



EMODnet



European Marine
Observation and
Data Network

The European Marine Observation and Data Network

www.emodnet.eu





"In Europe, marine data records are currently held by hundreds of organisations. Until recently, finding out who held data collected at great expense was hard. Obtaining permission to use them took extensive negotiation and putting together data from different sources required so much effort that many potential applications or studies never got off the ground. Unlike on land, where maps of topography and geology are universally available, some scientists and engineers have found it easier to resurvey areas that had already been surveyed but for which the data were too difficult to get hold of. This creates extra work, increases costs and makes offshore development more expensive.

The "EU's Blue Data Network" - also known as European Marine Observation and Data Network (EMODnet) - is now beginning to change things. In EMODnet, more than 150 organisations, both public and private, are working together to create a portal where stakeholders can search for, visualise and retrieve ocean and coastal data concerning a specific place within a certain time. The information is publicly accessible without restrictions and free of charge.

Since its inception in 2009, EMODnet has already achieved what it set out to do by 2020: deliver a complete multi-resolution seabed map of European seas. EMODnet is now a reference source of data for those working in the coastal and offshore blue economy. It is already improving the forecasting of storm surges and helping national and regional authorities develop spatial plans and report on the state of their marine environment.

We need to maintain this effort. Businesses, authorities, scientists and civil society need to be sure that the services we are offering will continue. We have listened to their feedback and work is already in progress to develop the services further with higher resolution, more parameters and deeper integration with our sister initiatives; the Copernicus Marine Environment Service and the Data Collection Framework for fisheries.

In 2017, EMODnet embarked on a new phase to improve the portal and extend its potential with more emphasis on emerging issues such as the distribution of marine litter. We will also engage more with business; partly to ensure that the services delivered by EMODnet meet their needs but also to bring in more of the data they collect for their own purposes via the new EMODnet Data Ingestion facility.

Finally, EMODnet is contributing towards greater transparency and public engagement in ocean management. Previously only governments and large industries could give informed opinions on developments that affected everyone. Now all citizens concerned can have their say. This can only be a step forward in good ocean management. Just like better knowledge, public involvement too will help us preserve the oceans for mankind."

Karmenu Vella
Commissioner for Environment, Maritime Affairs and Fisheries
March 2018

EMODnet: Your gateway to marine data

Data from the marine environment are a valuable asset. Rapid access to reliable and accurate information is vital in addressing threats to the marine environment, for developing policies and legislation to protect vulnerable areas of our coasts and oceans, in understanding trends and forecasting future changes. Better quality and more easily accessible marine data is a prerequisite for further sustainable economic development, or 'blue growth'.

Unfortunately, marine data collection, storage and access in Europe has been carried out in a fragmented way for many years. Most data collection has focused on meeting the needs of a single purpose by a wide range of private and public organisations, often in isolation from each other.

The European Marine Observation and Data Network (EMODnet) is a network of organisations supported by the EU's Integrated Maritime Policy who work together to observe the sea, process the data according to international standards and make that information freely available as interoperable data layers and data products.

This 'collect once and use many times' philosophy benefits all marine data users, including policy makers, scientists, private industry and the public. It has been estimated that such an integrated marine data policy will save offshore operators at least one billion Euros per year, as well as opening up new opportunities for innovation and growth.

Access to marine data is of vital importance for marine industries, decision-making bodies and scientific research. An effective pan-European marine data infrastructure will enable effective and efficient marine spatial planning and legislation for environment, fisheries, transport, border control, customs and defence. It will also help reduce uncertainty in our knowledge and ability to forecast the behaviour of the sea - essential for understanding and responding to the effects of climate change and will support Member States' implementation of the Marine Strategy Framework Directive. Better access to marine data will improve offshore operators' efficiency in gathering and processing marine data for operational and planning purposes, and stimulate competition and innovation in established and emerging maritime sectors.

The aim of EMODnet is to increase productivity in all tasks involving marine data, to promote innovation and to reduce uncertainty about the behaviour of the sea. This will lessen the risks associated with private

and public investments in the blue economy, and facilitate more effective protection of the marine environment.

EMODnet has a set of core principles that underpin the development of its services:

- Collect data once and use them many times
- Develop data standards across disciplines as well as within them
- Process and validate data at different scales: regional, basin and pan-European
- Build on existing efforts where data communities have already organised themselves
- Put the user first when developing priorities and taking decisions
- Provide statements on data ownership, accuracy and precision
- Sustainable funding at a European level to maximise benefit from the efforts of individual Member States



EMODnet is a long-term marine data initiative that is developing through a series of phases. It currently provides access to marine data, metadata and data products spanning seven broad disciplinary themes: bathymetry, geology, physics, chemistry, biology, seafloor habitats and human activities. Each theme is looked after by a partnership of organisations that have the necessary expertise to standardise the presentation of data and create data products.

For each theme, EMODnet has created a gateway to a range of data archives managed by local, national, regional and international organisations. Through these gateways, users have access to standardised observations, data quality indicators and processed data products, such as basin-scale maps. These data products are free to access and use.

Currently, data are being used to improve the multi-resolution maps of all Europe's seas and oceans spanning all seven disciplinary themes. A pan-European multi-resolution seabed map is already available and further upgrades will be released over the coming years.

User requirements are a priority, so a series of sea-basin 'checkpoints' were launched to assess the adequacy of marine data against common challenges in each of the sea basins. These were initiated in the Mediterranean and North Sea in 2013 and extended to the Arctic, NE Atlantic, Black Sea and the Baltic Sea in 2015. These mechanisms are helping us to identify whether the present observation infrastructure is the most effective possible, and whether it meets the needs of users to address societal problems.

More than 150 organisations are currently involved in the EMODnet programme and new contributors are always welcome. EMODnet will continue to strengthen its collaboration with other marine knowledge providers, including fisheries, the marine component of the EU's Copernicus programme and the private sector, to create a common platform for marine data in Europe.

The EMODnet Vision

"A flagship project to prepare a seamless multi-resolution digital seabed map of European waters by 2020 ... of the highest resolution possible, covering topography, geology, habitats and ecosystems ... accompanied by access to timely observations and information on the present and past physical, chemical and biological state of the overlying water column, by associated data on human activities, by their impact on the sea and by oceanographic forecasts. All this should be easily accessible, interoperable and free of restrictions on use. It should be nourished by a sustainable process that progressively improves its fitness for purpose and helps Member States maximise the potential of their marine observation, sampling and surveying programmes."

European Commission's Green Paper Marine Knowledge 2020 – from seabed mapping to ocean forecasting. 2012. DOI 10.2771/4154

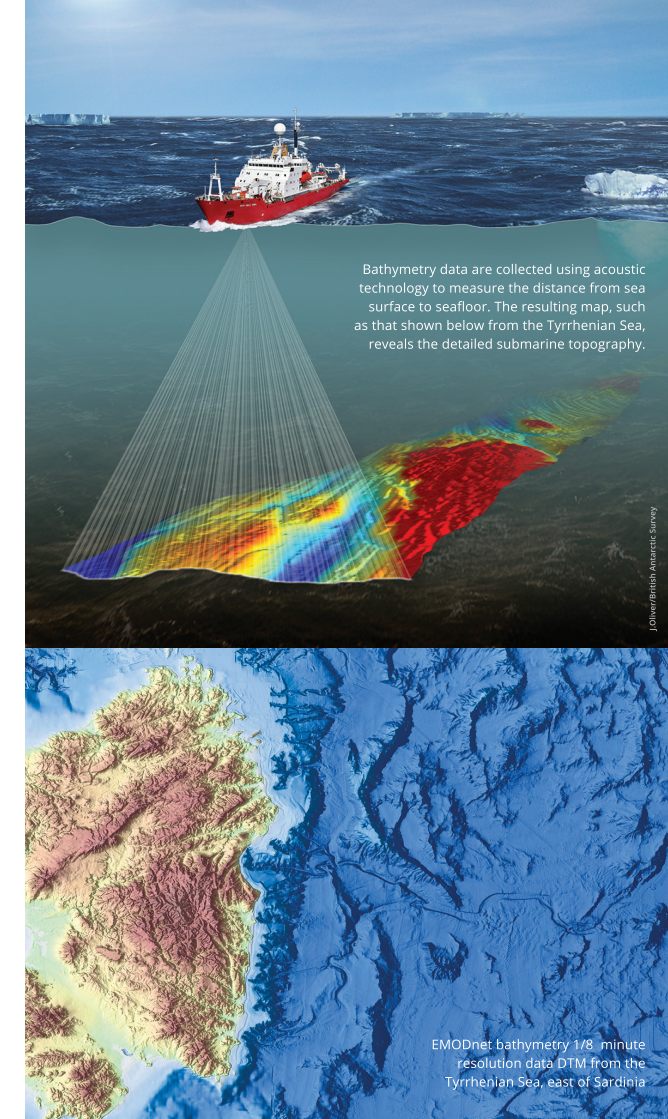
Bathymetry

The shape and depth of the European seafloor is hugely variable, reaching depths of more than 5000 metres and featuring extensive continental shelves, enormous submarine canyons, towering underwater volcanoes and dramatic submarine landslide scars.

Bathymetry is the information that describes the topography of the seabed, as depth from the sea surface to the seafloor. It is an essential component in understanding the dynamics of the marine environment: the shape of the seabed is controlled by the underlying geology, and it exerts a strong influence on ocean circulation and currents, local fauna and seafloor habitats. Safe ocean navigation relies on accurate bathymetry data, which are also essential for planning marine installations and infrastructure such as wind turbines, coastal defences, oil platforms and pipelines. Bathymetry forms the foundation of any comprehensive marine dataset; without it, the picture is incomplete.

EMODnet provides bathymetric data and data products for all European sea basins. Users can discover metadata and request access to survey data held by an increasing number of data providers. Moreover users can browse, interact and freely download tiles of the EMODnet Digital Terrain Model (DTM) which at present has a common grid resolution of 1/8 arc minutes.

Users can integrate the EMODnet DTM map layers in their websites as OGC web services to use in combination with other EMODnet data layers. The services also facilitate identification of the bathymetric survey data which form the basis of the DTM products. These surveys are described with metadata in the continually-updated data discovery and access service. Developments are underway for gathering more survey datasets, increasing the resolution of the EMODnet DTM to 1/16 arc minutes, complementing the DTM coverage with coastal zones, and providing areas with higher resolution where possible.





Seafloor geology

The geology of Europe's seafloor is diverse, ranging from hard rock outcrops to glacial sediment layers that may reach hundreds of metres in thickness, and recent sediment input from rivers. The geological picture is further complicated by structural faults, episodic events such as earthquakes, submarine landslides and volcanic activity, and continuous processes such as coastal erosion and transport of sediment along the seafloor by currents.

Geological data are collected in a number of ways: physical samples via coring, drilling, grab sampling or dredging; direct observations using towed cameras and remotely operated vehicles; and acoustic remote sensing techniques that give an indication of the seafloor substrate. Of these techniques, only drilling or coring can reveal more than just the surficial geology. In order to probe deeper into the sub-seafloor, seismic survey methods are required.

Primary geological survey information requires significant expert interpretation to generate maps, and geological data are often used in combination with bathymetry to build up a comprehensive picture of the seabed. These data are a vital component of seafloor habitat maps, and are essential tools in marine spatial planning, coastline protection, offshore installation design, environmental conservation, risk management and resource mapping.

EMODnet provides access to geological data and maps at a resolution of 1:250,000 wherever possible (improved to 1:100,000 by 2019). These provide information on seabed substrate, seafloor geology (including boundaries, faults, lithology and age), sediment accumulation rates, coastline erosion and migration, areas of mineral resources, reconstruction of the historic submerged landscapes of the European continental shelf, and the location and probable frequency of significant geological events such as earthquakes and volcanic eruptions.

Ocean physics

Information about the physical properties of the oceans is fundamental to our understanding of natural processes. Ocean currents shape the seafloor, drive our weather systems and strongly influence the distribution and health of marine species and habitats. The ability to understand, detect and predict changes in our oceans is essential in managing and protecting our natural resources, and for the safety of human activities at sea.

Europe's oceans and atmosphere are constantly measured and monitored through an extensive network of remote, fixed and mobile in situ observing stations. The volume of data collected is enormous, ranging from the most fundamental information such as sea level, atmospheric pressure, sea temperature and salinity, to more complex measurements of turbidity and fluorescence in the water column.

EMODnet provides a gateway to this vast resource of ocean physics data. Users can access both near-real time data (within a few hours of measurement) made available via the EuroGOOS Regional Operational Oceanographic Systems (ROOS) and the Copernicus Marine Environmental Monitoring Service (CMEMS)'s INSTAC, and historical archive data managed by National Oceanographic Data Centres. These data can be combined with supplementary data from ongoing observing programmes such as EuroArgo.

Data layers currently being made available include: wave height and duration, sea temperature, wind speed and direction, salinity, horizontal speed of the water column, water clarity, changes in sea level, inflow from rivers, ice cover and underwater sound.



Ocean chemistry

Many chemical pollutants in the marine environment are invisible to the naked eye and can only be detected and tracked using specialised sensors. A good understanding of seawater chemistry and its natural variability in a given region is fundamental for detecting short-, medium- and long-term change, and in assessing whether those changes pose a risk and require mediation.

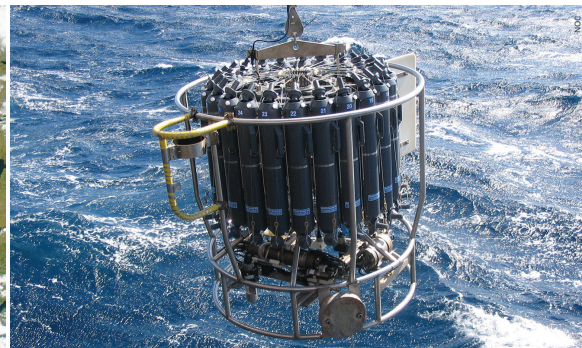
Examples of such change in seawater chemistry might include increase in pH due to ocean acidification, influx of nitrates in run-off from agricultural fertilisers, emissions from land-based industry such as power stations or sewage plants, phytoplankton blooms (either natural seasonal blooms or human-induced events), oil leaks or chemical spills, and pollution from mobile activities such as shipping or aggregate dredging.

Early detection, tracking and prediction of the movement of pollutants at sea are vital for the effective mitigation of their impacts on marine habitats and human infrastructures. Seawater chemistry data is used in combination with physical oceanographic data and bathymetry

to trace the source of pollution, track its likely future trajectory, concentration and persistence, and to formulate a course of action to prevent or reduce impacts on the marine environment and to human well-being. Water chemistry data acquisition is often at the centre of routine monitoring efforts of Member States in response to national and European legislation or regional obligations.

EMODnet provides access to measurements and maps of concentrations of chemicals in the seawater of all Europe's sea basins as well as dynamic plots of contaminant density, such as time series. Data include:

- Fertilisers
- Dissolved gases
- Chlorophyll, silicates, pH
- Organic matter
- Pesticides and biocides
- Nutrient load to regional seas from major rivers
- Antifoulants
- Heavy metals
- Hydrocarbons
- Radionuclides
- Marine litter



Ocean biology

Europe's seas and oceans are home to a staggering abundance and diversity of life, from large charismatic species such as seals, whales and dolphins, to the microscopic marine algae that form the base of the marine food chain. More than 36,000 known species of marine plants and animals are found in Europe, and understanding their geographic distribution, abundance and seasonal, annual or decadal variation is key to detecting change in the marine ecosystem.

Measuring or observing marine life on a large scale is difficult. For the most part, data are collected over short time periods or in relation to specific species in target locations. Often, data are collected using different standards, technologies and conventions, making it challenging to combine information from different surveys or different databases.

EMODnet assembles these individual datasets and processes them into interoperable data products for assessing the environmental state of ecosystems and sea basins. These data products illustrate the temporal and geographic variability of occurrences and abundances of marine phytoplankton, zooplankton, macro-algae, angiosperms, fish, reptile, benthos, bird and sea mammal species - in particular, introduced or harmful species, species of conservation concern and those used as ecological indicators.

Products include gridded map layers showing the average abundance of marine species of different trophic levels for different time windows (seasonal, annual or multi-annual) using geospatial modelling and spatially distributed data products. Calculation of specific aggregated and gridded products indicating the presence, absence, abundance and diversity of species and communities can give an indication of ecosystem health and temporal trends for specific sea basins, which can be used to improve ecosystem-based management.



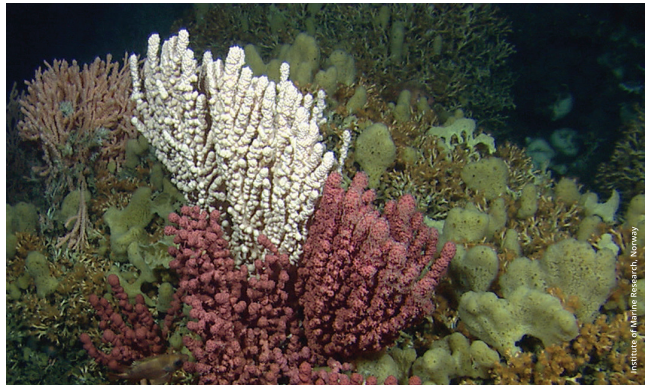
Seafloor habitats

Understanding the occurrence and distribution of different seafloor habitats around Europe is important for effective planning, conservation and sustainable development of the marine environment. EMODnet provides a single point of access for information on Europe's seafloor habitats, assembling data from various sources, ensuring they are described in a standard way, and are available to be discovered and accessed. Furthermore, it produces new data products that are used to assess the environmental state of ecosystems and sea basins.

The nature and distribution of a habitat is dependent on several physical characteristics, such as depth and geology – which define the type, shape and depth of seafloor substrate – and energy, temperature, salinity and optical properties – which can limit the flora and fauna able to live there. Some habitats are described by their physical characteristics alone, while others are described by their biological communities. EMODnet uses the European Nature Information System (EUNIS) habitat classification – the standard, comprehensive system in operation across Europe – as well as regional classifications and habitats listed for protection.

Data and data products available through EMODnet include:

- Broad-scale seabed habitat map for Europe (called EUSeaMap) – classified to EUNIS and MSFD Benthic Broad Habitats;
- Habitat data and products collated from all around Europe, including finer-scale habitat maps from surveys, point samples and modelled habitat maps;
- Gridded environmental variables relevant to habitat distribution, including optical properties, waves, currents, depth (from EMODnet Bathymetry), substrate (from EMODnet Geology), temperature, salinity and dissolved gasses.
- Confidence assessments on all the above.



Human activities

Pressure on Europe's marine space and resources is at an all-time high. Continual demand for resources such as oil and gas, marine minerals and fish must be managed alongside the need to use marine space for renewable energy installations, communications cables, waste disposal sites and shipping. Additionally, societal demand for marine tourism and leisure activities, and the need to conserve marine ecosystems and habitats is leading to increasing competition and conflict between different marine sectors. Having access to accurate information to assist with planning, regulating and managing marine activities in a sustainable and responsible manner is critical.

EMODnet provides access to data describing the geographical position, spatial extent and attributes of a wide array of human activities in the marine environment. From pipeline routes and waste disposal sites, to ports and protected areas, EMODnet maps activities or installations that could affect other ocean users, have an impact on the marine environment or that are themselves vulnerable to disturbance. It also provides a historical view of activities so that trends can be analysed and future requirements better anticipated. Providing transboundary data is of particular importance for activities such as maritime spatial planning. EMODnet provides information on:

- | | |
|---------------------------|---|
| • Aggregate extraction | • Pipelines and cables |
| • Aquaculture | • Protected areas |
| • Cultural heritage | • Status of bathing sites |
| • Dredging | • Vessel density |
| • Fisheries | • Waste disposal (solids) |
| • Hydrocarbon extraction | • Wind farms |
| • Traffic in main ports | • Other forms of area management or designation |
| • Ocean energy facilities | |





Sea-basin Checkpoints



ARCTIC



BALTIC



MED SEA



ATLANTIC



BLACK SEA



NORTH SEA

EMODnet is not only about providing access to data. It is also about assessing how fit for purpose the observation networks, surveying strategies and data access are in six regional European sea basins. EMODnet is also concerned with data quality, and what quality thresholds are necessary to satisfy multiple user needs. This is the aim of EMODnet Sea-basin Checkpoints. The Checkpoints act as surrogate users attempting to address a number of simulated challenges (such as windfarm siting, predicting the fate of an oil spill at sea, etc.). In doing so, they assess and report for each sea basin on the adequacy of the data: what is available and how useful it is.

Each of the six Sea-basin Checkpoints have undertaken these assessments using different approaches, whilst always striving to maintain the user perspective. Their findings will contribute to identify priorities in terms of new datasets needed and how the existing available data can be better exploited. The uniqueness and originality of this exercise lies in its user-oriented focus and perspective, which will facilitate the development of more concrete and practical recommendations for the future development of Europe's ocean observing capacity.

Checkpoints have been established for a limited period for the following seabasins; their findings can be found online via the EMODnet Central Portal:

- Arctic Ocean
- Atlantic Ocean
- Baltic Sea
- Black Sea
- Mediterranean Sea
- North Sea





Adam Norro / BBN



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Data Ingestion Project

There is a wealth of marine data collected in Europe by public and private users, such as governmental organisations carrying out environmental monitoring, academic researchers studying the status of and fluctuations in our marine environment, private companies and even citizen science initiatives. In recent years, EMODnet has made huge advances in facilitating access to data from many sources. However, many data still remain hidden or unusable. There are many and diverse reasons for this, depending on why the data was collected and by whom; these may be related to security, business competition or concerns related to liability. However, data holders are often willing to share their data but lack the resources to do so because of restricted resources, lack of time or limited technical know-how.

EMODnet's Data Ingestion Project tackles these problems by reaching out to data holders, explaining the benefits of sharing their data and offering a support service to assist them in releasing their data for subsequent processing and quality control. The result is to increase the quantity and quality of available European marine data for re-use by diverse stakeholders.


The Data Ingestion Project takes a proactive and strategic approach to target datasets that can fill key gaps - identified through the work of EMODnet's thematic portals, Checkpoints and other initiatives, or specific communities that are collecting data but who do not traditionally share their data, such as the private sector.

In doing so, the Data Ingestion Project embodies one of the EMODnet core principles to "collect data once and use them many times".



Quito AI

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