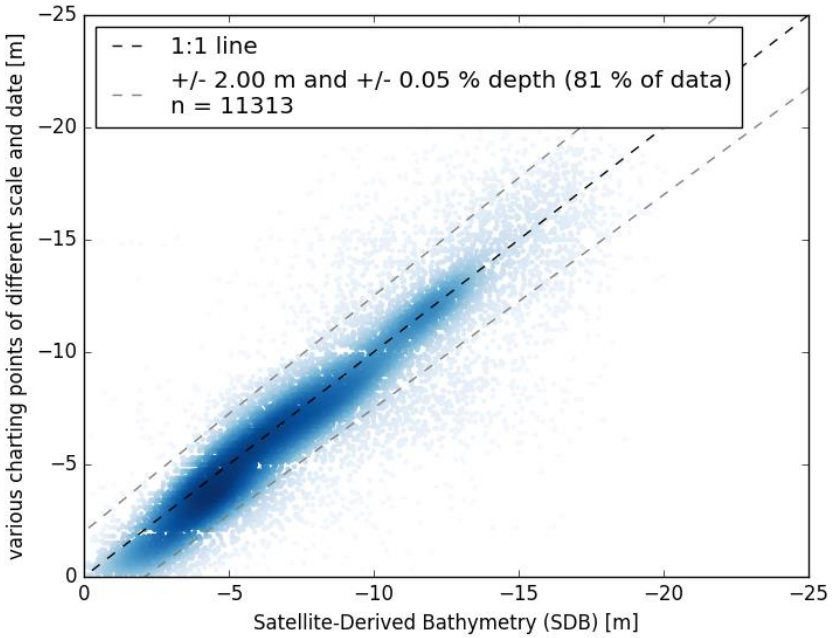


Image: Comparison of Satellite-Derived Bathymetry in native 10m spatial resolution against various nautical charting points.

Considering the above-mentioned restrictions of the comparison of SDB data with nautical charts, we can conclude, that the overall comparison shows good agreement. But, based on this comparison it is not possible to validate the SDB data. This procedure would require higher resolution acoustic survey data.

Overall, the number of data providers, summarised for the CDI and the Sextant catalogues, has stabilized at 51 organisations. As indicated earlier, population activities are to be continued in the first two months of 2020. Moreover, data providers will need to prepare additional entries that will populate the High Resolution DTM layer. However, that deadline is at end June 2020 and it is not on the critical path for generating the new release of the EMODnet DTM.

WP1 contributes to the following tasks as shared with WP2:

- Task 1: Bathymetric surveys

WP1 also contributes to the following tasks as shared with WP2 and WP5:

- Task 3: Coastline data

WP1 also contributes to the following tasks as shared with WP6:

- Task 7: International interoperability

WP1 also contributes to the following tasks as shared with WP3 and WP4:

- Task 8: INSPIRE compliance

Task 1 and 3 have progressed as described in the progress of WP1 and WP5. Task 7 and 8 have also progressed. This is described in the progress of WP4 and documented in detail in the separate report on interoperability and international collaboration.

WP2 – QA-QC, data processing and producing Digital Terrain Models for the basins

The latest version of the EMODnet DTM (Digital Terrain Model) was released 24th September 2018 with its improved resolution of 1/16 * 1/16 arc minutes (circa 115 * 115 m2). The overall methodology for the generation of the new EMODnet DTM remains the same as the one applied in the previous EMODnet HRSM phase. Following the usual approach, the new DTM will be compiled by an integration of new versions of regional DTMs that will be generated by regional coordinators. They have not yet started with their processing as they have to wait for the data providers to finish their data population, pre-processing and transfer of their gridded DTMs. However, there already exists a list of known anomalies in the current EMODnet DTM and regional coordinators were requested to review the DTM for their region in search of more artefacts that might be improved. Possible remediation of these artefacts might be undertaken by having access to new input data and/or by improving the methods. Development is underway for a spike identification detector and removal that will be integrated in the upgraded Globe software. And, use will be made of the new version of GEBCO (GEBCO 2019) for filling gaps. That latest GEBCO bathymetry includes the EMODnet Bathymetry 2018 version. In November 2019, a technical tuning meeting took place between IFREMER, Shom and GGSgc to discuss and refine the actions and planning for the compilation of the new version of the EMODnet Digital Terrain Model (DTM). Current and future steps are:

- Finalising the upgrading developments for a new release of the Globe (data processing software) by end of February 2020. The new version is in particular aimed at facilitating the handling of large files which will make the activities by the basin coordinators more efficient and less time consuming; the associated adoption of the NetCDF V4 data format for input and output of Globe will also optimise the compliance with international standards;
- Data providers are expected to pre-process their data contributions, as indexed in WP1, using the existing Globe version, followed by delivery to the regional coordinators until the end of February 2020;
- From March to July 2020, regional basin coordinators will analyse, process and merge selected contributions using the new Globe version into regional DTMs. A meeting gathering

the basin coordinators and core technical partners will be organised in April 2020, aiming at monitoring progress and gaining feedback on the new Globe version and the common methodology;

- The regional DTMs will be transferred to the DTM integrator (GGSGC) around summer 2020 and then analysed and merged from August to October 2020 in order to produce a new version of the EMODnet bathymetry grid. After validation, checking all data references, and additional activities such as preparing a new 3D model and new set of downloadable DTM tiles in multiple formats, the new release should be made available around November 2020 on the portal.

WP2 concerns the following task as formulated in the tender and as shared with WP1:

- Task 1: Bathymetric surveys

WP2 also concerns the following tasks as shared with WP1 and WP5:

- Task 2: Digital Terrain Model
- Task 3: Coastline data

All tasks have progressed more or less as can be derived from the WP1, WP2 and WP5 progress reporting.

WP3 – Integration and inclusion of the DTMs into the portal

The integration of the Regional DTMs into the overall EMODnet DTM will be performed by partner GGSGC with support of regional basin coordinators and MARIS. The actual integration will start around summer 2020 when the new regional DTMs should become available and GGSGC will adopt the methods that it already successfully applied in the previous round.

In the meantime GGSGC has made great progress with developing a worldwide elevation base layer in the EMODnet ATLAS style which is expected to be released near end February 2020. The underlying idea is that all EMODnet portals would benefit from having a common worldwide base layer in a common EMODnet look & feel. This suggestion was presented at the EMODnet Steering Committee meeting of November 2018 and welcomed by the EMODnet community. Having a common elevation base layer in all thematic portals will contribute to having a consistent “family” look and it will further promote the EMODnet brand as it can also be shared with external users. The base layer will use the EMODnet Bathymetry dataset of 2018 for European waters and GEBCO_2019 data for the rest of the world. Next to bathymetry also terrestrial elevation will be included. Source for the land terrain model is a combination of the Shuttle Radar Topography Mission (SRTM) 3 arc seconds data, ASTER 1 arc second and topographic maps. All land data used for this layer is compiled, corrected and resampled by www.viewfinderpanoramas.org. A link will be provided with the base layer with a disclaimer and copyright information for layer.

At the start of the work, two major challenges were identified:

1. The amount of data for a global dataset at the same zoom level as the EMODnet Bathymetry viewing service
2. Mismatch between data sources

Data volume

In order to display the entire world at the same zoom level as used for the EMODnet Bathymetry viewing service a total of 9.33120-e10 (more than 93 billion) source data points have to be taken into account. To improve the viewing, the source data will eventually be up sampled to over 135 billion points. The size of the dataset comes with a price. High resolution global elevation viewing services including both land and water have so far only been produced by Google and Esri. Of these two, the only continuous dataset is the Esri Ocean base map as Google basically has photographically blended water and land. The Esri Ocean Base map however is a proprietary service and only available when Esri technology is used. In order to produce the EMODnet World base layer at an affordable cost GGSGC was facing a huge challenge. By using Amazon Web Services (AWS) and a highly optimized version of the GGSG workbench software this challenge was successfully managed. The solution was found in dividing the world in tiles of 1 by 1 degree with an overlap of 20 data cells on each side. By analyzing these using the Open Streetmap coastline, it is possible to differentiate between three tile types:

- Just water
- Just land
- Combination

The first two types are easy and need no complex processing to combine land and water (this is explained below). The third type is the problematic one as the various sources do not match nicely.

Mismatch between data sources

Global land data is available from different sources (ASTER, SRTM and others). They usually have in common that the data is organized in tiles of 1 by 1 degree and formatted as HGT files. This format was introduced by NASA for use during the SRTM project. The best available global datasets are all in a 3 arc second (~90 meter) resolution. Higher resolutions are usable for local regions but the world wide data sets contain too much voids. Land elevation source data usually is not filtered for seas and oceans. That is, sea and oceans are set to (or measured at) 0 meter. So the first preparation step is to mask out all these 0 meter sea elevation. This is not a simple filter process as many areas on land have a valid 0 meter elevation and with a filter, these will also disappear. By using a mask based on the global OpenStreetMap coastline a correct distinction can be made between valid and invalid 0 meter elevation. Using this map also ensures that there will be a perfect match between the final dataset and the OpenStreetMap data which is used as an overlay in the viewing service. Global sea elevation are derived from the GEBCO 2019 dataset. The source resolution for GEBCO 2019 is ¼ of an arc minute (~500 meter) . Although the dataset

resolution has doubled compared to the previous release (GEBCO 2014), most of the 2014 data has been up-sampled. The quality of the dataset in many areas therefore is not better than ½ arc minutes. This causes a major mismatch between the high resolution land data and the water. This is called the GEBCO effect and is visualized in the image below.

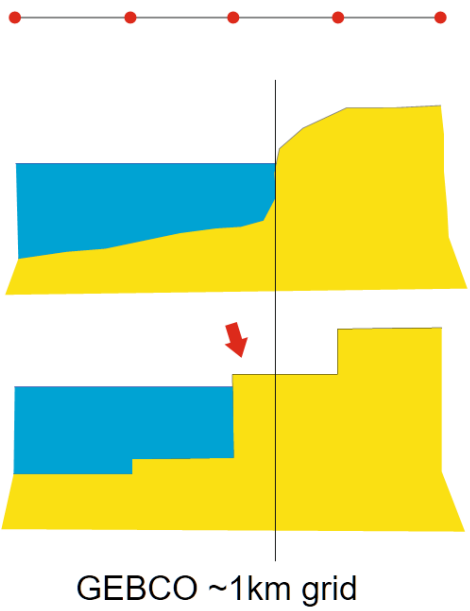


Image: GEBCO effect

The GEBCO effect causes water areas along the coast to become drying heights (the yellow area in the image outside the coastline). The steeper the coast, the stronger this unwanted effect. Just like with the 0 meter elevations discussed above, there is no simple way to filter out this GEBCO effect. One could remove all drying heights but this would still cause a discontinuity between the land and the water. The solution earlier developed for the EMODnet Bathymetry dataset is therefore also used for the world base layer. The idea is that somewhere between the land and the water a 0-meter elevation exists. Given the resolution of ~90 meters in most cases it is safe to assume that the 0 meter will be within a single data cell adjacent to the coast. Except for shallow areas that have a large tidal difference this may not be the case but for the purpose of the base layer this will be acceptable as shallow areas show little color nuance in the viewing service anyway. A special algorithm was developed to mark all data cells around the land as coastline data cells which are then given the value 0. An exception has to be made for the Caspian Sea. By many this inland lake is defined as a sea and is therefore incorporated in the world base layer. The Caspian Sea however has an elevation of -28 meter so the shoreline around the Caspian Sea has to be set to -28 meter instead of 0.
Next step is to create a buffer zone around these coastline data cells in the direction of the water. When combining the land and the water this buffer zone is left empty. At a later processing stage the buffer

zone is interpolated which results in a smooth transition between land and water. The width of the buffer zone is set to 12 data cells, causing it to spawn a little bit more than a single GEBCO 2014 data cell. In most cases this is sufficient to remove the GEBCO effect. The width does however cause an issue for narrow channels and fjords. The buffer is applied to both sides of the narrow channel and therefore the channel is sometimes completely masked. This causes the whole channel to be set to zero meter after interpolation. Especially for deep fjords this is an unwanted effect. A solution was found by detecting what is called the channel center line before applying the buffer. The buffer is not applied to the channel center and this results in a correct interpolation of the channel. Channel detection is developed for the World base layer and has so far not been applied to the EMODnet data set. For the EMODnet data set the channel effect is less prominent because buffering is not performed on CDI data. The narrow channel effect is however visible in areas where only GEBCO data is available. For the next release of EMODnet Bathymetry these areas will be processed using channel detection as well.

Results

The following images give examples of the EMODnet World base layer. To manage the larger depth and elevation range for the global scale, minor changes have been applied to the color scheme. This new color scheme will also be used for the 2020 release of EMODnet Bathymetry.

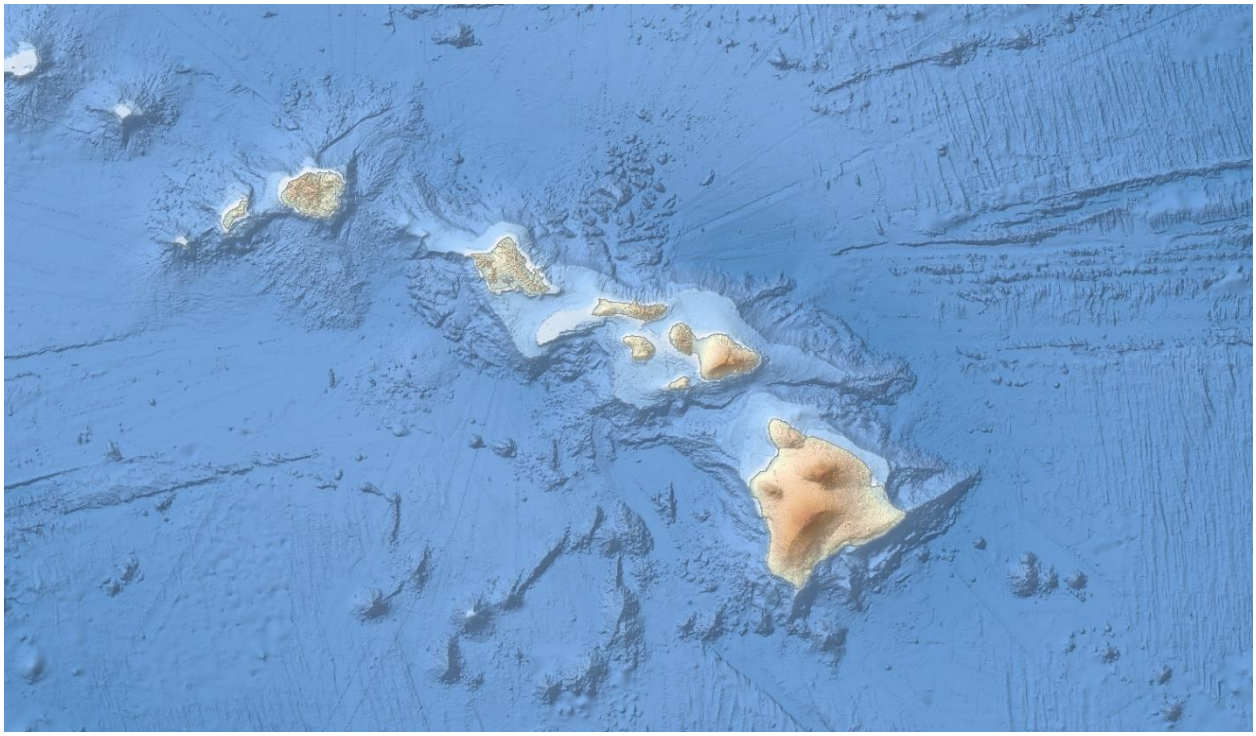


Image: Hawaii overview

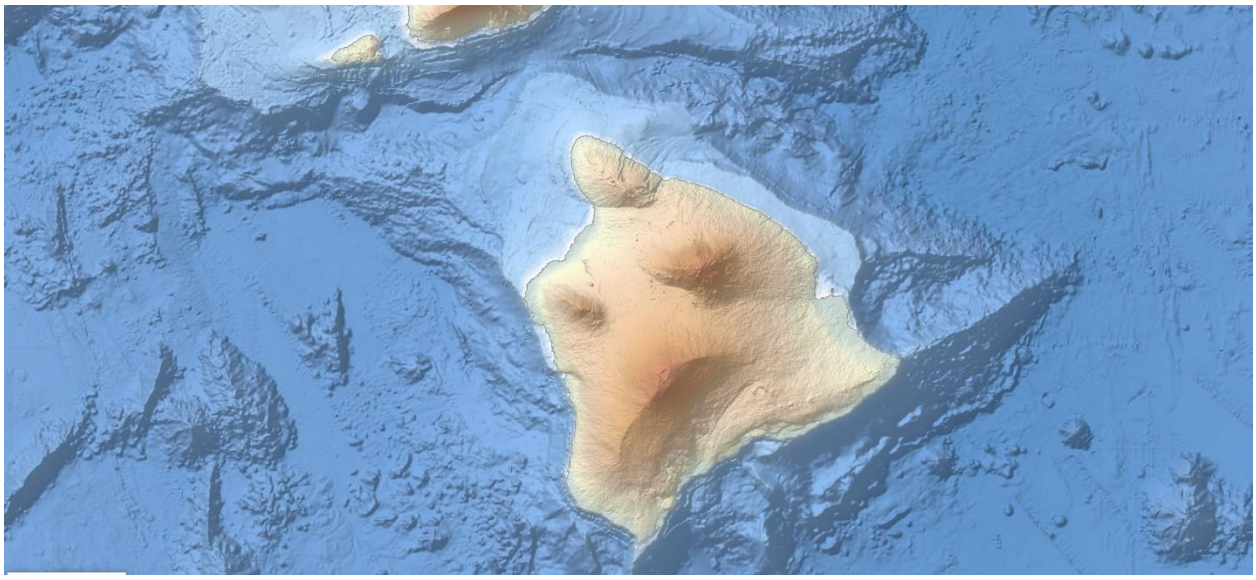


Image: Hawaii detail

Image: Tierra del Fuego overview

Image: Tierra del Fuego detail

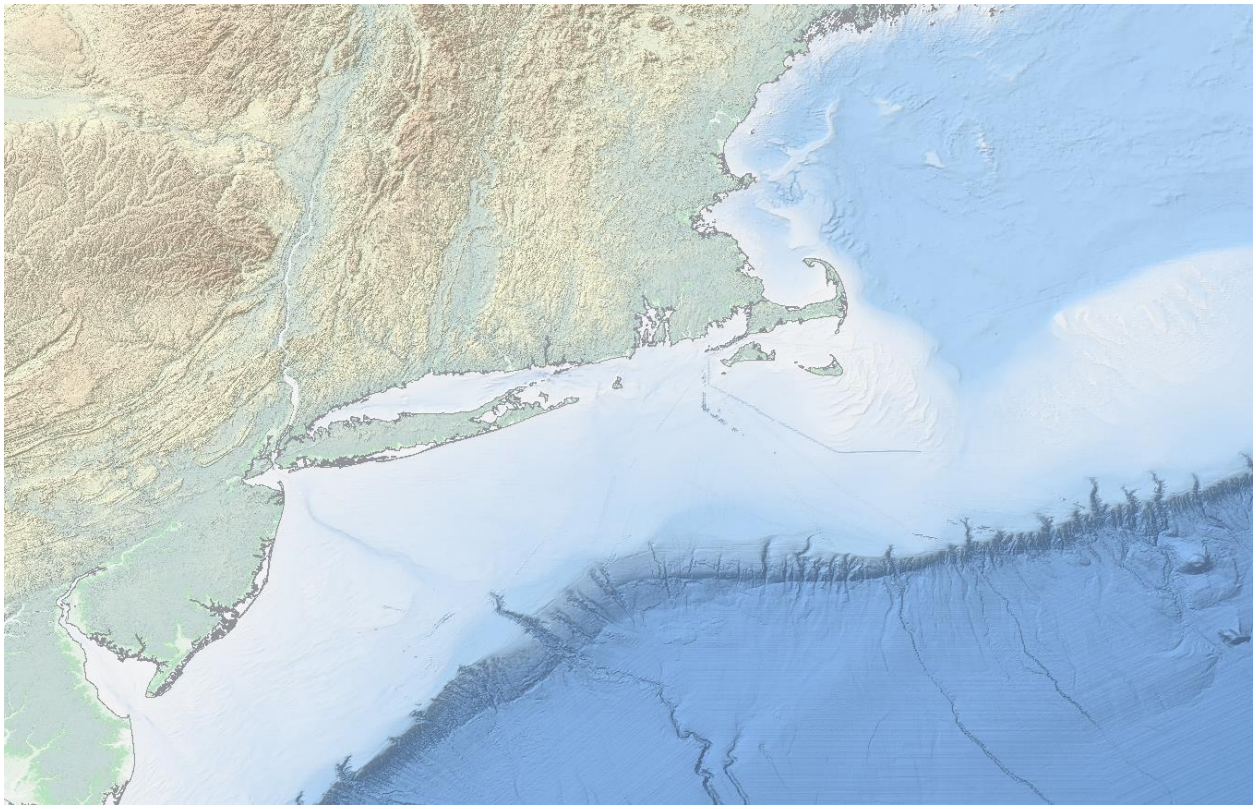


Image: US East coast overview

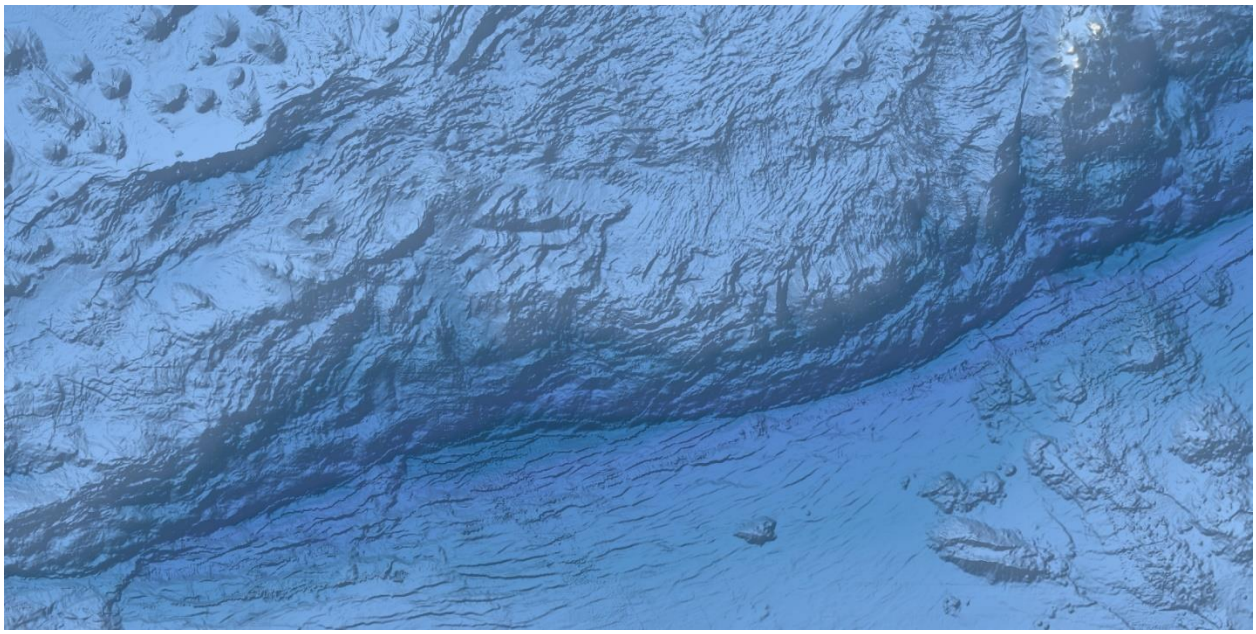


Image: Mariana Trench (deepest point on earth) Detail

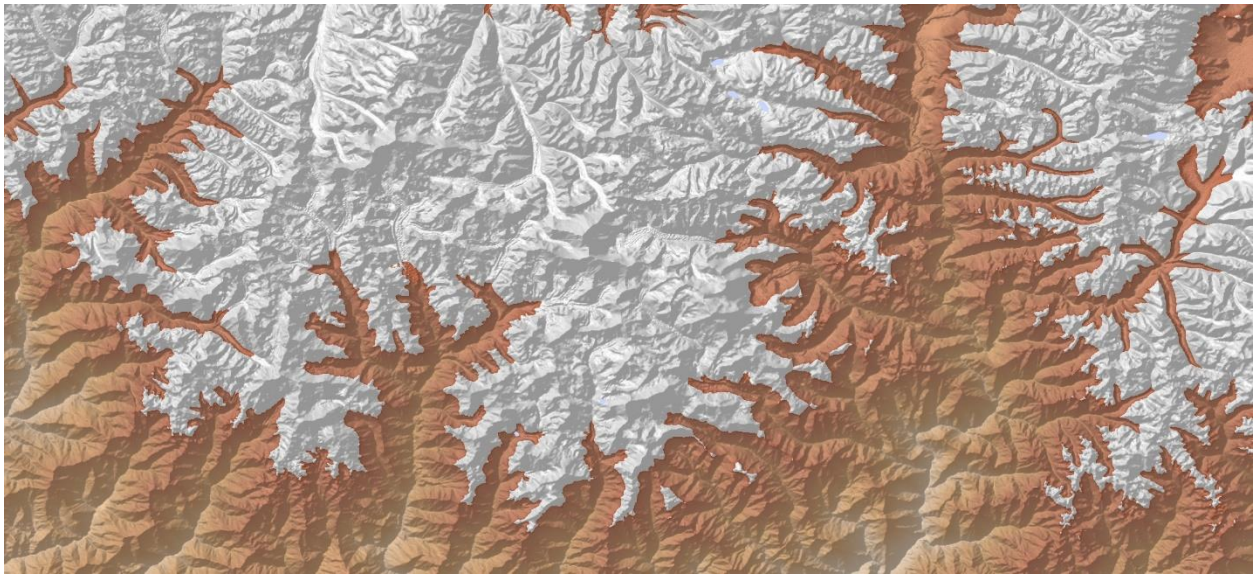


Image: Mount Everest detail

As earlier indicated, the EMODnet worldwide elevation base layer is making good progress and is expected to be released near end February 2020. It will be made availale as an OGC web service, so that all portals can add this layer their viewing services. It will also be a good addition to the European Atlas of the Seas.

WP3 contributes to the following task as formulated in the tender and as shared with WP2 and WP5:

- Task 2: Digital Terrain Model

WP3 also contributes to the following task as shared with WP4:

- Task 4: Machine-to-machine connections to data and data products

WP3 also contributes to the following task as shared with WP1 and WP4:

- Task 8: INSPIRE compliance

All tasks have progressed as can be derived from the WP1, WP2, WP3, and WP4 progress reporting and the separate report on international interoperability.

WP4 – Technical Development & Operation of portal, tools and services:

The EMODnet Bathymetry portal is operational at the domain https://www.emodnet-bathymetry.eu. Following the GDPR Directive and upon request of the EU, activities were undertaken together with the EMODnet Secretariate and EU services to improve the GDPR compliance of the EMODnet Bathymetry website and related services. For instance, https:// certificates were acquired and implemented for the main domain and for all the services, such as for the dedicated CDI and Sextant catalogues and the Bathymetry Viewing and Download service. And sections were formulated and added for 'privacy policy' and 'cookies'. This was undertaken in tune with the other EMODnet portals for further establishing harmony. In the first quarter of the reporting period, some remaining activities from the previous contract took place, namely expanding the Bathymetry Viewing and Download service with layers and extra functionality for the Satellite Derived Coastlines, the High Resolution DTMs, and the Quality Index. These are well-embedded and fully operational.

IFREMER worked on upgrading the Globe software. A major improvement is the moving of support for NetCDF V3 to NetCDF V4 file format in all relevant functions (import xyz, reduce, merge, export). This has two major advantages: 1) overcomes the 2Gb size limit of NetCDF V3 files, which will implicate that data providers and regional coordinators no longer have to chop up areas in smaller pieces, and 2) overcomes the use of the scale factor. Earlier this scale factor raised concerns, as cumulative effects seemed to affect individual surveys during the compilation, and generate discontinuities between contiguous datasets. The new Globe software will avoid that effect, however it implicates that regional coordinators will need to reprocess with the upgraded Globe software the data sources as received from data providers and should not use the data sources that were provided previously to the project and potentially have been processed already a multiple number of times by the regional coordinators. Internal tests within the Globe code will be made in order to prevent regional coordinators to use previous NetCDF V3 contributions in their new compilation. Integration of all the new functionalities is planned by end of February 2020 and tests will then be done to ensure that the upgraded Globe software is operational prior to the release to the regional coordinators.

CORONIS made progress on developing a smart solution for interpolation issues, which should be state-of-the-art and based upon slope directions. They completed a literature analysis gaining insight in state-of-the-art interpolation methods. As follow-up they implemented a Matlab version of the main interpolation methods, and are prototyping their methods also in this platform, followed by

comparisons. The toolbox and documentation will be made available on github. Once it has been decided which is the best method, then this will be ported to Globe, for which CORONIS will provide a C++ implementation as a library/function with the input/output that IFREMER requires which will make it easier for IFREMER to include the algorithm. To give a bit more detail, the interpolation problem is approached by CORONIS from two perspectives:

- Interpolation of scattered data: the most usual case, in which the depth samples are sparse compared to the resolution at which we want to rasterize the terrain. CORONIS implemented some of the most common methods (IDW, Natural Neighbors, Kriging) and are checking the applicability of some triangle mesh-based methods. The most simple is the direct creation of the TIN using Delaunay, but CORONIS is trying to provide a smoother result using a refinement procedure on that surface prior to rasterizing it;
- Interpolation of missing data: given an already rasterized map, fill the areas without data. Normally, this problem is also tackled with the methods above in nowadays GIS systems. However, this problem seems closely related to image restoration, and might benefit from the current literature in "inpainting" methods to propose some improvements over the state of the art. Therefore, CORONIS is also experimenting with those methods.

Considering the overall project planning and workflow, a three stage approach was reached between CORONIS, IFREMER and GGSgc: CORONIS will deliver soon a quick and dirty interpolation algorithm that can work with Globe and which performs better that what is available now. All points that are interpolated will be flagged in the data so can be replaced later in 2020 with an improved algorithm that is planned to be ready before summer 2020. The third step will be more a scientific approach of bathymetric interpolation that should lead to a publication and which will possibly be based on deep learning AI.

CORONIS has also been asked by the team to develop a function for individually viewing, rotating and distorting vertical scale of the High Resolution DTMs. Right now, the HRDTMs are available as a separate layer and each HRDTM can be identified by retrieving metadata from the special HRDTM Sextant catalogue. And one can zoom in on the HRDTM till its maximum resolution is reached. However the HRDTMs have the legend of the overall EMODnet DTM which makes it less easy to distinct the depth intervals as it concerns colors in the same color range. The extra viewing and rotating functionality will allow to inspect the HRDTMs in much more detail. Once CORONIS succeeds, this function will be integrated by GGSgc as part of the functionality of the Bathymetry Viewing and Download service. Timing is having it working around autumn 2020.

A major upgrade has taken place of the CDI Data Discovery & Access service which gives overview and access to the gathered bathymetric surveys. As part of the EU SeaDataCloud project, the CDI service has been improved in functionality and performance by adopting the cloud and completely renewing the user interface and the data shopping experience. Following the upgrade of the SeaDataNet CDI user

interface, also efforts were undertaken by MARIS for upgrading the CDI service user interface of EMODnet Bathymetry. And upgrading took place of the CDI OGC WMS – WFS services, which are integrated in the Bathymetry Viewing and Download service. Further progress was made with replacing the existing CDI Download Manager (DM) software component at several data providers with the new CDI Replication Manager (RM) component. This deployment process is ongoing and is relevant for data providers for submissions of new and updated CDI entries and for handling requests for restricted data sets. While copies of unrestricted data sets are added to the new CDI data cloud from which data deliveries to users are being served. The planning is that the deployment of the RMs at the relevant data providers of EMODnet Bathymetry will be completed early 2020 as it directly influences progress of WP1. Finally, editorial activities took place to update several pages of the web portal for describing the upgraded CDI service.

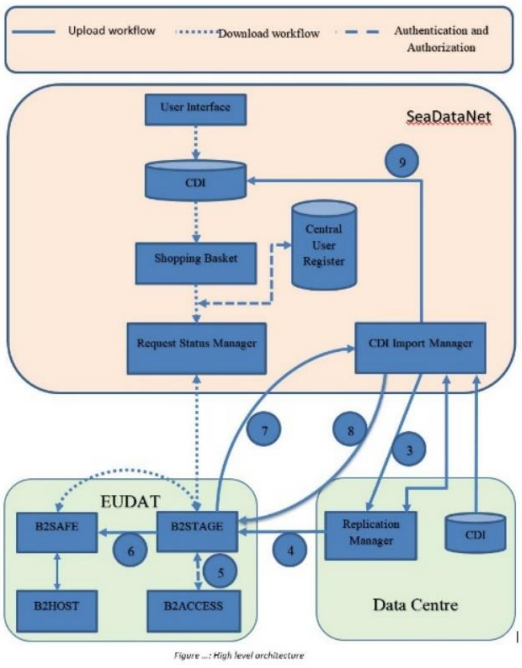
New CDI service components	
• **Local software tools** at data centres to prepare ingestions • **Replication Manager (RM)** at data centres for exchanging to Import Manager and EUDAT cloud • **EUDAT cloud** with adapted EUDAT services • **EUDAT cloud** with central data cloud for unrestricted data sets • **Upgraded CDI User Interface,** ordering and downloading facility • **CDI Import Manager** for managing the import and validation process	

Table and image: components of the new CDI service architecture

The CDI service infrastructure has been expanded with the EUDAT data cloud. This data cloud communicates with an upgraded central CDI Import Manager and the new decentral Replication Managers, replacing the existing Download Managers, to perform the CDI metadata and data import workflow. The CDI Import Manager provides a dashboard to data providers to control the import process while the Replication Manager component provides the data centres a toolbox for local data management and for preparing the batches of metadata and data sets that are to be populated in the CDI service. The CDI Import Manager and data cloud also host and allow to run extra quality control,

transformation, metadata enriching, extracting, and versioning services. The data cloud also communicates with an upgraded Request Status Manager, now integrated in the CDI User Interface through MyCDI, to perform the delivery of data sets to users following the processing of their shopping baskets, also considering possible negotiations in case of restricted data requests.

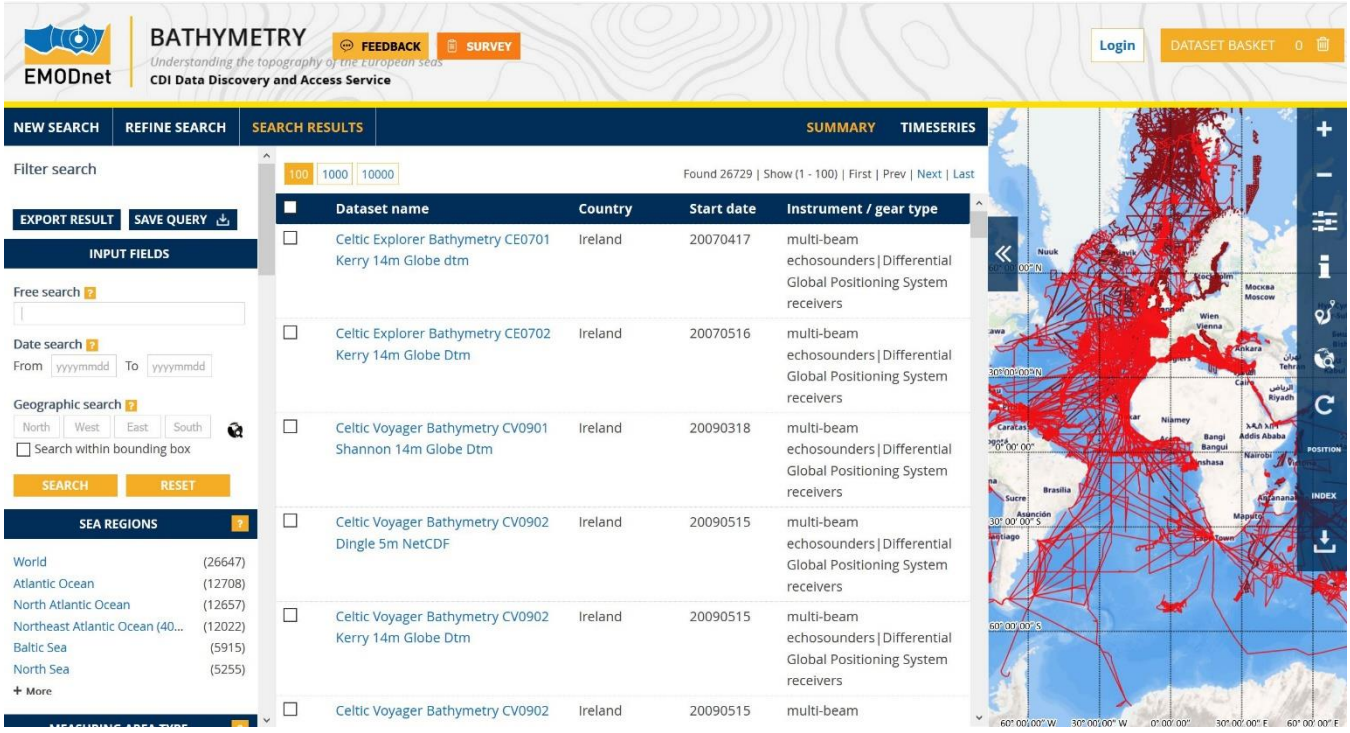


Image: User Interface of upgraded CDI service

An important element of the new CDI User Interface is that all functions for both users and data providers can be reached from the new MyCDI dashboard, depending on the Marine-ID and associated registered functions and roles. As part of this, also the shopping process is now an integrated dialogue instead of having to jump to separate applications and URLs for example for searching, registering, checking shopping progress, and retrieving data sets. This makes the dialogues for users and providers much more efficient, and easy to understand and perform. Furthermore, several processes and functionalities have been reviewed and optimised, including performances, which again is in favour of the users and data providers.The new CDI User Interface allows to combine search criteria from pull down lists, search by facets, and perform powerfull full text search over all contents. This is supported by SQL server for database queries and Elastic Search for free text search (very fast!). Moreover, the User Interface features a full screen mapping service which is powered by GeoServer in combination with Elastic Search.

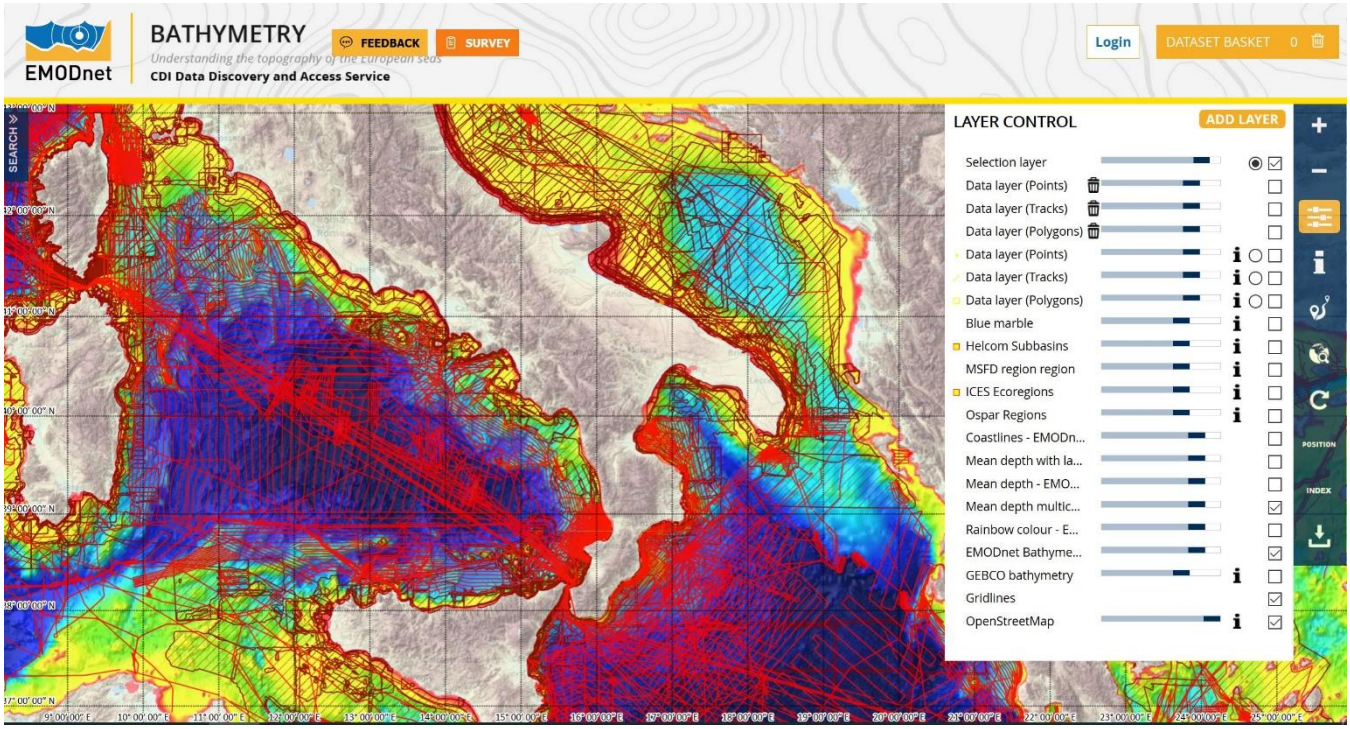


Image: Large mapping interface as part of new User Interface of upgraded CDI service

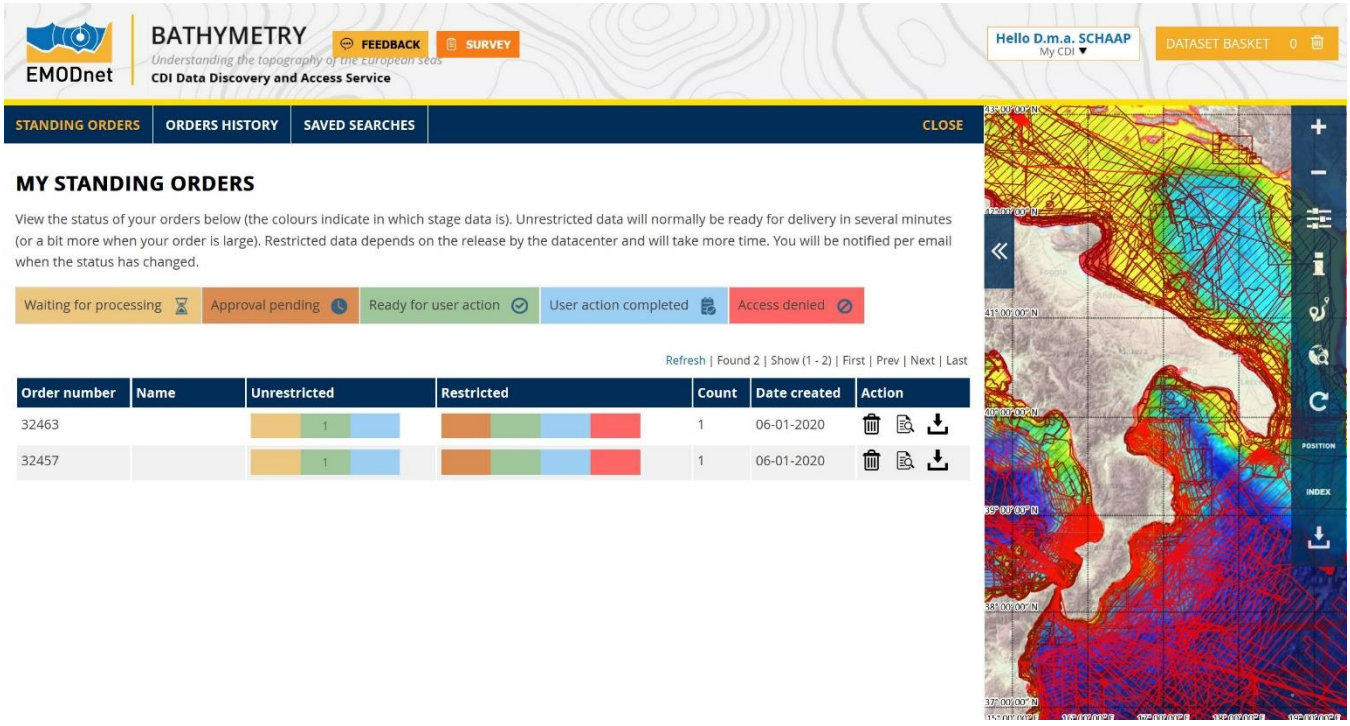


Image: MyCDI dashboard with multiple functions, including overview of outstanding data requests and options for downloading

The CDI scheme had been made INSPIRE compliant, already in September 2013. However, due to changes by the INSPIRE team at EU-JRC, both on the INSPIRE ISO19139 metadata schema as concerning

the introduction of a new official (beta) validator service, it appeared that the CDI XML output was not compliant anymore. This gave reason for a dialogue with the INSPIRE team for overcoming the issues on both sides as it was clear that the functioning of the new validator was one of the reasons for concern. Recently, activities have been concluded in discussion and cooperation with the INSPIRE team at EU-JRC to update the CDI XML coding in full compliance with the latest INSPIRE ISO19139 metadata schema. This can be validated using the latest version of the new ETF validator of INSPIRE: http://inspire.ec.europa.eu/validator/. Whereby one has to select metadata for interoperability as the target conformance class. To reach this milestone, a number of change requests have been submitted by SeaDataNet to INSPIRE (at JRC) to let them accept community profiles such as the SeaDataNet CDI format with its own controlled vocabularies as INSPIRE compliant profiles, and to accept geographic datums such as WGS84 next to European datums and to make their INSPIRE validator fully fit for these. The change requests were supported by EU DG Environment and DG MARE and a follow-up was given by the INSPIRE JRC team. Also a number of updates were made in the CDI schema (now version 12, published at the SeaDataNet portal under standards) to fully support INSPIRE specific requirements such as textual references to the INSPIRE legislation. Thus, all XML output of the CDI services at SeaDataNet and EMODnet Bathymetry portals is now fully INSPIRE compliant again. More details are in the separate report on international interoperability.

The pilot for the **Collaborative Virtual Environment (CVE)** was successfully finalized in the previous contract. It had a focus on generating 2 neighbouring RDTMs (West Med and Central Med) and 1 additional RDTM (Bay of Biscay) using Globe online on a cloud computing platform and involving a few basin coordinators. The pilot concerned building selected regional DTMs having all data and the Globe software online together in the cloud. Two ways for working with the GLOBE software on the cloud were set-up: 1) as a full package and installed as a Docker container instance; and 2) as a set of OGC WPS services for selected Globe functions. Examples of both have been made available to pilot regional coordinators for try-out and feedback in order to improve the services. As part of the pilot, an OGC WPS has been developed, facilitating to select DTMs stored on the cloud and merge them. The pilot has provided insights into the practical feasibility of adopting the cloud for the EMODnet Bathymetry workflow and where it should be improved. Also it demonstrated how two basin coordinators for neighbouring regions can collaborate, in particular for establishing seamless boundaries between their two regional DTMs. Based upon this experience it was decided to continue with developing the **CVE** and adopting it for generating the 3 RDTMs that together cover the Mediterranean. This concerns IFREMER, CNR and HCMR as regional coordinators. The basis approach is to use the online Globe version on the DATARMOR computing facility of IFREMER and bringing all relevant input data sets to this location. IFREMER has been busy with making the necessary preparations and among others, made progress with developing visualisation services which will facilitate the basin coordinators to evaluate the quality of the regional DTMs in an easier way. For this a migration is made from QGIS2 to QGIS3 server for the WPS environment. This should significantly improve the work performance. Also a demonstrator has been

set up of a processing function for spikes identification. The tools for the production of regional DTMs have been tested, and the next step will be to move to an operational context with a dedicated user interface for the CVE. Underway are developments for a WPS for annotating DTMs artefacts and producing a QC file, which can be shared between a group of CVE users. The actual uptake of the CVE approach for genertng the three Mediterranean regional DTM components will take place from March 2020 onwards, adopting the latest Globe version and involving the relevant regional coordinators. The CVE approach will also be presented at the meeting of core team and regional coordinators which is planned in April 2020.

WP4 contributes to the following task as formulated in the tender and as shared with WP3:

- Task 4: Machine-to-machine connections to data and data products

WP4 also contributes to the following task as shared with WP6:

- Task 5: Web portal

WP4 also contributes to the following task as shared with WP1 and WP3:

- Task 8: INSPIRE compliance

WP4 also contributes to the following task as shared with WP0 and WP6:

- Task 9: Monitoring of performance

All tasks have progressed well as can be derived from the WP0, WP1, WP3, WP4 and WP6 progress reporting and the separate report on international interoperability.

WP5 – Coastlines, legal baselines and vertical reference levels:

In the first quarter of the reporting period, some remaining activities from the previous contract took place, namely satellite derived coastlines were added as an extra layer in the Bathymetry Viewer and Download service and made downloadable with documentation from the EMODnet Bathymetry portal. These best-estimate coastlines were earlier determined by Deltares from satellite data (typically Sentinel-2 and Landsat-8) and in combination with the Global Tide Surge Model (GTSM) processed into digital coastlines for the European seas at LAT (Lowest Astronomical Tide), MSL (Mean-Sea-Level), and MHW (Mean-High-Water). The level of detail is bound to the resolution of the satellite sensor (e.g. 10m for Sentinel-2). Furthermore the inventory and report of Deltares with baseline and coastline data as collected from 21 national authorities in Europe was published at the Bathymetry portal. It describes the information available per country, the resolution, the source of the data and the institute providing/ hosting the data. It can be downloaded from the portal together with shapefiles of the baselines and coastlines. A disclaimer has been included to underpin the prerogatives that national states have on this type of information, including legal implications. It also states that the main objective of this report is to provide the contracting authority with an inventory of these available datasets at a fixed date in time.

As part of the new contract, Deltares is progressing with the task for updating and refining the best-estimate European digital coastlines for a range of vertical levels. As one input, all National Hydrographic Services were asked at the kick-off meeting and since then reminded several times by Deltares to check national coastlines in the existing inventory and to report any known updates of national coastlines in highest resolution. They were also asked to provide contact information for neighboring countries that are not part of the EMODnet consortium in order to complete the overall coverage. This activity is underway and should result in an updated inventory around spring 2020. As second input, Deltares has progressed at refining the GTSM tidal model and recalibrating the GTSM model at 5 km and 1.25 km grids. An updated version of GTSM has been created making use of the EMODnet 2018 DTM and the 2019 release of GEBCO. This has resulted in a significant improvement of the accuracy, e.g. from 8.0 to 5.6 cm RMSE in the North Atlantic and from 6.3 to 4.9 cm RMSE globally. An extensive calibration of the model is ongoing in cooperation with the TU Delft. While the calibration is ongoing the current version has an accuracy of 3.5 cm RMSE in the North Atlantic and 3.3 cm on average globally.

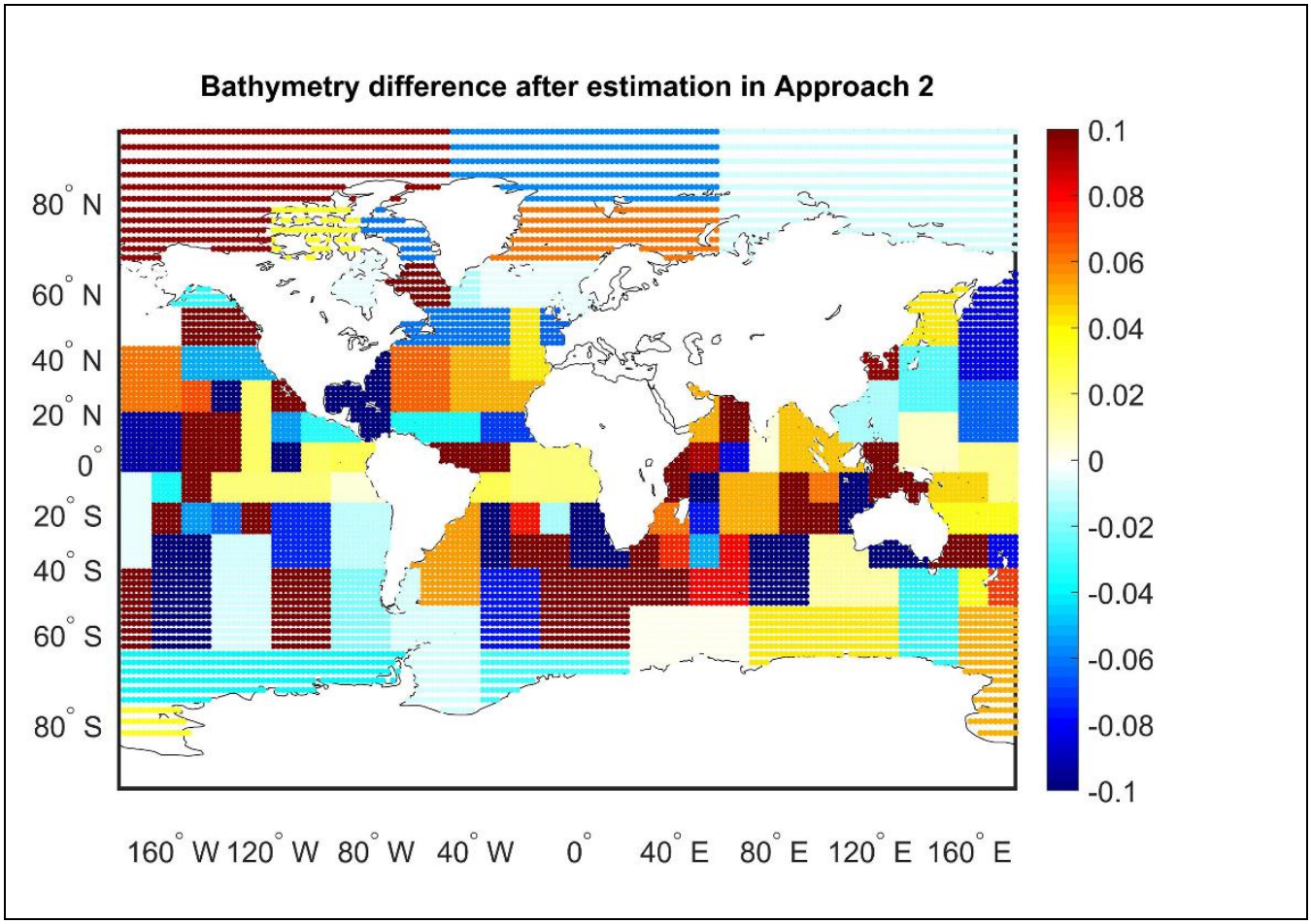


Image: Bathymetry adjustments during calibration of GTSM

As third input, Deltares has identified and analysed the difficulties that were earlier experienced with estimating the digital coastlines from satellite views. Several steps have been performed in making the land-water-detection more robust and considering the dynamics of the seabed for very dynamic areas. Based upon these three inputs, Deltares will prepare a complete update of the coastlines at different tidal levels by the middle of October 2020.

Deltares is also busy with updating and further completing the overview of legal baselines. National Hydrographic Services have been requested to check official information about the legal baselines for their countries in the existing inventory and to provide to Deltares any known updates of legal baselines (preferably with web links for more info and future updates as well as GIS files). Once received, Deltares will update the currently published legal baselines inventory, trying to complete missing countries among others via UNCLOS. An overview was created of which countries in Europe are listed in UNCLOS. For those countries, the deposition stating the baseline has been identified. This information will be added to the EMODnet inventory of baselines.

The third activity of Deltares is to establish tidal bathymetry for a selection of coastal areas. The proposed methodology has been presented at the kick-off meeting along with a number of potential areas of application. Based on the feedback, the following areas have been selected: Danish west-coast, Portuguese Faro region and Dutch Wadden Sea. The latter for validation of the methodology. The development for the Dutch Wadden Sea and Danish West Coast is ongoing. An issue has been identified with the existing EMODnet 2018 DTM around Denmark. There seems to be a bias in the bathymetry (too deep). One option is that there was a mistake in the vertical reference of the data-source. This will be investigated further together with the regional coordinator.

Images: 1) EMODnet 2018 DTM relative to MSL; 2) EMODnet 2018 DTM relative to MSL with Danish part corrected for LAT-MSL difference.

Later on, around November 2020, it is planned that GGSgc will prepare from the updated coastlines from Deltares a raster layer with intertidal areas which will added to the viewer layer menu. And Deltares will improve and make the MSL – LAT conversion data set available for the EMODnet grid at resolution of 1/16 arc second around July 2020.

WP5 contributes to the following task as formulated in the tender and as shared with WP2 and WP3:

- Task 2: Digital terrain model

WP5 also contributes to the following task as formulated in the tender and as shared with WP1 and WP2:

- Task 3: Coastline data

All tasks have progressed well as can be derived from the WP1, WP2, WP3 and WP5 progress reporting.

WP6 – Outreach, helpdesk and evaluation

The earlier success of the EMODnet Bathymetry portal and services is continued and also in the reporting period there are lots of interest and users registered. Chapter 10 gives a list of participations of consortium members in conferences, papers and other outreaching activities. For instance, an official Memorandum of Understanding was established between EMODnet Bathymetry, IHO-IOC General Bathymetric Chart of the Ocean / Seabed 2030 and the Seabed 2030 initiative (https://seabed2030.gebco.net/), led by the IHO-IOC GEBCO, under the financial sponsorships of the Nippon Foundation. EMODnet Bathymetry is recognized as a worldwide key actor of bathymetric data production and important partner for the Seabed 2030 initiative.

The web portal was maintained, statistics about use of portal and services were collected and several questions were received and answered by the helpdesk. The web statistics are detailed in chapter 11 and are very good. The user questions received and answered through the helpdesk are detailed in chapter 8. Many references to EMODnet Bathymetry can be found in scientific articals and thesis documents. These have been identified using Google Scholar and these listings are given in Chapter 13.

International interoperability is ensured in a number of ways. First of all, the EMODnet HRSM2 consortium consists of organisations that have international networks and are well acquainted with international cooperation also aiming at international interoperability. This includes relationships concerning standards such as: ISO, OGC, INSPIRE, SeaDataNet, IHO, IOC, and ODIP. It also includes collection and sharing of metadata, data and DTMs such as GEBCO, IBCAO, BSBD, NSBD, and NOAA/NCEI. Both levels results in formats and controlled terms that are applied to the metadata and datasets in EMODnet HRSM2 and which are therefore interoperable with international practices. It also comes back

in the web services that are based upon OGC standards and tools which are broadly used by international communities. Another element ensuring coherence and interoperability is the fact that bathymetry data are collected in-situ by remote sensing techniques and instruments which are used by the global community of hydrographers and bathymetric researchers, with relatively similar principles, methodologies and practices. This implicates that the original collected data sets are comparable in formats. Finally there is a long tradition on a global scale, such as through IHO and the GEBCO project, to share bathymetry methods and resulting datasets which also results in international interoperability. Benefiting from the previous EMODnet Bathymetry activities, EMODnet HRSM2 is well engaged in multiple active international collaborations (International Hydrographic Organisation (IHO), General Bathymetric Chart of the Ocean (GEBCO), US National Oceanographic and Atmospheric Agency (NOAA) through the Atlanctic Ocean Research Aliance (AORA), and the International Bathymetric Chart of the Arctic Ocean (IBCAO)). Further details about international cooperation are detailed as part of the separate report on interoperability and international collaboration.

WP6 combines the following task as formulated in the tender:

- Task 6: Helpdesk

WP6 contributes to the following task as formulated in the tender and as shared with WP4:

- Task 5: Web portal

WP6 also contributes to the following task as formulated in the tender and as shared with WP1:

- Task 7: International interoperability

WP6 also contributes to the following task as formulated in the tender and as shared with WP4:

- Task 9: Monitoring of performance

All tasks have progressed well as can be derived from the WP1, WP4, and WP6 progress reporting and the separate report on interoperability and international collaboration.

8. User Feedback

Quite a number of feedback forms were received through the Helpdesk. These were support messages for the project, and questions about technical issues and citation. Messages were answered where needed. The table below gives an overview of feedback events. Due to privacy law no personal names or email addresses are mentioned. In some cases, use of general email providers like Yahoo, Hotmail and Gmail made it difficult to identify the organization of users.

Date	Type	Organization	Type of user feedback (*e.g. technical, case study etc)*	Response time to address user request
7 Jan 2019	Research Institute	IFREMER, France	Problem with response mail with download URLs	Same day
18 Jan 2019	Unknown	?, Netherlands	Problem with downloading files	Same day
23 Jan 2019	Unknown	?, France	Problem with downloading files	Two days later
25 Jan 2019	Research Institute	IFREMER, France	Looking for geology maps	Same day
2 Feb 2019	Unknown	?, Spain	Problem with coastline of Menorca	Two days later
18 Feb 2019	Government	DEFRA, United Kingdom	Question about download options	Next day
22 Feb 2019	Research Institute	JRC, Italy	Question about overlap between tiles	Same day
25 Feb 2019	Research Institute	GTK, Finland	Question about MSL - LAT	Next day
28 Feb 2019	Company	GMZ, Switzerland	Question about metadata and acknowledgement	Same day
11 Mar 2019	Unknown	?,?	Question about CDI service	Same day
13 Mar 2019	Unknown	?,?	Compliments about the service	Same day
13 Mar 2019	Research Institute	CNR-ISMAR, Italy	Question about wrecks layer	Same day
19 Mar 2019	Company	HAFOK, Sweden	Question about shift in land cover	Few days later
2 Apr 2019	Company	HAFOK, Sweden	Continued communication about shift in land cover	Few days later
3 Apr 2019	Company	Noveltis, France	Question about .emo format	Same day
8 Apr 2019	Company	Noveltis, France	Question about metadata for HR-DTMs	Same day
17 Apr 2019	Company	Global Maritime Services, UK	Question whether a tile for MSL is correct	Same day
17 Apr 2019	Company	Svasek, The Netherlands	Question about a tile with issues	Same day

Date	Type	Organization	Type of user feedback (*e.g. technical, case study etc)*	Response time to address user request
25 Apr 2019	Unknown	?,?	Question about wrecks layer	Same day
25 Apr 2019	Research Institute	Institute of Marine Research, Norway	Question about 2D – 3D and about ESRI ASCII format of tiles	Same day
25 Apr 2019	Unknown	?,?	Question about Help page	Few days later
9 May 2019	University	University of Louvain, Belgium	Question about problem with downloading	Same day
9 May 2019	Company	Grizzly Geosciences Inc, USA	Question about problem with GMT software	Next day
10 May 2019	Company	Grizzly Geosciences Inc, USA	Question about GeoTiffs	Same day
14 May 2019	Private	?,?	Question about possible job positions	Few days later
16 May 2019	Company	Wsense, Italy	Question about maximum zoom level	Few days later
20 May 2019	University	University of Salento, Italy	Question about NetCDF	Next day
21 May 2019	Unknown	?,?	Question about WMS in Arc	Few days later
5 Jun 2019	Unknown	?, France	Question about resolution	Next day
11 Jun 2017	Unknown	?,?	Question about coordinate system	Few days later
19 Jun 2019	Government	US Navy, USA	Question about emo file format	Same day
20 Jun 2019	Research Institute	AWI, Germany	Question about emo format documentation	Same day
20 Jun 2019	Unknown	?,?	Question about LAT - MSL	Next day
27 Jun 2019	Unknown	?,?	Question about meaning of positive values in DTM	Same day
2 Jul 2019	Government	UK HO, UK	Question about emo format	Next day
7 Aug 2019	Company	Gavin and Doherty	Question about MSL DTM tiles	Same day

Date	Type	Organization	Type of user feedback (*e.g. technical, case study etc)*	Response time to address user request
		Geosolutions Ltd, Ireland		
9 Aug 2019	Government	Scotland government, Scotland	Noted a spelling mistake in map	Same day
14 Aug 2019	Company	Grupo Gimeno, Spain	Question about river bathymetry	Same day
14 Aug 2019	Unknown	Unknown	Question about bathymetry survey time series	Next day
15 Aug 2019	University	National University of Ireland, Ireland	Question about downloading of isolines	Same day
25 Aug 2019	University	University of York, UK	Question about referencing EMODnet Bathymetry	Next day
2 Sep 2019	University	Aarhus University, Dep of Bioscience, Denmark	Remark about anomalies in Danish bathymetry	Next day
11 Sep 2019	Student	?,Spain	Question about referencing EMODnet Bathymetry and about vessel traffic density maps	Next day
17 Sep 2019	Government	GeoData Agency, Denmark	Problem with order processing	Next day
18 Sep 2019	Government	Geology Service, Sweden	Question about identification of low and high resolution DTM parts	A week later
18 Sep 2019	University	University of Nantes, France	Question about using the DTM	Same day
20 Sep 2019	Government	GeoData Agency, Denmark	Signals a displacement of one grid cell	A week later
27 Sep 2019	Company	NoLogin, Spain	Question about LAT – MSL references	Two days later
3 Oct 2019	Company	ThinkRCG, United Kingdom	Question about difference between DTM and nautical chart depths near Ireland	Three days later
6 Oct 2019	Company	UMA, Spain	Question about losing information when joining DTM data	Two days later
10 Oct 2019	Company	UIS, Norway	How to download High Resolution DTMs near Greece	2 weeks later
28 Oct 2019	Company	Vattenfall, Germany	Question about vertical reference used in DTM	Same day

Date	Type	Organization	Type of user feedback (*e.g. technical, case study etc)*	Response time to address user request
31 Oct 2019	??	??	Whether the DTM can be downloaded with negative values	One week later
15 Nov 2019	Research Institute	FMI, Finland	Warning that the WMS service was not functioning	Same day
29 Nov 2019	University	UniCT, Italy	How to acknowledge EMODnet DTM in scientific abstracts	Three days later
3 Dec 2019	University	University of Colorado, USA	Question about geographical coverage of EMODnet DTM	Same day
15 Dec 2019	??	??	Whether EMODnet Bathymetry performs environmental studies	Next day
17 Dec 2019	Company	Tinopolis, United Kingdom	Asking permission to use EMODnet Bathymetry maps in a tv documentary	Same day
17 Dec 2019	Research Institute	HZG, Germany	Question about including land cover in downloads	Next day

9. Meetings held

Date	Location	Type event (meeting, training (workshop), etc.)	Attended (A) / Organised (O)	Short description and main results (# participants, agreements made, etc.)
5 Apr 2019	Paris - France	Technical core group meeting	O	11 Representatives of the consortium, all leading one or more work package met in Paris to discuss the organisation of the Kick Off Meeting planned in June 2019, alongside the detailed agenda of the organisation of the full project.
11- 12 Jun 2019	Brest - France	Kick off meeting	O	All Representatives of the consortium met in Brest to implement the production agenda and refresh their skills related to the use of the software
2 – 3 Sept 2019	Ghent - Belgium	EMODnet Steering Committee meeting	A	Progress presented

Date	Location	Type event (meeting, training (workshop), etc.)	Attended (A) / Organised (O)	Short description and main results (# participants, agreements made, etc.)
3 – 4 Sept 2019	Ghent - Belgium	EMODnet Technical Working Group	A	Various topics discussed
16 – 20 Sept 2019	Honolulu - USA	Ocean Obs 2019 Conference	A	Participant in Data Interoperability forum and EMODnet Bathymetry poster
22-23 Oct 2019	London - UK	Seabed 2030 meeting	A	GEBCO Meeting - The Nippon Foundation-GEBCO Seabed 2030 Project: From Vision to Action. Drafting a Memorandum of understanding.
29 Oct 2019	Brest - France	Technical meeting	O	to discuss GLOBE upgrading and QA-QC methods, and possible implications for the overall planning
4-9 Nov 2019	Portsmouth – USA	GEBCO Symposium	A	Various topics discussed

10. Outreach and communication activities

See also WP6 report in Chapter 7.

Date	Communication action/material	Short description (of the material, title, …) and/or link to the activity	Main results (# participants, # views, # press clippings, etc.)
18 Jan 2019	Webpage about	News item at portal about release of new products	Aimed at attracting users to the portal. http://www.emodnetbathymetry.eu/news/newsdetails/several-new-layers-andproducts-released-at-the-portal/59
05 Jun 2019	Scientific paper	"Seafloor Mapping – The Challenge of a Truly Global Ocean Bathymetry"	2685 views at https://www.frontiersin.org/articles/10.3389/fmars.2019.00283/full
20 Jun 2019	Conference paper and associated presentation	EMODnet Bathymetry - a compilation of bathymetric data in the European waters Presented at IEEE Oceans 2019	2000 attendees at the conference
29 Jun 2019 – 10 Jul 2019	Presentation / small group conferences	La Mer XXL	Over 30000 visitors
27 Sep 2019	Movies (fly-through) and 3D views	"Nuit européenne des Chercheurs"	>5000 visitors
16 – 20 Sep 2019	Poster	Ocean Obs 2019 Conference	1500 participants
22-23 Oct 2019	London, UK.	Meeting - The Nippon Foundation-GEBCO Seabed 2030 Project: From Vision to Action	Memorandum of understanding established between IHO and EMODnet Bathymetry
3 Nov 2019	Poster	EMODnet poster presented for the "Journée de l'information scientifique du Shom"	Approx. 70 participants

11. Updates on Progress Indicators

Indicator 1.1: Volume and coverage of available acquired data

Survey data sets are gathered from data providers and are populated into the CDI Data Discovery & Access service. This way, the number of acquired data sets can be expressed as number of CDI records.

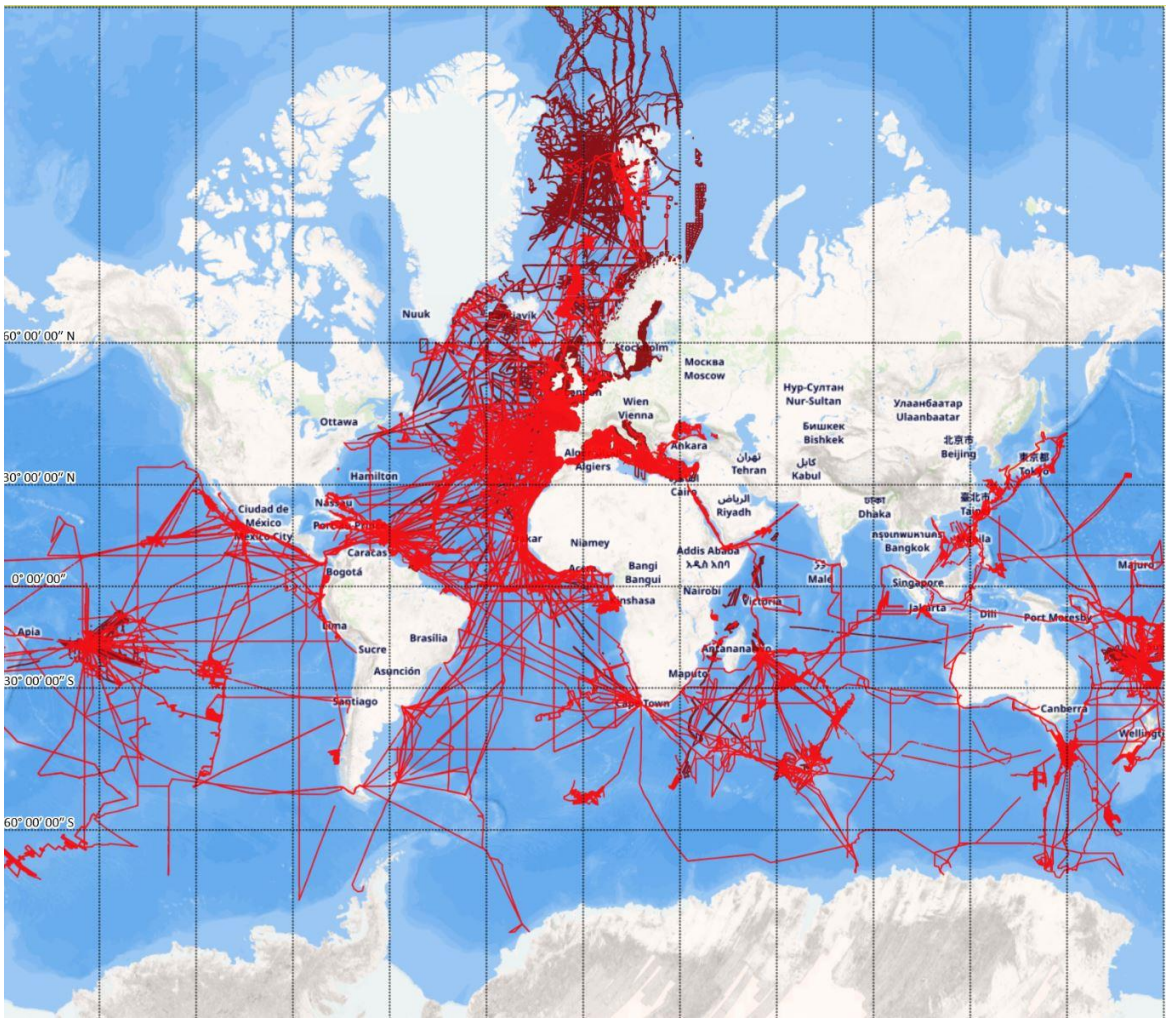


Image: Map of all entries in the CDI catalogue service

The division over sea areas is given in the following table.

Sub-theme	Atlantic	Arctic	Baltic	Black Sea	Med Sea	North Sea	Other Seas	***Total Volume per theme in portal***	***Trend %***
Bathymetry	2165	1034	5314	138	3507	10970	3703	26447	-2.65

Comments: In the reporting year, the total number of CDI records decreased from **27.168 to 26.447** CDIs. This negative trend can be explained as follows: the total number of CDI records firstly decreased from **27.168 to 26.223** records, due to a change of policy at Shom and implications of file format checks as part of the upgrading of the CDI service. Thereafter, the number of CDIs increased again by multiple data providers from **26.223 to 26.447** CDIs. See also indicator 2 for more details about the increase per data provider.

Indicator 1.2: Number and coverage of built & external data products

Next to survey data as described in the CDI Data Discovery and Access service, there are also **Composite DTM's** used as source data. These are generated by data providers as external data products and described with metadata in the Sextant catalogue service. In addition, the portal gives access to the EMODnet Digital Terrain Model (DTM) which current version was released on 14 September 2018. The table below gives a summary of the present Composite DTM entries and DTMs.

Data product	Atlantic	Arctic	Baltic	Black Sea	Med Sea	North Sea	Other Seas	***Total Volume per theme in portal***	***Trend %***
Composite DTM	15	11	9	23	89	34	0	181	23.13
EMODnet DTM	1	1	1	1	1	1	0	1	0

Comments: The trend indicates that the total number of Composite DTM entries has increased from **147 to 181** during the reporting year. See also indicator 2 for more details about the increase per data provider.

Indicator 2: Organisations supplying data and data products within reporting period

The following tables give overviews of the providers of survey data sets for the CDI service and of Composite DTMs for the Sextant products catalogue. Both data sources are relevant input for the later production of the new EMODnet DTM.

Organisation name	**Type**	**Country**	**No of CDIs**	**% of restricted data**
Flemish Ministry of Mobility and Public Works; Agency for Maritime and Coastal Services; Coastal Division	Hyd. Service	Belgium	455	100

Organisation name	Type	Country	No of CDIs	% of restricted data
Management Unit of North Sea and Scheldt Estuary Mathematical Models, Belgian Marine Data Centre	Research	Belgium	93	0
Bulgarian National Oceanographic Data Centre(BGODC), Institute of Oceanology	Research	Bulgaria	25	96
Croatian Hydrographic Institute	Hyd. Service	Croatia	54	100
Jardfeingi, the Faroe Islands Earth and Energy Directorate	Hyd. Service	Faroe Islands	13	100
IFREMER / IDM / SISMER - Scientific Information Systems for the SEA	Research	France	1424	67.7
Shom	Hyd. Service	France	7841	100
Iv.Javakhishvili Tbilisi State University, Centre of Relations with UNESCO Oceanological Research Centre and GeoDNA (UNESCO)	Research	Georgia	12	0
German Oceanographic Datacentre	Hyd. Service	Germany	1004	0
Marum - Center for Marine Environmental Sciences, University of Bremen	Research	Germany	35	100
Hellenic Centre for Marine Research, Hellenic National Oceanographic Data Centre (HCMR/HNODC)	Research	Greece	94	100
Geological Survey Ireland	Hyd. Service	Ireland	309	0
Israel Oceanographic and Limnological Research (IOLR)	Research	Israel	2	100
CNR, Institute for the Marine and Coastal Environment (IAMC) - Napoli	Research	Italy	38	100

Organisation name	Type	Country	No of CDIs	% of restricted data
CNR, Institute of Environmental Geology and Geoengineering (IGAG)	Research	Italy	20	100
CNR, Institute of Marine Science (ISMAR) - Bologna	Research	Italy	119	100
CONISMA, National Interuniversity Consortium for Marine Science	Research	Italy	45	100
Italian Navy Hydrographic Office	Hyd. Service	Italy	1116	100
OGS (Istituto Nazionale di Oceanografia e di Geofisica Sperimentale), Infrastructures Division	Research	Italy	22	100
OGS (Istituto Nazionale di Oceanografia e di Geofisica Sperimentale), Division of Oceanography	Research	Italy	10	100
Maritime Administration of Latvia	Hyd. Service	Latvia	580	100
International Ocean Institute - Malta Operational Centre (University Of Malta) / Physical Oceanography Unit	Research	Malta	6	100
NIOZ Royal Netherlands Institute for Sea Research	Research	Netherlands	49	100
Rijkswaterstaat Central Information Services	Hyd. Service	Netherlands	2703	100
Royal Netherlands Navy, Hydrographic Service	Hyd. Service	Netherlands	371	100
GRID-Arendal	Research	Norway	18	100
Norwegian Hydrographic Service (NHS)	Hyd. Service	Norway	1233	100

Organisation name	Type	Country	No of CDIs	% of restricted data
IHPT, Hydrographic Institute	Hyd. Service	Portugal	301	100
Portuguese Institute of Ocean and Atmosphere	Research	Portugal	79	100
National Institute for Marine Research and Development Grigore Antipa""	Research	Romania	11	81.8
National Institute of Marine Geology and Geoecology	Research	Romania	17	100
SC Marine Research SRL	Company	Romania	12	100
Geodetic Institute of Slovenia	Hyd. Service	Slovenia	3	100
CSIC-UTM/ Marine Technology Unit	Research	Spain	45	100
IEO/ Spanish Oceanographic Institute	Research	Spain	109	60.5
IGME, Geological Survey of Spain	Research	Spain	8	87.5
IHM, Hydrographic Institute of the Navy	Hyd. Service	Spain	58	100
Stockholm University, Department of Geological Sciences	Research	Sweden	67	100
Swedish Maritime Administration	Hyd. Service	Sweden	5724	100
British Geological Survey, Edinburgh	Research	United Kingdom	62	100
British Oceanographic Data Centre	Research	United Kingdom	130	1
OceanWise Limited	Company	United Kingdom	2130	100
TOTAL			**26447**	**92.24**

Table: Overview of data centres and number of CDI entries

Most of the CDI data sets require negotiation. Bathymetric survey data are costly to acquire and by most data providers treated with access restrictions which are indicated as part of the CDI metadata. Users can submit requests for access by means of the shopping mechanism in the CDI Data Discovery and Access service. This way data providers are informed about the requests and will contact the users by email or telephone for further discussing their requests. Most of the time this leads to positive decisions and delivery of data sets through the CDI Data Discovery and Access service or directly by e-mail by-passing the CDI service. It can also be that no agreement can be reached and then users will not get access to the requested data sets. Anyway the negotiation is an issue between the users and the data providers whereby the CDI service and in particular its Request Status Manager (RSM) service can serve as an instrument, but it can be by-passed. So as EMODnet Bathymetry there is no absolute complete insight in all transactions.

Most data providers are government and research institutes. Industry parties are: OceanWise and SC Marine Research SRL. The differences in the first project year are given in the next table.

Organisation name	Country	No of CDIs end 2018	No of CDIs end 2019	Difference
Flemish Ministry of Mobility and Public Works; Agency for Maritime and Coastal Services; Coastal Division	Belgium	342	455	113
Management Unit of North Sea and Scheldt Estuary Mathematical Models, Belgian Marine Data Centre	Belgium	93	93	0
Bulgarian National Oceanographic Data Centre(BGODC), Institute of Oceanology	Bulgaria	25	25	0
Croatian Hydrographic Institute	Croatia	54	54	0
Jardfeingi, the Faroe Islands Earth and Energy Directorate	Faroe Islands	13	13	0
IFREMER / IDM / SISMER - Scientific Information Systems for the SEA	France	1390	1424	34
Shom	France	8801	7841	-960

Organisation name	Country	No of CDIs end 2018	No of CDIs end 2019	Difference
Iv.Javakhishvili Tbilisi State University, Centre of Relations with UNESCO Oceanological Research Centre and GeoDNA (UNESCO)	Georgia	3	12	9
German Oceanographic Datacentre	Germany	1004	1004	0
Marum - Center for Marine Environmental Sciences, University of Bremen	Germany	35	35	0
Hellenic Centre for Marine Research, Hellenic National Oceanographic Data Centre (HCMR/HNODC)	Greece	94	94	0
Geological Survey Ireland	Ireland	266	309	43
Israel Oceanographic and Limnological Research (IOLR)	Israel	2	2	0
CNR, Institute for the Marine and Coastal Environment (IAMC) - Napoli	Italy	30	38	8
CNR, Institute of Environmental Geology and Geoengineering (IGAG)	Italy	20	20	0
CNR, Institute of Marine Science (ISMAR) - Bologna	Italy	119	119	0
CONISMA, National Interuniversity Consortium for Marine Science	Italy	37	45	8
Italian Navy Hydrographic Office	Italy	1073	1116	43
OGS (Istituto Nazionale di Oceanografia e di Geofisica Sperimentale), Infrastructures Division	Italy	22	22	0
OGS (Istituto Nazionale di Oceanografia e di Geofisica Sperimentale), Division of Oceanography	Italy	10	10	0
Maritime Administration of Latvia	Latvia	580	580	0

Organisation name	Country	No of CDIs end 2018	No of CDIs end 2019	Difference
International Ocean Institute - Malta Operational Centre (University Of Malta) / Physical Oceanography Unit	Malta	6	6	0
NIOZ Royal Netherlands Institute for Sea Research	Netherlands	37	49	12
Rijkswaterstaat Central Information Services	Netherlands	2703	2703	0
Royal Netherlands Navy, Hydrographic Service	Netherlands	332	371	39
GRID-Arendal	Norway	14	18	4
Norwegian Hydrographic Service (NHS)	Norway	1233	1233	0
IHPT, Hydrographic Institute	Portugal	301	301	0
Portuguese Institute of Ocean and Atmosphere	Portugal	86	79	-7
National Institute for Marine Research and Development Grigore Antipa""	Romania	9	11	2
National Institute of Marine Geology and Geoecology	Romania	14	17	3
SC Marine Research SRL	Romania	12	12	0
Geodetic Institute of Slovenia	Slovenia	3	3	0
CSIC-UTM/ Marine Technology Unit	Spain	34	45	11
IEO/ Spanish Oceanographic Institute	Spain	112	109	-3
IGME, Geological Survey of Spain	Spain	8	8	0
IHM/ Hydrographic Institute of the Navy	Spain	58	58	0
Stockholm University, Department of Geological Sciences	Sweden	67	67	0

Organisation name	Country	No of CDIs end 2018	No of CDIs end 2019	Difference
Swedish Maritime Administration	Sweden	5774	5724	-50
British Geological Survey, Edinburgh	United Kingdom	62	62	0
British Oceanographic Data Centre	United Kingdom	160	130	-30
OceanWise Limited	United Kingdom	2130	2130	0
TOTAL		**27168**	**26447**	**-721**

Table: Overview of data centres and differences in number of CDI entries in the first project year

Next to survey data as described in the CDI Data Discovery and Access service, there are also **Composite DTM's** used as source data. These are generated by data providers as external data products and described with metadata in the Sextant catalogue service. The following tables give overviews of the number of Composite DTMs per data provider and the difference in population in the first project year.

Organisation name	Type	Country	No of CDTMs end 2018	No of CDTMs end 2019	Difference
Flemish Ministry of Mobility and Public Works; Agency for Maritime and Coastal Services; Coastal Division	Hyd. Service	Belgium	4	5	1
Bulgarian National Oceanographic Data Centre(BGODC), Institute of Oceanology	Research	Bulgaria	2	3	1
Croatian Hydrographic Institute	Hyd. Service	Croatia	0	1	1
Danish Maritime Agency	Hyd. Service	Denmark	1	1	0
Estonian Maritime Administration	Hyd. Service	Estonia	2	2	0

Organisation name	Type	Country	No of CDTMs end 2018	No of CDTMs end 2019	Difference
Finnish Transport Agency	Hyd. Service	Finland	2	2	0
IFREMER / IDM / SISMER - Scientific Information Systems for the SEA	Research	France	3	3	0
Shom	Hyd. Service	France	1	1	0
BSH	Hyd. Service	Germany	15	16	1
EOMAP	Company	Germany	20	28	8
Marum - Center for Marine Environmental Sciences, University of Bremen	Research	Germany	22	32	10
Geological Survey of Israel	Research	Israel	4	4	0
CNR, Institute of Environmental Geology and Geoengineering (IGAG)	Research	Italy	1	1	0
CNR, Institute of Marine Science (ISMAR) - Bologna	Research	Italy	5	6	1
CONISMA, National Interuniversity Consortium for Marine Science	Research	Italy	7	7	0
Italian Navy Hydrographic Office	Hyd. Service	Italy	0	2	2
Maritime Administration of Latvia	Hyd. Service	Latvia	1	1	0
International Ocean Institute - Malta Operational Centre (University Of Malta) / Physical Oceanography Unit	Research	Malta	0	3	3

Organisation name	Type	Country	No of CDTMs end 2018	No of CDTMs end 2019	Difference
Royal Netherlands Navy, Hydrographic Service	Hyd. Service	Netherlands	2	2	0
Norwegian Hydrographic Service (NHS)	Hyd. Service	Norway	6	6	0
Hydrographic Office of the Polish Navy	Hyd. Service	Poland	1	1	0
EMEPC	Research	Portugal	2	2	0
Portuguese Institute of Ocean and Atmosphere	Research	Portugal	1	1	0
Geodetic Institute of Slovenia	Research	Slovenia	1	1	0
IEO, Spanish Oceanographic Institute	Research	Spain	37	41	4
IGME, Geological Survey of Spain	Research	Spain	0	1	1
IHM, Hydrographic Institute of the Navy	Hyd. Service	Spain	1	1	0
isardSAT	Company	Spain	1	1	0
Baltic Sea Hydrographic Commission (BSHC)	Hyd. Service	Sweden	1	1	0
Stockholm University, Department of Geological Sciences	Research	Sweden	1	2	1
Swedish Maritime Administration	Hyd. Service	Sweden	2	2	0
OceanWise Limited	Company	United Kingdom	1	1	0
TOTAL			**147**	**181**	**34**

Table: Overview of data providers and increase in number of Sextant entries in the first project year

Comments: The number of data providers for the CDI service is stable at 42, while in combination with the Sextant catalogue for Composite DTMs a stable number of 51 data providers continues to be active. The total volume of CDIs has decreased from 27168 to 26447, which is mostly due to a change in data distribution policy by Shom. Other CDI decreases are due to validations of data files which have taken place in the framework of the upgrading of the CDI Data Discovery & Access service. It is expected that these data files will be corrected and re-populated early 2020. One can also observe a good increase in CDIs from many data providers as well as in number of Composite DTMs (from 147 to 181). The CDI increase should continue in the first months of 2020 as part of all data providers fulfilling the data gathering tasks of the EMODnet HRSM2 contract. Some delay has occurred due to implications of the upgrading of the CDI service. However, this is not critical.

Indicator 3: Interfaces to access or view data

Theme/interface	CDI service
Data/Data product	Data
Map viewer	https://www.emodnet-bathymetry.eu/search
WMS	https://geo-service.maris.nl/emodnet_bathymetry/wms?request=getcapabilities
WFS	https://geo-service.maris.nl/emodnet_bathymetry/wfs?request=getcapabilities
WCS	
Theme/interface	Bathymetry Viewer and Download service
Data/Data product	Data product
Map viewer	https://portal.emodnet-bathymetry.eu
WMS	https://ows.emodnet-bathymetry.eu/wms
WFS	https://ows.emodnet-bathymetry.eu/wfs
WCS	https://ows.emodnet-bathymetry.eu/wcs

Table: Overview of user interfaces and web services

Comments: The CDI Data Discovery & Access service has been completely upgraded in the reporting period. This has also introduced new URLs for User Interfaces and OGC services. Moreover, all EMODnet Bathymetry services are now with equipped with https:// which is more safe and contributes to GDPR compliance.

Indicator 4: Usage of data and data products per interface and per theme

Theme/ interface name	CDI service
Data/Data Product	Data
Unit and Downloadable Volume (CDI)	26447
Trend (%)	-2.65
Number of manual downloads	5254

Trend (%)	-63.10
Number of map visualisations	123965
Trend (%)	?
Number of WMS requests	5964
Trend (%)	?
Number of WFS requests	4532
Trend (%)	?
Theme/ interface name	Bathymetry Viewer and Download service
Data/Data Product	Data product
Unit and Downloadable Volume (DTM tiles)	64
Trend (%)	0
Number of manual downloads	38417
Trend (%)	-13.13
Number of map visualisations	104258
Trend (%)	-20.77
Number of WMS requests	25148245
Trend (%)	46.30
Number of WFS requests	136017
Trend (%)	16.93

Table: Overview of user interfaces and web services

Comments: Most users are interested in browsing the EMODnet DTM and downloading DTM tiles, using the EMODnet Bathymetry Viewing & Download service, while a fraction of users is interested in requesting access to the underlying survey data sets, using the CDI service. However, without the data gathering for the CDI service, it would not be possible to generate the EMODnet DTM. Moreover, the CDI WMS and WFS web services are integrated as a layer in the EMODnet Bathymetry Viewing & Download service, and then used by users for retrieving details of surveys at specific locations. Compared to the previous year there is a slight decrease in number of downloaded DTM tiles and map visualisations, although the reported numbers continue to be very high. On top of that there is a steady increase in the use of the DTM web services, with an increase of 46% for the WMS service compared to the previous year. Overall, this indicates that EMODnet Bathymetry is providing a service which has great interest and is supporting many other web applications.

Indicator 5: Distribution of users that have used the portal's data and data products per organisation type and country, and their main use cases

Interfaces	Means of information collection	Number of users giving information	Total number of users
CDI service	Shopping form	94	94
Bathy viewing service	Shopping form	4092	4092
Organisation type	**% of users**	**Main use cases and application areas**	
company	22.09	consultancy, Project preparation, map products, study, hydrodynamic modelling, area characterisation, job preview, military exercise preparation, bathymetry and topography investigation, cable routing, pipeline routing, underwater noise calculations, geological desk study, base mapping, environmental study, wave power R&D, wind farm planning, water depths assessment for vessels, diving operations, background map	
government	5.69	coral assessment, background map, wave research, hydrodynamic modelling, military applications, geological research, route analysis environmental context, research, marine protected areas analysis, fisheries analysis, fish stock modelling, underwater acoustics, sediment transport study	
international organisation	0.27	sea defence design, Pristine Seas initiative	
NGO	2.13	university paper, education, dolphins distribution, research, basemap, fisheries research, tourism	
public	6.11	interest, research, fishing, diving, art, gis training, sea wave modelling, recreational map, background map, environmental studies,	
research institute	18.11	master thesis, fellowship, research, background map, geophysical research, underwater acoustics research, gis mapping, writing proposals, marine conservation study, hydrodynamic modelling, tsunami simulations, PhD study, ship routing, marine species habitat studies, MSFD, deriving products, fisheries research, teaching,	

university	44.31	education, teaching, students projects, case studies, GIS course, research, master thesis, PhD thesis, academic archaeological research, hydrogeological modelling, scientific papers, active tectonics research, modelling, glacial geomorphological mapping, volcanology, acoustic propagation models	
unknown	1.27	research, general interest	

Table: Overview of number of users per service, their organization types, and their interests

Country	% of users	Country	% of users
Afghanistan	0.12	Libya	0.02
Åland Islands	0.15	Lithuania	0.07
Albania	0.07	Luxembourg	0.02
Algeria	0.39	Madagascar	0.05
Andorra	0.12	Malaysia	0.05
Angola	0.07	Malta	0.54
Anguilla	0.03	Mexico	0.42
Antigua and Barbuda	0.03	Moldova	0.02
Argentina	0.03	Monaco	0.02
Australia	0.37	Montenegro	0.02
Austria	0.2	Morocco	0.39
Azerbaijan	0.03	Myanmar	0.05
Bangladesh	0.03	Namibia	0.02
Belgium	1.81	Netherlands	4.96
Bosnia and Herzegovina	0.05	New Caledonia	0.02
Brasil	0.2	New Zealand	0.12
Brazil	0.12	Nigeria	0.02
Bulgaria	0.27	Norway	1.96

Country	% of users	Country	% of users
Canada	0.59	Oman	0.05
Cape Verde	0.03	Palestine, State of	0.02
Chile	0.27	Peru	0.27
China	0.29	Philippines	0.02
Colombia	0.17	Phillipines	0.1
Costa Rica	0.05	Poland	0.64
Croatia	0.34	Portugal	4.57
Cuba	0.03	Réunion	0.02
Cyprus	0.32	Romania	0.86
Czechia	0.03	Russian Federation	0.66
Denmark	2.42	Saudi Arabia	0.12
Ecuador	0.15	Serbia	0.07
Egypt	0.46	Singapore	0.05
El Salvador	0.03	Slovakia	0.07
Estonia	0.07	Slovenia	0.02
Ethiopia	0.03	South Korea	0.02
Faroe Islands	0.03	Spain	16.2
Finland	0.51	Sri Lanka	0.05
France	7.62	Suriname	0.02
Georgia	0.07	Sweden	2.39
Germany	4.59	Switzerland	0.64
Greece	4.42	Syria	0.02
Guernsey	0.03	Syrian Arab Republic	0.05

Country	% of users	Country	% of users
Honduras	0.03	Taiwan, Province of China	0.07
Hong Kong	0.05	Tajikistan	0.02
Hungary	0.03	Thailand	0.02
Iceland	0.17	Trinidad and Tobago	0.02
India	0.24	Tunesia	0.05
Indonesia	0.37	Tunisia	0.27
Iran	0.05	Turkey	3.08
Iran, Islamic Republic of	0.07	UAE	0.05
Ireland	1.91	Ukraine	0.15
Isle Of Man	0.03	United Arab Emirates	0.05
Israel	0.81	United Kingdom	17.3
Italy	9.09	United States	2.05
Japan	0.1	Unknown	0.05
Korea, Democratic People's Republic of	0.02	USA	1.22
Korea, Republic of	0.05	Viet Nam	0.02
Lebanon	0.12		

Table: Overview of % of users per country

Comments: Most users are interested in browsing the EMODnet DTM and downloading DTM tiles using the EMODnet Bathymetry Viewing & Download service. Over the reporting period more than 4000 users from more than 2100 different organisations have downloaded one or more DTM tiles. The downloading users originate from more than 110 countries and their organisations are well divided over all society sectors.

Indicator 6: External products (websites, apps,…) built on top of web-services

We have no knowledge or information to complete the table.

Indicator 7: Published use cases and number of readings

Use case title	Release date	Number of views on Portal in reporting period (if applicable)	Appears in Central Portal	Number of views on Central Portal in reporting period
EMODnet Bathymetry & Physics data supporting Sea Situational Awareness for tourist navigation	24/03/2019	n/a	Yes	96
Bathymetry data at the basis of geomorphological mapping	25/02/2019	n/a	Yes	152
EMODnet Human Activities Data Facilitate Business Opportunities	25/02/2019	n/a	Yes	41
Seagrass detection in the Mediterranean: A supervised learning approach	15/01/2019	n/a	Yes	94
EMODnet plays a role in building the first submarine electricity interconnection between Spain and France	28/08/2018	n/a	Yes	31
Centralised public access to high quality bathymetry and sediment data facilitates SMEs both for consultancy work, outreach and service development	21/08/2018	n/a	Yes	42
'Symphony' and marine spatial planning in Swedish Geology	12/03/2018	n/a	Yes	73
EMODnet bathymetry data supporting IMDC consultants in tackling water-related issues	07/11/2017	n/a	Yes	20
Enhancing marine topographical data discovery and access in the North Atlantic	16/10/2017	n/a	Yes	9
Improving storm surge modelling in the North Sea	16/10/2017	n/a	Yes	66

Comments: This indicator concerns use cases related to EMODnet Bathymetry which have been published at the central portal. It appears that a number of users has shown an interest in the different use case publications during the first annual reporting period.

Indicator 8: Portal & Social Media visibility

The following information has been collated on the basis of the quarterly reports as provided by Trust-IT.

8.1 Visibility & Analytics (Portal overview)	*Reporting date*	*Reporting date*	*Reporting date*	*Reporting date*	*Analytics tool*
	01/04/2020	*01/07/2020*	*01/10/2020*	*01/01/2020*	*Matomo*
	Actual Report	Actual Report	Actual Report	Actual Report	
Unique visitors	10245	6486	5115	5391	
Unique returning visitor	4331	2561	1884	2148	
Unique page views	24840	15991	12161	16054	
Bounce rate	46%	34%	33.53	26.41	
Bounce rate for Returning Visits	48%	31%	30.31	25.05	

Comments: These indicators indicate that the number of visitors was quite high in the first quarter compared to the rest of the year. This can be explained by the publicity that was given end 2018 and begin 2019 around the release of the new EMODnet DTM and several others layers and services. Luckily the three following quarters the number of visitors is quite stable.

8.2 SEO assessment -Brand monitoring	*Reporting date*	*Reporting date*	*Reporting date*	*Reporting date*	*Analytics tool*
	01/04/2019	*01/07/2019*	*01/10/2019*	*01/01/2020*	*SEMrush*
URL	BM scores [1]	BM scores [1]	BM scores [1]	BM scores [1]	
https://www.marinetechnologynews.com/news/c/ireland	46	NA	NA	58	

https://www.gebco.net/about_us/meetings_and_minutes/forum/	NA	NA	NA	48	
https://www.gebco.net/about_us/committees_and_groups/scrum/mapping_projects/	NA	NA	NA	48	
https://www.gebco.net/about_us/acknowledgements/our_data_contributors/	NA	NA	NA	48	
https://www.frontiersin.org/articles/10.3389/fmars.2019.00283/full	NA	76	NA	NA	

URL	Total Mentions	Total Mentions	Total Mentions	Total Mentions	
https://www.marinetechnologynews.com/news/c/ireland	NA	NA	NA	1	
https://www.gebco.net/about_us/meetings_and_minutes/forum/	NA	NA	NA	1	
https://www.gebco.net/about_us/committees_and_groups/scrum/mapping_projects/	NA	NA	NA	1	
https://www.gebco.net/about_us/acknowledgements/our_data_contributors/	NA	NA	NA	1	
https://www.frontiersin.org/articles/10.3389/fmars.2019.00283/full	NA	8	NA	NA	

URL	Mentions with backlinks	Mentions with backlinks	Mentions with backlinks	Mentions with backlinks	
https://www.marinetechnologynews.com/news/c/ireland	NA	NA	NA	0	
https://www.gebco.net/about_us/meetings_and_minutes/forum/	NA	NA	NA	0	
https://www.gebco.net/about_us/committees_and_groups/scrum/mapping_projects/	NA	NA	NA	0	

https://www.gebco.net/about_us/acknowledgements/our_data_contributors/	NA	NA	NA	0	
https://www.frontiersin.org/articles/10.3389/fmars.2019.00283/full	NA	yes	NA	NA	
[1] Measures the domain's authority on a 100-point scale, based on SEMrush's Domain Score.					

Comments: These tables give a number and indicators of website pages which refer to the EMODnet Bathymetry website.

8.3 SEO assessment - Acquisitions	*Reporting date*	*Reporting date*	*Reporting date*	*Reporting date*	*Analytics tool*
	01/04/2019	*01/07/2019*	*01/10/2019*	*01/01/2019*	*Matomo*
	Acquisitions				
	Visits	Visits	Visits	Visits	
Direct	7770	4063	3192	3577	
Referral	953	546	582	459	
Organic Search	2620	3499	2013	2137	
8.4 SEO assessment - Performances	*Reporting date*	*Reporting date*	*Reporting date*	*Reporting date*	*Analytics tool*
	01/04/2019	*01/07/2019*	*01/10/2019*	*01/01/2019*	*SEMrush*
Keyword	Volume	Volume	Volume	Volume	
dtm reference framework	n/a	n/a	n/a	n/a	
dtm coverage	10	10	10	10	
Keyword	Portal Positioning	Portal Positioning	Portal Positioning	Portal Positioning	
dtm reference framework	3	1	1	1	
dtm coverage	75	45	17	99	
[1] The amount or quantity of searches that occur for a particular keyword or term					

Comments: These first table gives a quite stable behaviour. For the latter we have no full understanding.

Indicator 9.1: Portal Technical monitoring

The following information has been collated by Trust-IT.

9.1 Technical monitoring	*Date*	*Date*	*Date*	*Date*
	01/04/2019	*01/07/2019*	*01/10/2019*	*01/01/2020*
Portals	Website availability [1] (Average value in the period)	Website availability [1] (Average value in the period)	Website availability [1] (Average value in the period)	Website availability [1] (Average value in the period)
Bathymetry	79%	99.95%	99.82%	99.83%
Portals	Response time [2] (Average value in the period)	Response time [2] (Average value in the period)	Response time [2] (Average value in the period)	Response time [2] (Average value in the period)
Bathymetry	2999.67ms	387.30ms	835.12ms	1010.16ms

Comments on Technical monitoring: The portal has a very good and stable website availability. Only the response time in the first quarter is quite long, maybe due to many users downloading large numbers of DTM tiles which are quite large.

Indicator 9.2: Portal user-friendliness

The following information has been collated by Trust-IT.

Visual Harmonisation score	***Date***	***Portal name***	***Visual harmonisation score***	
	01/01/2020	*Bathymetry*	*75/81*	
Harmonisation elements	***Description***		***Score [1] (3 1 0)***	***Trend (+ - =)***
Logo usage	*subtotal*		*12 /12*	(+ - =)
Logo position			*3*	=
Logo type			*3*	=
Logo size			*3*	=
Logo url			*3*	=
Font usage	*subtotal*		*15/15*	(+ - =)
Font type			*3*	=

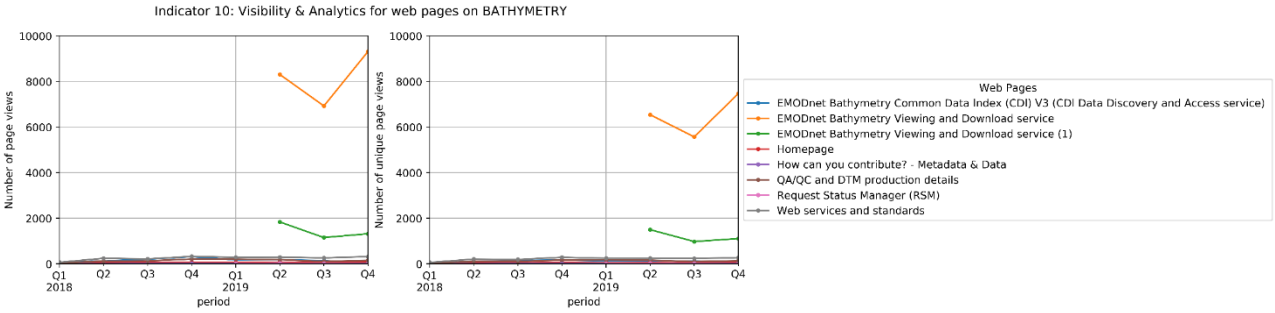
Font usage (capital letters, etc.)			*3*	=
Font spacing			*3*	=
Font colour			*3*	=
Font justification			*3*	=
Webportal header	*subtotal*		*21/21*	(+ - =)
Pattern usage			*3*	=
Header size			*3*	=
Search box			*3*	=
Contact Us button			*3*	=
Submit Data button			*3*	=
Favicon			*3*	+
Stripline colour			*3*	=
Footer structure	*subtotal*		*17/21*	(+ - =)
Footer size			*1*	=
Footer elements			*1*	=
Footer visuals			*3*	=
EC Acknowledgement			*3*	=
EC flag			*3*	=
Link to social media			*3*	=
Social Media icons			*3*	=
Policy Privacy	*subtotal*		*4/6*	(+ - =)
Presence			*3*	=
GDPR compliant		*No I Accept Privacy Policy under Contact us form*	*1*	=
Main menu	*subtotal*		*6/6*	(+ - =)
User experience			*3*	=
Sub menu			-	=
Menu tabs terminology			-	=
Menu size			*3*	=
Responsive				(+ - =)

Comments: The overall score has increased regularly during the reporting period and is now very good. Further instructions have been requested and received from Trust-IT concerning the low footer scores.

These will be implemented in the expectation of an even higher score in the following quarter. The same applies for optimising the GDPR compliance score.

Indicator 10: Visibility & Analytics for web pages

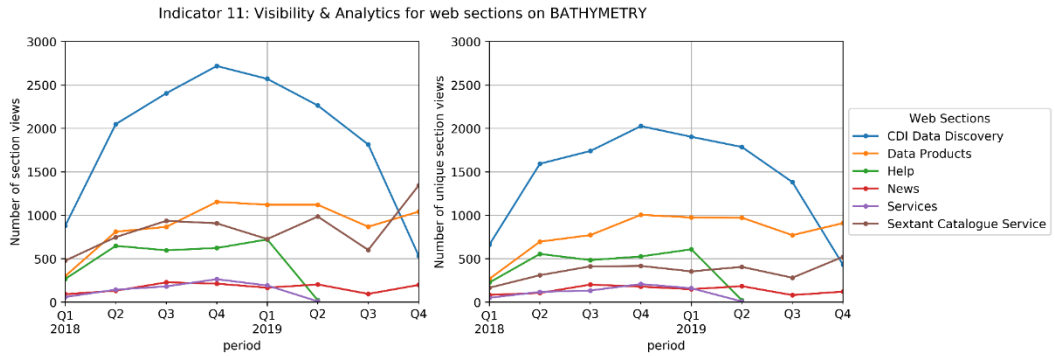
The following graphics has been collated by Trust-IT.



Comments: As expected, pages relative to the "EMODnet bathymetry viewing and Download Service" have the highest score. This means that users spent the most time browsing and interacting with the viewing service which as many functions and overall is the most interesting product and service that EMODnet Bathymetry has to offer. From there, users also undertake downloading of DTM tiles which has a continuous high score of circa 9000 – 10000 downloaded files per quarter.

Indicator 11: Visibility & Analytics for web sections

The following graphics has been collated by Trust-IT.

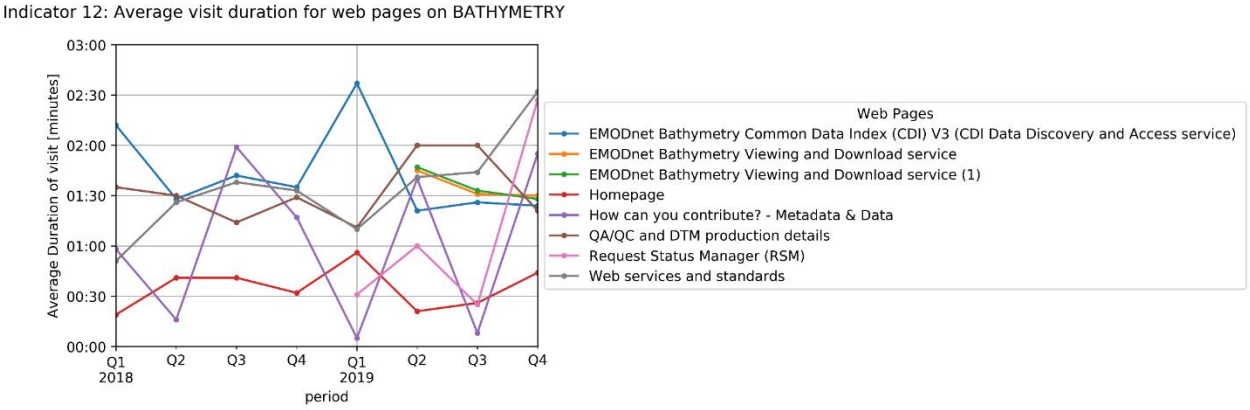


Comments: See comments provided for 8. The data product section with the viewing services remains a constant driver for most of the visitors. The number of visits on the CDI Data discovery shows a decrease. As part of the recent upgrading, which makes the user interface more attractive and efficient, and the

ongoing further population, it is expected that this will increase again. Extra promotion will be undertaken to make users aware of the upgraded service. Also, it needs checking if the Matomo script has been implemented in a correct way when moving from the old V3 to the new V5 CDI service.

Indicator 12: Average visit duration for web pages

The following graphics has been collated by Trust-IT.



Comments: Average visit duration is erratic, ranging from few seconds to 2:30 minutes. The interpretation of this diagram is complex as it might be interpreted in terms of user's interest but also, difficulty to understand the concept described on the web page. From Q3 to Q4 the following pages have seen some increase in average visit duration: RSM, How can you contribute and Web services.

12. Recommendations for follow-up actions by the EU

- Promote the EMODnet Bathymetry infrastructure as a repository for all european bathymetric data and more especially those financed by european funds. This could take the form of citing EMODnet Bathymetry in contractual documents (tenders or calls for proposal) which concern bathymetry data acquisition and/or management.
- Discuss strategies to motivate non EU data providers, especially for north Africa, but also Russian Federation.

13. Additional user statistics

List of publications referencing to EMODnet Bathymetry

The following references to EMODnet Bathymetry can be found using Google Scholar early 2020. References are given for accepted papers and edited books for the first project year. This list is not exhaustive.

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
Jan 19	*Peer Reviewed Journal:* Natural hazards and earth system sciences	Tsunami run-up estimation based on a hybrid numerical flume and a parameterization of real topobathymetric profiles.	Aniel-Quiroga, I.; Quetzalcóatl, O.; González, M.; Guillou L.	Universidad de Cantabria, SP
Jan 19	*Peer Reviewed Journal: Geochemistry, Geophysics, Geosystems*,	Pockmarks in the Witch Ground Basin, central North Sea.	BÖTTNER, C., BERNDT, C., REINARDY, B, *et al.*	GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany
Jan 19	*Peer Reviewed Journal: Progress in Oceanography*	Vertical distribution of Microbial Communities abundance and biomass in two NW Mediterranean Sea submarine canyons.	DIOCIAIUTI, T., AUBRY, F. B, et UMANI, S	Oceanography Division-Istituto Nazionale di Oceanografia e Geofisica Sperimental, IT

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
Jan 19	*Peer Reviewed Journal: Heliyon*.	Endobiotic communities of Marine Sponges in Cyprus (Levantine Sea).	PAPATHEODOULOU, M., JIMENEZ, C., PETROU, A., *et al.*	University of Glasgow, UK
Jan 19	*Peer Reviewed Journal: Marine and Petroleum Geology*	Active degassing across the Maltese Islands (Mediterranean Sea) and implications for its neotectonics.	MICALLEF, A., SPATOLA, D., CARACAUSI, A., *et al.*	University of Malta, MT
Feb 19	*Peer Reviewed Journal: Geomorphology*	Regional scale morphological pattern of the Tyrrhenian Sea: New insights from EMODnet bathymetry	Palmiotto, C., Loreto, M. F.	CNR, Bologna IT
Feb 19	6th Mediterranean Symposium on Marine Vegetation	STRATEGY TO STUDY BLUE CARBON ECOSYSTEMS IN CORSICA.	VALETTE-SANSEVIN, A.	University of Corsica, FR
Feb 19	Report	Stakeholder Engagement 'Support Facility' Test Exercise (Demonstrator)	Miguez, B. M.; Calewaert, J. B.	Seascape consultant, BE
Feb 19	Peer reviewed journal *Journal of Maps*	Seabed classification around Lampione islet, Pelagie Islands Marine Protected area, Sicily Channel, Mediterranean Sea.	INNANGI, S.; DI MARTINO, G.; ROMAGNOLI, C.; *et al.*	CNR ISMAR, IT
Feb 19	BSc grade report	*Viabilidade dun parque eólico mariño en Cantabria considerando plataformas flotantes de tipo semisumerxible*	Feijoo Díaz, L.	Universidade de Coruna, SP
Feb 19	Peer reviewed journal *Ecological Indicators*	Assessing the environmental status of temperate mesophotic reefs: A new, integrated methodological approach	ENRICHETTI, F. ; BO, M. ; MORRI, C. *et al.*	Università di Genova, IT

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
Feb 19	Journal Geomedia	Le Carte Nautiche: dalla carta ai BIT	*Aldo Caterino*	Istituto Idrografico della Marina, IT
Feb 19	Peer reviewed Journal *Quaternary International*	Late Holocene sea-level evolution of Paros Island (Cyclades, Greece).	KARKANI, A., EVELPIDOU, N., GIAIME, M., *et al.*	University of Athens, GR
Feb 19	*Peer Reviewed Journal: Energies*,	Characterization of Wave Energy Potential for the Baltic Sea with Focus on the Swedish Exclusive Economic Zone.	Nilsson, E., Rutgersson, A., Dingwell, A., Björkqvist, J. V., Pettersson, H., Axell, et al	Department of Earth Sciences, Uppsala University, SE
Feb 19	*Peer Reviewed Journal: Progress in Oceanography*,	Living foraminiferal assemblages in two submarine canyons (Polcevera and Bisagno) of the Ligurian basin (Mediterranean Sea).	Di Bella, L., Sabbatini, A., Carugati, L., Martire, M. L., Luna, G. M., Pierdomenico, M., et al.	Dipartimento di Scienze della Terra, "Sapienza" Università di Roma, IT
Feb 19	Data acquisition report	RV MARIA S. MERIAN Fahrtbericht/Cruise Report MSM78-PERMO 2, Edinburgh–Edinburgh (UK), 16.10.–25.10. 2018.	Karstens, J., Böttner, C., Edwards, M., Falcon-Suarez, I., Flohr, A., James, R., et al.	Geomar Helmoltz-Zentrum für Ozeanforschung Kiel DE

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
Feb 19	*Peer Reviewed Journal: Mitigation and Adaptation Strategies for Global Change*	Carbon dioxide submarine storage in glass containers: Life Cycle Assessment and cost analysis of four case studies in the cement sector.	BARRETO, B. B., CASERINI, S., DOLCI, G., *et al.*	Dipartimento di Ingegneria Civile e Ambientale Politecnico di MilanoMilan IT
Feb 19	Peer review journal Nature Scientific report	A unique and threatened deep water coral-bivalve biotope new to the Mediterranean Sea offshore the Naples megalopolis.	TAVIANI, M., ANGELETTI, L., CARDONE, F., *et al.*	CNR, IT
Feb 19	MsC Thesis	Positioning of Danish offshore wind farms until 2030-using Levelized Cost of Energy.	OHLSEN, G. L, CLAUSEN, N-E, et ABRAHAMSEN, A. B.	Technical University of Denmark DK
Feb 19	Peer review journal Natural Hazards and Earth System and Sciences	From regional to local SPTHA: efficient computation of probabilistic tsunami inundation maps addressing near-field sources	**Volpe, M.; Lorito, S; Selva, J; Tonini, R.; Romano, F. Brizuela**, B	Istituto Nazionale di Geofisica e Vulcanologia, IT
Feb 19	*Conference proceedings: 2018 IEEE International Workshop on Metrology for the Sea; Learning to Measure Sea Health Parameters (MetroSea)*	Monitoring for Coastal Resilience: A Project for Five Italian Beaches.	Melito, L., Parlagreco, L., Perugini, E., Postacchini, M., Zitti, G., Brocchini, M.	Università Politecnica delle Marche, IT
Feb 19	*Conference proceedings: 2018 IEEE International*	Seafloor habitat mapping on the" Pelagie Islands" MPA (Sicily Channel) using Remote Sensing Object Image Analysis supported	Innangi, S., Tonielli, R., Romagnoli,	Istituto per l'Ambiente

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
	Workshop on Metrology for the Sea; Learning to Measure Sea Health Parameters (MetroSea)	by multibeam bathymetry and ground-truth data	C., Innangi, M	Marino Costiero, IT
March 19	Conference: 8th International Workshop on Marine Technology : MARTECH 2018. "Instrumentation Viewpoint".	*EMODnet physics: towards an European impulsive noise register*	Novellino, A.; Alba, M.	ETT Spa, IT
March 19	*Peer Reviewed Journal: Natural Hazards and Earth System Sciences*	*Tsunamigenic potential of a Holocene submarine landslide along the North Anatolian Fault (northern Aegean Sea, off Thasos island): insights from numerical modelling*	**Janin, A; Rodriguez M.; Sakellariou D.; Lykousis V.; Gorini** C.	Laboratoire de Géologie de l'Ecole normale supérieure de Paris, FR
March 19	Msc Thesis	*Modelling shelf morphodynamics and shoreline change: free behaviour and response to the construction of artificial islands*	Wolf T.	Utrecht University, NL
March 19	Book	*Maritime Spatial Planning.*	ZAUCHA, J.; GEE, K.	University of Gdansk
March 19	Book section In: *Maritime Spatial Planning*.	Challenges and Opportunities for Ecosystem-Based Management and Marine Spatial Planning in the Irish Sea.	O'HIGGINS, T.; O'HIGGINS, L.; O'HAGAN, A-M, *et al.*	University College Cork, IE
March 19	Book section In: *Coasts and Estuaries*	The Black Sea—The Past, Present, and Future Status.	GÜNEROĞLU, A.; SAMSUN, O.;	Faculty of Marine Sciences, Karadeniz Technical

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
			FEYZIOĞLU, M.; *et al.*	University, Çamburnu, Trabzon TK
March 19	Peer reviewed journal *Energy Procedia*,	Marine Currents Energy Resource Characterization for Morocco.	HAZIM, S.; EL OUATOUATI, A.; JANAN, M. T.; *et al.*	Mohammed V University of Rabat, Morocco
March 19	Peer reviewed journal *Irish Geography*	Temporal variability in winter wave conditions and storminess in the northwest of Ireland	LOUREIRO, C.; COOPER, A.	University of Stirling UK
March 19	*Peer Reviewed Journal:* Miscellanea Malacologica	A unique and diverse amalgamated mollusk assemblage from the Coral Patch Seamount, eastern Atlantic.	HOFFMAN, L.; FREIWALD, A.	Senckenberg am Meer, Abteilung Meeresforschung DE
April 2019	*Peer Reviewed Journal: Science advances.*	*Ice-stream demise dynamically conditioned by trough shape and bed strength.*	BRADWELL, T., SMALL, D., FABEL, D., et al.	University of Stirling, UK
April 2019	*Peer Reviewed Journal: Geosciences*.	Legacy Data: How Decades of Seabed Sampling can Produce Robust Predictions and Versatile Products.	MITCHELL, P J., ALDRIDGE, J, et DIESING, M.	CEFAS, UK
April 2019	*Peer Reviewed Journal: Tectonophysics.*	Fault pattern and seismotectonic potential at the south-western edge of the Ionian Subduction system (southern Italy): New field and geophysical constraints.	BARRECA, G., SCARFÌ, L., GROSS, F., et al.	University of Catania, Italy
April 2019	*Peer Reviewed Journal: European*	Medieval Bruges and its outports. A landscape-archaeological contribution to the Zwin-debate. 2019.	TRACHET, J. et DE	University Gent, BE

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
	Harbour Data Repository.		RUIJSSCHER, D.	
April 2019	*Peer Reviewed Journal: European Harbour Data Repository.*	The Thracian harbour city Ainos.	SCHMIDTS, T.	University of Tuebingen, Germany
April 2019	*Peer Reviewed Journal: Nature Scientific data.*	Nutrient, pigment, suspended matter and turbidity measurements in the Belgian part of the North Sea.	MORTELMANS, J., DENEUDT, K., CATTRIJSSE, A., et al.	VLIZ, Oostende, Belgium
April 2019	*Peer Reviewed Journal: Wind Energy.*	Estimation of offshore extreme wind from wind-wave coupled modeling.	LARSÉN, X. G., DU, J., BOLAÑOS, R., et al.	Technical University of Denmark, Denmark
April 2019	*Peer Reviewed Journal: Marine and Petroleum Geology.*	Active degassing across the Maltese Islands (Mediterranean Sea) and implications for its neotectonics.	MICALLEF, A., SPATOLA, D., CARACAUSI, A., et al.	University of Malta, MT
April 2019	*Peer Reviewed Journal: Scientia Marina.*	Spatiotemporal abundance pattern of deep-water rose shrimp, Parapenaeus longirostris, and Norway lobster, Nephrops norvegicus, in European Mediterranean waters.	SBRANA, M., ZUPA, W., LIGAS, A., et al.	Centro Interuniversitario di Biologia Marina ed Ecologia Applicata "G. Bacci" (CIBM), Italy
April 2019	*Peer Reviewed Journal: Heliyon.*	Endobiotic communities of Marine Sponges in Cyprus (Levantine Sea).	PAPATHEODOULOU, M., JIMENEZ, C., PETROU, A., et al.	University of Glasgow,

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
April 2019	*Peer Reviewed Journal: Progress in Oceanography.*	Vertical distribution of Microbial Communities abundance and biomass in two NW Mediterranean Sea submarine canyons.	DIOCIAIUTI, T., AUBRY, F. B., et UMANI, S. F.	OGS, Trieste, IT
April 2019	*Peer Reviewed Journal: Geochemistry, Geophysics, Geosystems.*	Pockmarks in the Witch Ground Basin, central North Sea.	BÖTTNER, C., BERNDT, C., REINARDY, B, et al.	GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany
April 2019	*Peer Reviewed Journal:* Sensors	Monitoring for Coastal Resilience: A Project for Five Italian Beaches.	MELITO, L., PARLAGRECO, L., PERUGINI, E., et al.	Istituto Superiore per la Protezione e la Ricerca Ambientale, Rome, Italy
May 2019	*Peer Reviewed Journal: Seismological Research Letters.*	Seismicity and Noise Recorded by Passive Seismic Monitoring of Drilling Operations Offshore the Eastern Canary Islands.	UGALDE, A., GAITE, B., RUIZ, M., et al.	CSIC, Barecelona, SP
May 2019	*Thesis (MSc)*	Hydrodynamics and sand transport on the lower shoreface of the Ameland tidel inlet.	Leummens, M. (2018)	University Twente, NL
May 2019	*Peer Reviewed Journal: Frontiers in Marine Science.*	Seafloor Mapping–the challenge of a truly global ocean bathymetry.	WÖLFL, A., SNAITH, H., AMIREBRAHIMI, S., et al.	GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany
May 2019	*Peer Reviewed Journal: Tectonophysics.*	Multi-temporal tectonic evolution of Capo Granitola and Sciacca foreland transcurrent faults (Sicily channel).	FERRANTI, L., PEPE, F., BARRECA, G., et al.	Università di Napoli, IT

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
May 2019	*Conference Proceedings: MARID VI, 2019, p. 127.*	Evolution of offshore sand ridges in tideless continental shelves (Western Mediterranean)	Durán , R., Guillén J., Ribó, M., Puig, P, Muñoz, A.	CSIC, Barcelona
May 2019	*Conference Proceedings: MARID VI, 2019, p. 127.*	Multi-scale analysis of sandbank features optimising geomorpho-logical mapping of sandy shelf environments: Belgian part of the North Sea.	KINT, Lars.	Royal Belgian Institute of Natural Sciences, BE
May 2019	*Peer Reviewed Journal: PlatForum.*	Marine Shell Ornaments in Atlantic Europe: Standardization of Form in the Gravettian.	ROGERS, Lisa.	
May 2019	*Peer Reviewed Journal: Marine Geology.*	Morphological evidence for marine ice stream shutdown, central Barents Sea.	KURJANSKI, B., REA, B. R., SPAGNOLO , M., et al.	University of Aberdeen, UK
May 2019	*Peer Reviewed Journal: Journal of Marine Science and Engineering.*	Weather-routing system based on METOC navigation risk assessment.	FABBRI, T. et VICEN-BUENO, R.	NATO STO, La Spezia, IT
May 2019	*Peer Reviewed Journal: Natural Hazards and Earth System Sciences*	Tsunami run-up estimation based on a hybrid numerical flume and a parameterization of real topobathymetric profiles. 2018.	ANIEL-QUIROGA ZORRILLA, I., GUTIÉRREZ GUTIÉRREZ, O. Q., GONZÁLEZ RODRÍGUE Z, E. M., et al.	Universidad de Cantabria
June 2019	*Peer Reviewed Journal: Pure and Applied Geophysics.*	Tsunami Potential of Moderate Earthquakes: The July 1, 2009 Earthquake (Mw 6.45) and its Associated Local Tsunami in the Hellenic Arc.	BOCCHINI, G. M., NOVIKOVA, T., PAPADOPO ULOS, G. A., et al.	Natioanl Observatory Athens, GR

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
June 2019	*Conference Proceedings: Proceedings of the 2018 International Conference on Computational Science and Computational Intelligence (CSCI'18).*	Multi-criteria weather routing optimization based on ship navigation resistance, risk and travel time.	Fabbri, T., Vicen Bueno, R., Hunter, A.	NATO CMRE, IT
June 2019	*Peer Reviewed Journal: Tectonics, 2019.*	Spatial and temporal evolution of rifting and continental breakup in the Eastern Black Sea Basin revealed by long-offset seismic reflection data.	MONTELEONE, V., MINSHULL, T. A., et MARIN-MORENO, H.	National Oceanography Centre,
June 2019	*MSc Report*	Estudio de áreas de implementación de sistemas undimotrices en la costa gallega.	RODRÍGUEZ ABAL, D. et al.	UNIVERSIDAD POLITÉCNICA DE CARTAGENA, SP
June 2019	*Conference Proceedings: International Conference on Computational Science. Springer, Cham, 2019. p. 265-278.*	Implementation of a 3-Dimensional Hydrodynamic Model to a Fish Aquaculture Area in Sines, Portugal-A Down-Scaling Approach.	CORREIA, A., PINTO, L., et MATEUS, M.	Universidade de LisboaLisbonPortugal
June 2019	*Peer Reviewed Journal: Geologia Croatica, 2019, vol. 72, no 2, p. 137-144.*	In search of the seismogenic fault of the March 23rd 2018 earthquake (Mw 3.7) near Brindisi (Puglia, Southern Italy).	FESTA, V., DE GIOSA, F., MORETTI, M., et al.	Università degli Studi di Bari "Aldo Moro", IT
June 2019	*Peer Reviewed Journal: Heritage, 2019, vol. 2, no 2, p. 1588-1613.*	Sustainable Management of Underwater Cultural Heritage: The Route from Discovery to Engagement—Open Issues in the Mediterranean.	ARGYROPOULOS, V. STRATIGEA, A.	Ag. Spyridonos,, GR

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
June 2019	*Peer Reviewed Journal: Paleoceanography and Paleoclimatology.*	Millennial-scale climate variability and dinoflagellate-cyst-based seasonality changes over the last~ 150 kyrs at 'Shackleton Site'U1385.	DATEMA, M., SANGIORGI, F., DE VERNAL, A., et al.	University Utrecht, NL
July 2019	*Journal of Operational Oceanography*	Developing community marine data service for Blue Growth sectors.	She, J., & Murawski, J. (2019)..	Danish Meteorological Institute, Denmark
July 2019	*Remote Sensing*, *11*(16), 1848.	(2019). On the Segmentation of the Cephalonia–Lefkada Transform Fault Zone (Greece) from an InSAR Multi-Mode Dataset of the Lefkada 2015 Sequence.	Svigkas, N., Atzori, S., Kiratzi, A., Tolomei, C., Antonioli, A., Papoutsis, I., ... & Kontoes, C. H.	Aristotle University of Thessaloniki, Greece
July 2019	*Geo-Marine Letters*, 1-14.	Geostatistical mapping of marine surficial sediment types in the Northern Aegean Sea using indicator kriging.	Zananiri, I., & Vakalas, I.	Hellenic Survey of Geology & Mineral Exploration, Greece
July 2019	Thesis	Estudi tècnic - econòmic d'un parc eòlic *offshore*	Victor Luid Pinol	UPC Barcelona, Spain
July 2019	Journal of Quaternary Science	ICE MARGIN OSCILLATIONS DURING DEGLACIATION OF THE NORTHERN IRISH SEA BASIN.	R.C. Chiverrell, et al.	University of Liverpool
July 2019	*Marine Geology*, *416*, 105999	A series of volcanic edifices discovered a few kilometers off the coast of SW Sicily.	Lodolo, E., Civile, D., Zecchin, M., Zampa, L. S., &	Istituto Nazionale di Oceanografia e di Geofisica

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
			Accaino, F. (2019)..	Sperimentale, Italy
July 2019	*Data in brief*, *25*, 104286.	Seagrass and hydrographic data for the Mediterranean Sea.	Effrosynidis, D., Arampatzis, A., & Sylaios, G. (2019).	Democritus University of Thrace, Greece
July 2019	*IEEE Transactions on Geoscience and Remote Sensing*	Measurements of Sea Surface Currents in the Baltic Sea Region Using Spaceborne Along-Track InSAR.	Elyouncha, A., Eriksson, L. E., Romeiser, R., & Ulander, L. M. (2019).	Chalmers University of Technology, Sweden
July 2019	*Deep Sea Research Part II: Topical Studies in Oceanography*.	Current structures and topographic Rossby waves in the Levantine basin south of Crete revealed by snapshot and time series current measurements.	Kontoyiannis, H., Velaoras, D., Papadopoulos, V., & Kioroglou, S. (2019).	Hellenic Center for Marine Research, Greece
July 2019	*Ocean Science*, *15*(4), 905-924.	(2019). Bathymetric properties of the Baltic Sea.	Jakobsson, M., Stranne, C., O'Regan, M., Greenwood, S. L., Gustafsson, B., Humborg, C., & Weidner, E.	Stockholm University, Sweden
July 2019	*Frontiers in Marine Science*, *6*, 493.	High emissions of carbon dioxide and methane from the coastal Baltic Sea at the end of a summer heat wave	Humborg, C., Geibel, M.	Stockholm University, Sweden

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
			C., Sun, X., McCrackin, M., Mörth, C. M., Stranne, C., ... & Norkko, J. (2019).	
July 2019	Aquatic Conservation: Marine and Freshwater Ecosystems.	Modelling dolphin distribution within an Important Marine Mammal Area in Greece to support spatial management planning.	Bonizzoni, S., Furey, N. B., Santostasi, N. L., Eddy, L., Valavanis, V. D., & Bearzi, G.	Dolphin Biology and Conservation, Italy
July 2019	Thesis	Island shelf and slope geomorphology of La Palma island (Southern sector).	Velasco Martínez, A.	Universidad de Las Palmas de Gran Canaria
July 2019	In *Mediterranean Cold-Water Corals: Past, Present and Future*	Review of the Circulation and Characteristics of Intermediate Water Masses of the Mediterranean: Implications for Cold-Water Coral Habitats.	Hayes, D. R., Schroeder, K., Poulain, P. M., Testor, P., Mortier, L., Bosse, A., & du Madron, X.	CNR-ISMAR, Italy
July 2019	*Data in brief*, *25*, 104186.	Biodiversity of gelatinous macrozooplankton: Quantitative assessment of data and distribution patterns in the southern and central North Sea during August 2018.	Gawinski, C., Huwer, B., Munk, P., & Jaspers, C.	Technical University of Denmark, Denmark

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
July 2019	*Tectonics*.	Magmatism along lateral slab edges: Insights from the Diamante-Enotrio-Ovidio volcanic-intrusive complex (Southern Tyrrhenian Sea).	De Ritis, R., Pepe, F., Orecchio, B., Casalbore, D., Bosman, A., Chiappini, M., ... & Monaco, C.	Istituto Nazionale di Geofisica e Vulcanologi, Italy
July 2019		Influence of the summer deep-sea circulations on passive drifts among the submarine canyons in the northwestern Mediterranean Sea.	Clavel-Henry, M., Solé, J., Ahumada-Sempoal, M. Á., Bahamon, N., & Briton, F.	Consejo Superior de Investigaciones Científicas, Spain
July 2019	*Data in brief*, *25*, 104188.	Database of historic ports and coastal sailing routes in England and Wales.	Alvarez-Palau, E. J., & Dunn, O.	Universitat Oberta de Catalunya, Spain
July 2019	*Natural Hazards and Earth System Sciences*, *19*(8), 1585-1600.	Assessment of the 1783 Scilla landslide–tsunami's effects on the Calabrian and Sicilian coasts through numerical modeling.	Zaniboni, F., Pagnoni, G., Gallotti, G., Paparo, M. A., Armigliato, A., & Tinti, S.	Università di Bologna, Italy
July 2019	*PloS one*, *14*(6), e0219015.	Effects of sampling site, season, and substrate on foraminiferal assemblages grown from propagule banks from lagoon sediments of Corfu Island (Greece, Ionian Sea).	Weinmann, A. E., Goldstein, S. T., Triantaphyllou, M. V.,	Rheinische Friedrich-Wilhelms-Universität Bonn, Germany

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
			& Langer, M. R.	
July 2019	*Journal of Geophysical Research: Oceans.*	The Impact of Waves and Tides on Residual Sand Transport on a Sediment-poor, Energetic and Macrotidal Continental Shelf.	King, E. V., Conley, D. C., Masselink, G., Leonardi, N., McCarroll, R. J., & Scott, T.	Plymouth University
August 2019	*International Journal of Greenhouse Gas Control*, *90*, 102820.	Application of three-dimensional fault stress models for assessment of fault stability for CO2 storage sites	Gamboa, D., Williams, J. D., Bentham, M., Schofield, D. I., & Mitchell, A. C.	British Geological Survey, United Kingdom
August 2019	PhD Thesis	Marine gravity and bathymetry modelling from recent satellite altimetry.	Abulaitijiang, A.	Technical University of Denamrk, Denmark
August 2019	*Nature communications*,	2019). Earthquake crisis unveils the growth of an incipient continental fault system	Gracia, E., Grevemeyer, I., Bartolome, R., Perea, H., Martinez-Loriente, S., de la Peña, L. G., ... & Calahorrano, A.	CSIC, Spain

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
August 2019	*Tectonophysics*, *768*, 228179	Tectonics controls on fluvial landscapes and drainage development in the westernmost part of Switzerland: Insights from DEM-derived geomorphic indices.	Radaideh, O. M., & Mosar, J.	University of Fribourg, Switzerland
August 2019	*Scientific reports*, *9*(1), 1-15.	Time and space scattered volcanism of Mt. Etna driven by strike-slip tectonics.	Carlino, M. F., Cavallaro, D., Coltelli, M., Cocchi, L., Zgur, F., & Patanè, D.	Istituto Nazionale di Geofisica e Vulcanologi, Italy
August 2019	*Journal of Geodynamics*, *132*, 101653.	Recent deformational state from morphological analysis of mud volcanoes in the Gulf of Cadiz (southwestern part of the Iberian Atlantic Margin).	Maestro, A., Bohoyo, F., & Corral, R.	Instituto Geológico y Minero de España, Spain
August 2019	*Marine and Petroleum Geology*.	Hydrate occurrence in Europe: A review of available evidence.	Minshull, T. A., Marín-Moreno, H., Betlem, P., Bialas, J., Buenz, S., Burwicz, E., ... & Hölz, S.	University of Southampton, United Kingdom
August 2019	Морской гидрофизический журнал	Оценка точности результатов моделирования циркуляции Черного моря при использовании различных данных о топографии дна.	Дымова, О. А., & Миклашевская, Н. А.	1.1.1 Russian Academy of Sciences, Russia
August 2019	*Sensors*	Evaluation of Sentinel-3A OLCI Products Derived Using the Case-2 Regional CoastColour Processor over the Baltic Sea.	Kyryliuk, D., & Kratzer, S.	Stockholm University, Sweden

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
Sept 19	*Marine Policy*,	Discard ban: A simulation-based approach combining hierarchical Bayesian and food web spatial models.	Pennino, M. G., Bevilacqua, A. H., Torres, M. A., Bellido, J. M., Sole, J., Steenbeek, J., & Coll, M.	Instituto Español de Oceanografía (IEO) Spain
Sept 19	Thesis	Sedimentary evidences of paleotsunamis in the Mediterranean Sea: accumulation of large boulders along the coastline and mass transport deposits.	Canals Artigas, M.,	UPC Barcelona, Spain
Sep 2019	*Journal of Maps*, *15*(2), 759-772	). Shallow geophysics of the Asinara Island Marine Reserve Area (NW Sardinia, Italy).	Romeo, R., Baradello, L., Blanos, R., Congiatu, P. P., Cotterle, D., Ciriaco, S., ... & Lodolo, E.	Instituto Nazionale di Oceanografia e di Geofisica Sperimentale, Italy
Sept 19	Revista Brasileira de Cartografia	Desenvolvimento e Perspectivas da Infraestrutura de Dados Espaciais Marinhos Brasileira	Florentino, C., Pimentel, V. B., & Neto, A. A.	Diretoria de Hidrografia e Navegação, Brasil
Sept 19	*Deep Sea Research Part I: Oceanographic Research Papers*	Analysis of the population structure of a gorgonian forest (Placogorgia sp.) using a photogrammetric 3D modeling approach at Le Danois Bank, Cantabrian Sea.	Prado, E., Sanchez, F., Basalo, A. R., Altuna, Á., & Cobo, A. (2019).	Instituto Español de Oceanografía (IEO), Spain
Sept 19	(Master's thesis).	*Habitat suitability mapping for Tursiops truncatus in the Aegean Sea*	van der Roest, R. A.	Supervisor Wageningen

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
				University:, Netherlands
Sept 19	*Minerals*, *9*(10), 577.	Potential for the Geological Storage of CO2 in the Croatian Part of the Adriatic Offshore.	Saftić, B., Kolenković Močilac, I., Cvetković, M., Vulin, D., Velić, J., & Tomljenović, B.	Faculty of Mining, Geology and Petroleum Engineering, University of Zagreb, Croatia
Sept 19	In *The Geology of Egypt* (pp. 295-342). Springer, Cham.	Structural Setting and Tectonic Evolution of the Gulf of Suez, NW Red Sea and Gulf of Aqaba Rift Systems.	Moustafa, A. R., & Khalil, S. M.	Ain Shams University, Egypt
Sept 19	*Marine Geodesy*, (just-accepted), 1-26.	Development of a User-Centred Web-Mapping Application for Ocean Modellers.	Padilla Ruiz, M., Stefanakis, E., & Church, I.	University of New Brunswick, Canada
Oct 19	*Morskoy Gidrofizicheskiy Zhurnal. 2019;35(5):496-510. (In Russ.) https://doi.org/10.22449/0233-7584-2019-5-496-510*	Long-Term Variability of Thermohaline Characteristics of the Azov Sea Based on the Numerical Eddy-Resolving Model.	Mizyuk A.I., Korotaev G.K., Grigoriev A.V., Puzina O.S., Lishaev P.N.	Marine Hydrophysical Institute of RAS, Sevastopol, Russian Federation
Oct 19	*Deep Sea Research Part I: Oceanographic Research Papers, 154, 103144.*	Estimating vertical mixing in the deep north Aegean Sea using argo data corrected for conductivity sensor drift.	Zervakis, V., Krauzig, N., Tragou, E., & Kunze, E.	Department of Marine Sciences, School of the Environment, University of the Aegean, Mytilene, Greece

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
Oct 19	*Scientific reports, 9(1), 1-10.*	Recreational vessels without Automatic Identification System (AIS) dominate anthropogenic noise contributions to a shallow water soundscape.	Hermannsen, L., Mikkelsen, L., Tougaard, J., Beedholm, K., Johnson, M., & Madsen, P. T.	Zoophysiology, Department of Bioscience, Aarhus University, Aarhus, Denmark
Oct 19	*Journal of environmental management, 253, 109749.*	Are FADs a significant source of marine litter? Assessment of released debris and mitigation strategy in the Mediterranean sea.	Mauro, S., Tiziana, C., Franco, A., Claudio, B., Pierpaolo, C., Francois, G., & Teresa, R.	Centro Interdipartimentale Della Sicilia, Integrative Marine Ecology, Palermo, Italy
Oct 19	*Journal of Applied Ecology.*	Distribution maps of cetacean and seabird populations in the North-East Atlantic	Waggitt, J. J., Evans, P. G., Andrade, J., Banks, A. N., Boisseau, O., Bolton, M., et al.	School of Ocean Sciences, Bangor University, Menai Bridge, UK
Oct 19	*Physical Oceanography, 26(4), 304-315.*	Accuracy Estimation of the Black Sea Circulation Modeling Results Obtained at Different Bottom Topography.	Dymova, O. A., & Miklashevskaya, N. A.	Marine Hydrophysical Institute of RAS, Sevastopol, Russian Federation

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
Oct 19	*International conference computational science ICCS 2019*	Implementation of a 3-dimentional hydrodynamic model to a fish aquaculture area in Sines, Portugal-A down-scaling approach.	Corre, A., Pinto, L., Mateus M.	Universidade de Lisboa, Lisbon
Oct 19	*Marine Geology, 419, 106061.*	Linking the high-resolution acoustic and sedimentary facies of a transgressed Late Quaternary alluvial plain (Gulf of Trieste, northern Adriatic).	Novak, A., Šmuc, A., Poglajen, S., & Vrabec, M.	University of Ljubljana, Slovenia
Oct 19	*Geochemistry, Geophysics, Geosystems.*	Progressive changes in magma transport at the active Serreta Ridge, Azores	Romer, R. H. W., Beier, C., Haase, K. M., Klügel, A., & Hamelin, C.	Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany
Oct 19	*PloS one, 14(10).*	Megabenthic communities of the Ligurian deep continental shelf and shelf break (NW Mediterranean Sea).	Enrichetti, F., Dominguez-Carrió, C., Toma, M., Bavestrello, G., Betti, F., Canese, S., & Bo, M.	Università degli Studi di Genova, Italy
Oct 19	*Geophysical Journal International, 220(1), 461-489.*	Tectonic deformation in the Santorini volcanic complex (Greece) as inferred by joint analysis of gravity, magnetotelluric and DGPS observations.	Tzanis, A., Chailas, S., Sakkas, V., & Lagios, E.	University of Athens, Greece
Oct 19	*Doctoral dissertation*	Beach carrying capacity assessment: case study for sustainable use of kusadasi beaches	Khodkar, G.	Middle East Technical University), Turkey

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
Oct 19	*Doctoral dissertation*	Historical Development of Heavy Metal Input into Near-Coastal Areas.	Boehnert, S.	Universität Bremen, Germany
Oct 19	*Journal of Maps, 15(2), 759-772.*	Shallow geophysics of the Asinara Island Marine Reserve Area (NW Sardinia, Italy).	Romeo, R., Baradello, L., Blanos, R., Congiatu, P. P., Cotterle, D., Ciriaco, S., ... & Lodolo, E.	OGS, Trieste, Italy
Oct 19	*15th Internat ional Congress of the Geological Society of Greece*	Post-Miocene Deformation in the South Aegean: Insights from Seafloor Morphology and Seismic Profiling Data	Tsampoura ki-Kraounaki, K., & Sakellariou, D..	Hellenic Centre for Marine Research, Greece
Oct 19	*Master dissertation*	MILDwave modelling of impact of WEC farms along a realistic coastline configuration	De Neve, M..	Ghent University, Belgium
Oct 19	*Deep Sea Research Part I: Oceanographic Research Papers, 153, 103124.*	Analysis of the population structure of a gorgonian forest (Placogorgia sp.) using a photogrammetric 3D modeling approach at Le Danois Bank, Cantabrian Sea	Prado, E., Sánchez, F., Rodríguez-Basalo, A., Altuna, Á., & Cobo, A.	Instituto Español de Oceanografía, Spain
Oct 19	*In Proceedings of the 5th International Conference on Geographical Information Systems Theory, Applications and Management (GISTAM 2019), pages 297-304*	Workflows for Virtual Reality Visualisation and Navigation Scenarios in Earth Sciences.	Mel, K., Luca, B. F., Fabio, V., Varvara, A., Ugo, B., Elena, R., ... & Eva, S.	University of Portsmouth, United Kingdom

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
Nov 19	*Briefing notes*	Arctic connections-Mapping an Arctic policy framework for the Scottish government.	Jafry, T., Mikulewicz, M., & Mattar, S.	Centre for Climate Justice, Glasgow Caledonian University, Scotland, UK.
Nov 19	*Deep Sea Research Part II: Topical Studies in Oceanography, 104701.*	Assessment of the eruptive activity and identification of the mud breccia's source in the Olimpi mud volcano field, Eastern Mediterranean.	Panagiotopoulos, I. P., Paraschos, F., Rousakis, G., Hatzianestis, I., Parinos, C., Morfis, I., & Gogou, A.	Institute of Oceanography, Hellenic Centre for Marine Research, 46.7 km Athens-Sounio Av., Anavyssos, 19013, Attica, Greece
Nov 19	*Doctoral dissertation*	Estudo geoquímico e mineralógico das crostas de Fe-Mn no Atlântico Norte	Pereira, A. R. C.	Universidade de Lisboa, Portugal
Nov 19	*Scientific reports, 9(1), 1-14.*	fault-controlled deep hydrothermal flow in a back-arc tectonic setting, SE Tyrrhenian Sea.	Loreto, M. F., Düşünür-Doğan, D., Üner, S., İşcan-Alp, Y., Ocakoğlu, N., Cocchi, L., et al.	Istituto di Scienze Marine, CNR, Via P. Gobetti 101, 40129, Bologna, Italy
Nov 19	*Geology.*	Recent inversion of the Tyrrhenian Basin.	Zitellini, N., Ranero, C. R., Loreto, M. F., Ligi, M.,	Istituto di Scienze Marine, CNR, Via P. Gobetti 101,

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
			Pastore, M., D'Oriano, F., et al.	40129, Bologna, Italy
Nov 19	*Journal of Quaternary Science.*	Pattern, style and timing of British–Irish Ice Sheet retreat: Shetland and northern North Sea sector	Bradwell, T., Small, D., Fabel, D., Clark, C. D., Chiverrell, R. C., Saher, M. H., et al.	British Geological Survey, Edinburgh, UK
Nov 19	*In Journal of Physics: Conference Series (Vol. 1359, No. 1, p. 012083). IOP Publishing*	Dynamics of the Azov-Black Sea basin by means of parallel ocean circulation modeling..	Mizyuk, A. I., & Puzina, O. S.	Marine Hydrophysical Institute of RAS, Sevastopol, Russian Federation
Nov 19	*Master Thesis*	Caracterización met-oceánica en el PN Marítimo-Terrestre del archipiélago de Cabrera e implicaciones en la navegación.	Megías Baños, C.	Universidad de Cantabria, Spain
Nov 19	*Geomorphology, 351, 106894.*	Morphology of retrogressive failures in the Eastern Rhone interfluve during the last glacial maximum (Gulf of Lions, Western Mediterranean).	Badhani, S., Cattaneo, A., Dennielou, B., Leroux, E., Colin, F., Thomas, Y., et al.	Ifremer, France
Nov 19	*Biogeosciences Discussion*	Benthic foraminifera as tracers of brine production in Storfjorden "sea ice factory".	Fossile, E., Nardelli, M. P., Jouini, A., Lansard, B., Pusceddu,	Université d'Angers, France

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
			A., Moccia, D., et al.	
Nov 19	*Recursos marins en el passat. IV Jornades d'arqueozoologia. Museu de Prehistòria de València (2019): 15-45.*	Areas litorales y recursos marinos durante el paleolítico-mesolítico de la región mediterránea ibérica. Sesgos y evidencias.	Tortosa, J. E. A.	Universitàt Valencia; Spain
Nov 19	*Remote Sensing, 11(22), 2636.*	Synergy of Satellite Remote Sensing and Numerical Ocean Modelling for Coastal Geomorphology Diagnosis.	Benincasa, M., Falcini, F., Adduce, C., Sannino, G., & Santoleri, R.	CNR-ISMAR, Institute of Marine Sciences, National Research Council, 00133 Rome, Italy
Nov 19	*Pure and Applied Geophysics, 1-25*	Spatio-Seasonal Variations in Long-Term Trends of Offshore Wind Speeds Over the Black Sea; an Inter-Comparison of Two Reanalysis Data.	Çarpar, T., Ayat, B., & Aydoğan, B.	Istanbul Water and Sewerage Administration (ISKI)Eyüp/IstanbulTurkey
Nov 19	*Human Adaptations to the Last Glacial Maximum: The Solutrean and its Neighbors, 372. Book section*	Fishes from solutrean sites of the iberian mediterranean region: palaeogeographical, palaeoecological.	Tortosa, J. E. A.	Universitàt Valencia, Spain
Nov 19	*Mediterranean demersal resources and ecosystems: 25 years of MEDITS trawl surveys M.T. Spedicato, G. Tserpes, B. Mérigot and E. Massutí (eds)*	Spatial distribution pattern of European hake, Merluccius merluccius (Pisces: Merlucciidae), in the Mediterranean Sea.	Spedicato, M. T., Tserpes, G., & Mérigot, B.	Department of Biology, University of Bari, Italy.

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
Nov 19	*Doctoral dissertation*	The coastal circulation model of büyük menderes river mouth and adjacent coastal areas	Gözlet, M. S.	Middle East Technical University), Turkey
Nov 19	*Romanian Reports in Physics*	Sound speed characteristics and impulsive noise hotspots assessment in the north-western black sea.	Mihailov, M. E.	National Institute for Marine Research and Development "Grigore Antipa" Constanta - Romania
Nov 19	*Geophysical Journal International, 220(2), 1128-1148.*	Mantle thermal structure at northern Mid-Atlantic Ridge from improved numerical methods and boundary conditions.	Cuffaro, M., Miglio, E., Penati, M., & Viganò, M.	Istituto di Geologia Ambientale e Geoingegneria Italy
Dec 19	*Rapp. Comm. int. Mer Médit., 42, 2019*	Morphogenetic processes on the continental slope of the galicia bank (west iberia margin).	Simões, M., Roque, C., Riberio, C., Madureira, P., & Somoza, L.	EMEPC, Portugal
Dec 19	*Master's thesis,*	High-resolution modeling of spread of anthropogenic contaminants in marine waters, influencing aquaculture	Perepelytsya, M.	Universitat Politècnica de Catalunya
Dec 19	*Doctoral dissertation,*	Développement d'un indice biotique basé sur les foraminifères benthiques: application sur la façade méditerranéenne française	Parent, B.	Université d'Angers, France

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
Dec 19	*Pure and Applied Geophysics, 1-22.*	The Tsunami Inundation Hazard of the Maltese Islands (Central Mediterranean Sea): A Submarine Landslide and Earthquake Tsunami Scenario Study.	Mueller, C., Micallef, A., Spatola, D., & Wang, X.	GNS Science, Lower Hutt, New Zealand
Dec 19	*Marine and Petroleum Geology, 104174.*	The Catalan magnetic anomaly: Its significance for the crustal structure of the Gulf of Lion passive margin and relationship to the Catalan transfer zone.	Canva, A., Thinon, I., Peyrefitte, A., Couëffé, R., Maillard, A., Jolivet, L., et al.	BRGM, GeoResources Division, Orleans, France
Dec 19	*Physical Oceanography, 26(5), 438.*	Long-Term Variability of Thermohaline Characteristics of the Azov Sea Based on the Numerical Eddy-Resolving Model.	Mizyuk, A. I., Korotaev, G. K., Grigoriev, A. V., Puzina, O. S., et al.	Marine Hydrophysical Institute of RAS, Sevastopol, Russian Federation
Dec 19	*Geophysical Journal International.*	A new 3-D P-wave velocity model for the Gulf of Cadiz and adjacent areas derived from controlled-source seismic data: application to non-linear probabilistic relocation of moderate earthquakes.	Lozano, L., Cantavella, J. V., & Barco, J.	Spanish Seismic Network, Instituto Geográfico Nacional, Madrid, Spain
Dec 19	*Geochemistry, Geophysics, Geosystems*	Pockmarks in the Witch Ground Basin, Central North Sea	Böttner, C., Berndt, C., Reinardy, B., Geersen, J., Karstens, J., et al.	GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
Dec 19	*Conference Series: Earth and Environmental Science (Vol. 386, No. 1, p. 012024). IOP Publishing.*	The impact of various types of open boundary conditions in numerical simulation of the Black Sea coastal circulation. In IOP	Senderov, M. V.	Marine Hydrophysical Institute, RAS, Kapitanskaya str. 4, Sevastopol, 299011, Russia
Dec 19	*Conference Series: Earth and Environmental Science (Vol. 386, No. 1, p. 012023). IOP Publishing.*	Sea ice modeling in the Sea of Azov for a study of long-term variability	Mizyuk, A. I., & Puzina, O. S.	Marine Hydrophysical Institute, RAS, Kapitanskaya str. 4, Sevastopol, 299011, Russia
Dec 19	*In Australasian Coasts and Ports 2019 Conference: Future directions from 40 [degrees] S and beyond, Hobart, 10-13 September 2019 (p. 276). Engineers Australia.*	Global-to-local scale storm surge modelling: Operational forecasting and model sensitivities.	De Kleermaeker, S., Apecechea, M. I., Verlaan, M., Mortlock, T., & Rego, J. L.	Deltares, Delft, The Netherlands
Dec 19	*Mediterranean demersal resources and ecosystems: 25 years of MEDITS trawl surveys M.T. Spedicato, G. Tserpes, B. Mérigot and E. Massutí (eds)*	Spatial variability of Chondrichthyes in the northern Mediterranean.	Follesa, M. C., Marongiu, M. F., Zupa, W., Bellodi, A., Cau, A.,	Department of Life and Environmental Science, University of Cagliari, Via T.

Date	Name of journal, conference, ...	Publication title	Authors	Organisation(s)
			Cannas, R., et al.	Fiorelli 1, Cagliari, Italy.
Dec 19	*Deep Sea Research Part I: Oceanographic Research Papers, 103186.*	Unveiling the deep biodiversity of the Janua Seamount (Ligurian Sea): first Mediterranean sighting of the rare Atlantic bamboo coral Chelidonisis aurantiaca Studer, 1890	Bo, M., Coppari, M., Betti, F., Massa, F., Gay, G., Cattaneo-Vietti, R., & Bavestrello, G.	CoNISMa, Roma, Italy
Dec 19	*Ocean Dynamics, 70(1), 57-75.*	The importance of wind forcing in fjord wave modelling.	Christakos, K., Furevik, B. R., Aarnes, O. J., Breivik, Ø., Tuomi, L., & Byrkjedal, Ø.	Norwegian Meteorological Institute, Bergen, Norway
Jan 20	*Quaternary Science Reviews, 229, 106135.*	Oceanic versus continental influences over the last 7 kyrs from a mid-shelf record in the northern Bay of Biscay (NE Atlantic).	Penaud, A., Ganne, A., Eynaud, F., Lambert, C., Coste, P. O., Herlédan, M., el al.	University of Brest, France
Jan 20	*Earth Surface Dynamics, 8(1), 1-15.*	Potential links between Baltic Sea submarine terraces and groundwater seeping.	Jakobsson, M., O'Regan, M., Mörth, C. M., Stranne, C., Weidner, E., et al.	University of Stockholm, Sweden

14. List of acronyms

Acronyms as used in this report are defined in the following list:

BSBD, Baltic Sea Bathymetry Database.

BSHC, Baltic Sea Hydrographic Commission.

CDI, Common Data Index, provides a highly detailed description of the survey data, answering to the questions: where, when, how and who collected the data, and how to get them. One CDI describes a survey by means of a polygon or survey track. The CDI service also includes a shopping service for requesting access to selected data sets and for downloading as data files, if access has been granted by the data owners.

CPRD, Composite DTM data sets, giving a gridded bathymetry. In practice it was found 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. Composite DTM's are DTM's that have been generated by the data provider itself at a specific resolution and making use of survey data sets as managed by that data provider. These Composite DTM's might contain grid cells for which no survey data were available and which are then possibly completed by interpolation or other manipulation. Overall the EMODnet project prefers to get access to survey data sets, where possible, and not the derived Composite DTM's. However in practice this is not (yet) always possible and using the Composite DTM's can then be considered as the next best option. In addition, Composite DTM providers are encouraged to describe anyway their survey data sets in the CDI Data Discovery and Access service in order to give better insight in the real survey coverage. This is followed up by an increasing number of providers, but not always possible for historic reasons.

CVE, Collaborative Virtual Environment, also known as Virtual Research Environment

DEM, Digital Elevation Model. It is a digital model or 3D representation of a terrain's surface. In the context of EMODnet HRSM it is used to describe the land elevation, while the bathymetry is described with a Digital Terrain Model (see next).

DTM, Digital Terrain Model, is a resulting grid data set with attributes for lat, lon, minimum depth, maximum depth, average water depth, standard deviation, number of values, number of elementary surfaces, smoothed average water depth, depth smoothed offset, CDI reference, and Composite DTM reference / GEBCO_2014 reference.

GEBCO, the General Bathymetric Chart of the Oceans (GEBCO) 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 operates under the joint auspices of the the International Hydrographic Organization (IHO) and the Intergovernmental Oceanographic Commission (IOC) (of UNESCO). GEBCO 30" gridded data is used by the EMODnet project to complete area coverage in case there are no survey data or Composite DTM data sets available to the partners. GEBCO is represented in the EMODnet HRSM consortium by its editor, NERC-BODC.

GTSM, Global Tide Surge Model developed and operated by Deltares.

IBCAO, the International Bathymetric Chart of the Arctic Ocean is an initiative to develop a Digital Terrain Model (DTM) based upon all available bathymetric data north of 64° North, for use by mapmakers, researchers, institutions, and others whose work requires a detailed and accurate knowledge of the depth and the shape of the Arctic seabed. Initiated in 1997, this undertaking has been endorsed by the Intergovernmental Oceanographic Commission (IOC), the International Arctic Science Committee (IASC), the International Hydrographic Organization (IHO), the General Bathymetric Chart of the Oceans (GEBCO), and the US National Centers for Environmental Information (NCEI). IBCAO is represented in the EMODnet HRSM consortium by its coordinator, the University of Stockholm.

Sextant, catalogue service used to provide details about Composite DTM data sets. It allows to discover any Composite DTM's as available and used for the EMODnet DTM instead of bathymetry survey data sets. The location is given by a Lat-Lon box in a map and descriptions are given of each Composite DTM with information for what, when, how, and who. The Sextant entries are linked as references in the EMODnet DTM grid cells, where appropriate, to indicate the source data. The Sextant service for EMODnet HRSM does not give a shopping service, but includes contact links for requesting access to the Composite DTM's.

SeaDataNet, is the pan-European infrastructure for ocean & marine data management sponsored within FP7 (grant agreement 283607, 1/10/2011-30/9/2015) connecting at present more than 100 national oceanographic data centres and marine data centres from 35 countries riparian to all European seas.

SeaDataCloud, is the successor project to SeaDataNet II for further developing the technical basis of the SeaDataNet infrastructure, funded by HORIZON 2020 (grant agreement 730960, 1/11/2016-31/10/2020).

TIN, triangulated irregular network, a way to model the EMODnet DTM using triangles in different sizes to support 3D viewing.

VRE, Virtual Research Environment, also known as Collaborative Virtual Environment

WCS, Web Coverage Service is an OGC standard defining Web-based retrieval of coverages i.e. digital geospatial information representing space/time-varying phenomena.

WFS, Web Feature Service is an OGC standard allowing requests for geographical features across the web using platform-independent calls.

WMS, Web Map Service is a standard OGC protocol for serving geo- referenced map images over the Internet.

WMST, Web Map Tile Service is a standard OGC protocol for serving pre-rendered georeferenced map tiles over the Internet.

15. References

[1] Methodology and Guidelines for processing original input data into DTMs for possible integration in EMODnet Regional DTMs; Service Contract No. EASME/EMFF/2015/1.3.1.7/ SI2.742125, EMODnet Bathymetry Internal document, 16 pages

[2] High Resolution Seabed Mapping WP1: Data provider contribution Completing metadata elements for the generation of the Quality Index for the EMODnet DTM Service Contract No. EASME/EMFF/2015/1.3.1.7/SI2.742125, EMODnet Bathymetry internal document, 22 pages.

[3] Guidelines for metadata, data and DTM QA/QC; Service Contract No. EASME/EMFF/2015/1.3.1.7/SI2.742125, EMODnet Bathymetry Internal document, 22 pages

[4] Interoperability and International Collaboration; Service Contract No. EASME/EMFF/2015/1.3.1.7/SI2.742125, EMODnet Bathymetry; Public Report, 33 pages.

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[6] Quantized Mesh Generator for Cesium 3D visualisation; Service Contract No. EASME/EMFFM2016/005, EMODnet Bathymetry; Public Report, 18 pages.

[7] Satellite Derived coastlines for Europe; Service Contract No. EASME/EMFFM2016/005, EMODnet Bathymetry; Public Report, 20 pages

[8] National coastlines and baselines – data set collection for European countries; Service Contract No. EASME/EMFFM2016/005, EMODnet Bathymetry; Public Report, 31 pages