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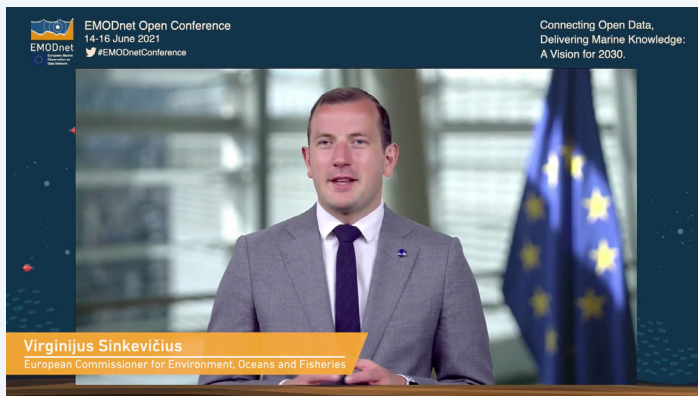
European Marine
Observation and
Data Network

The European Marine Observation and Data Network

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EMODnet Open Conference
14-16 June 2021
🐦 #EMODnetConference

Connecting Open Data,
Delivering Marine Knowledge:
A Vision for 2030.

Virginijus Sinkevičius
European Commissioner for Environment, Oceans and Fisheries

"In just over 10 years, EMODnet has become a reference for marine data collection and sharing, in the EU and globally, and its importance will only grow in the future. Marine knowledge is at the core of our fight against climate change and in unlocking the Blue Economy the creation of EMODnet has been a game changer, enabling for the first time the connection of so many people, organisations and datasets related to the marine environment.

Moreover, access to high quality marine data and related information on human activities at sea – as delivered by EMODnet – is showing its impact, providing better knowledge of the ocean and its ecosystems, enabling and supporting Blue Economy operations, and providing the scientific evidence to underpin decision-making on ocean use, management and conservation.

EMODnet is a key enabler and contributor to the EU Green Deal and digital transition and DG MARE will support EMODnet for full coverage of data for the EU seas and will provide the Blue Economy a solid basis to grow while conserving the marine environment. "

Virginijus Sinkevičius
Commissioner for Environment,
Oceans and Fisheries
EMODnet Open Conference, June 2021

EMODnet:
Your gateway to *in situ* marine data in Europe and beyond

The European Marine Observation and Data Network (EMODnet) is a long-term marine data initiative funded by the European Maritime, Fisheries and Aquaculture Fund (previously: European Maritime and Fisheries Fund).

Now fully centralised, EMODnet is the most comprehensive *in situ* marine data service in Europe, offering a wealth of in water ocean observations, data and data products, spanning the coast to the open ocean and the surface to the deep sea. The common map viewer, central catalogue and other functionalities offer the user easy and seamless access to search, discover, visualise and download multidisciplinary marine environmental and human activities data.

EMODnet is implemented by a large network of over 120 organisations supported by the EU's Integrated Maritime Policy who work together to observe the sea, source and assemble marine data from diverse sources and 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.

EMODnet provides easy and free access to marine data, metadata and data products and services spanning seven broad disciplinary themes: bathymetry, geology, physics, chemistry, biology, seabed habitats and human activities. Each theme is dealt with by a partnership of organisations that possesses the expertise necessary to standardise the presentation of data and create data products. To demonstrate the power of opening up Europe's wealth of marine observations and data, EMODnet turns marine data into maps, digital terrain models, time series & statistics, dynamic plots, and provides a central map viewer and other applications ready to support researchers, industries and policy makers to tackle grand societal challenges.

High quality marine data are the foundation for delivering the EU Green Deal. The EMODnet service is the focal point for *in situ* integrated marine environmental and human activities data and data products that are used by thousands of users who need high quality, harmonised and standardised data and information as input to operations at sea, as observations and information on the health of the ocean and on human impact for regional sea-basin assessments and European Directives e.g., the Marine Strategy Framework Directive, and as evidence to underpin wider policy decisions, international ocean governance and more.

This kind of integrated marine data policy saves costs for offshore operators, while also opening up new opportunities for innovation and growth. 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 is a core data infrastructure and marine data service which, together with the Copernicus Marine Service and Copernicus Data and Information access service (DIAS), form the backbone of a future European Digital Twin Ocean, a key contribution to the EU marine data space and regional best practices for the global ocean data ecosystem.

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 describes the topography of the seabed, by measuring the distance from the sea surface to the seafloor. It provides essential information to understand the dynamics of the marine environment: the shape of the seabed can influence ocean circulation and currents, local fauna and seafloor habitats. It is also very important for hydraulic models calculating tides and waves and other derived parameters.

EMODnet provides access to standardised, harmonised and integrated data and data products on bathymetry (water depth), such as the EMODnet Digital Terrain Model (DTM) for all European seas, depth contours, survey tracks, best-estimate satellite derived coastlines, national baselines, and various options to view, query, and download.

The EMODnet DTM is a flagship product utilised by diverse users spanning the private sector, hydrographic offices, national authorities, the academic research community and more. The DTM is prepared using a common methodology by an experienced team of bathymetry experts as a composite of more than 16,000 data sets, selected from the EMODnet Bathymetry catalogues and processed to common standards and grid. This EMODnet DTM has a grid resolution of 1/16 arc minutes * 1/16 arc minutes.

The EMODnet DTM is progressively updated with higher resolution bathymetry and data from new regions, including data from European Overseas Territories and beyond.

EMODnet Bathymetry also offers the EMODnet World Base Layer Service (EBWBL), available as OGC WMTS service. It provides a fast and easy access to worldwide bathymetric and topographic information as a composite of EMODnet DTM, General Bathymetric Chart of the Oceans (GEBCO) 2019, and a satellite derived DTM for land cover with a common grid and colour palette, while the coastline is based upon OpenStreetMap.

Search, discover, visualise and download the EMODnet Bathymetry offer at: emodnet.ec.europa.eu/geoviewer/#!/

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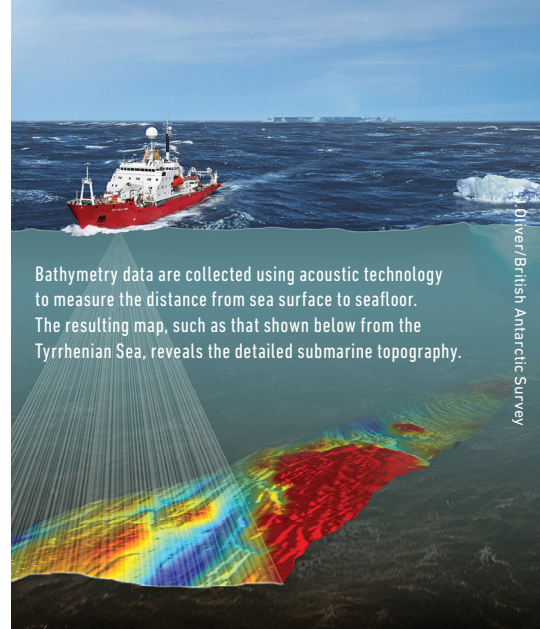
Bathymetry data are collected using acoustic technology to measure the distance from sea surface to seafloor. The resulting map, such as that shown below from the Tyrrhenian Sea, reveals the detailed submarine topography.
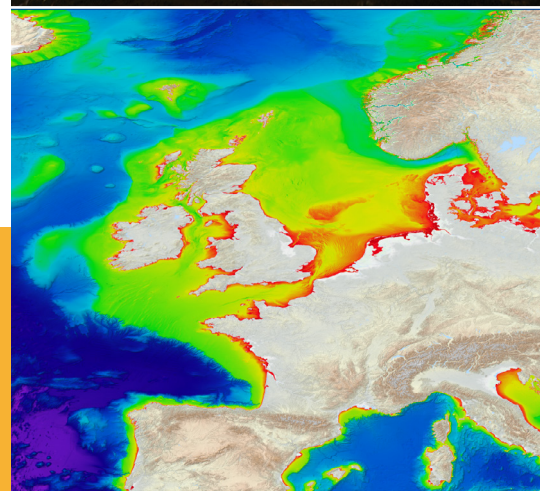
Seafloor geology

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. 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 essential to support maritime spatial planning, coastline prediction, geohazard assessment, offshore installation design, academic research leading to new marine knowledge, and environmental conservation.

A variety of marine landscapes, submarine processes and relics of ancient environments evident throughout our oceans have resulted in different types of mineral accumulations on and beneath Europe's seafloor from coastal areas to deep abyssal plains. The importance of submarine mineralisation systems is related to the abundance and exploitation-potential of many strategic aggregates, energy, metals and Critical Raw Materials (CRM), necessary for the development of modern day societies.

EMODnet provides access to data and data products on a broad range of seafloor geology parameters, including seabed substrate, seafloor geology, coastal behaviour, sediment accumulation rates, geological events and probabilities, and mineral occurrences, and submerged landscapes, amongst others.

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.

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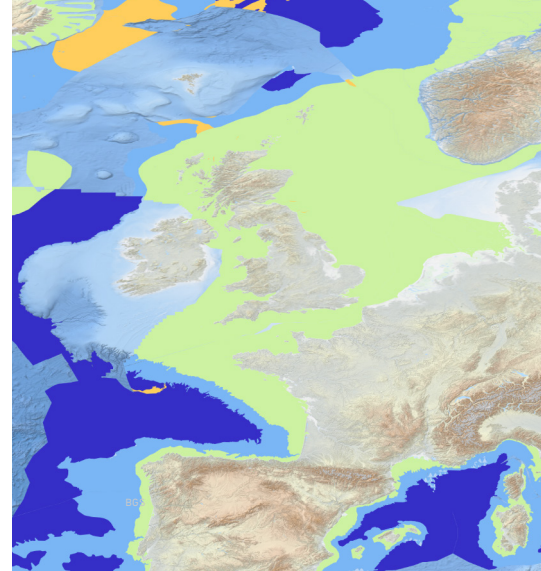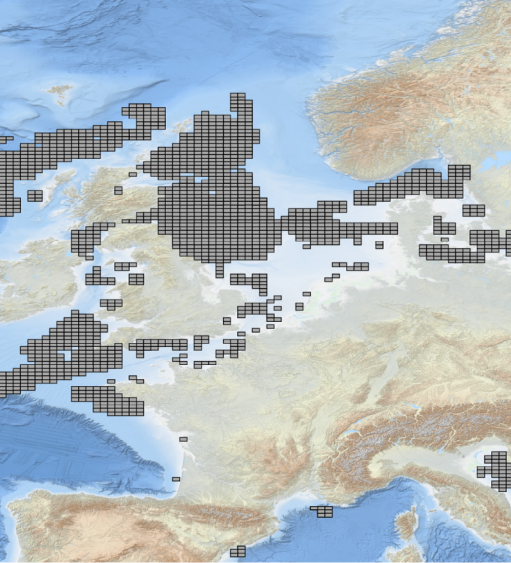
Ocean physics

Prompt and continuous access to physical properties of the oceans is fundamental to our understanding of natural processes and physical properties of the ocean such as ocean circulation, and distribution of and transport of heat, salt and other water properties. 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 also essential for the blue economy in operations at sea, for managing and protecting our natural resources, and to provide the data and information to deliver ocean forecasts and early warnings, climate projections and assessments, and for the safety of human activities at sea.

EMODnet provides a single point of access to *in situ* ocean physics data, data products and metadata built with common standards, free of charge and without restrictions.

EMODnet's current offer of *in situ* ocean physical data and data products covering: temperature of the water column, salinity of the water column, horizontal velocity of the water column, changes in sea level and sea level trends, wave height and period, wind speed and atmospheric pressure, water clarity (light attenuation), underwater sound (noise), inflow from rivers, and sea ice coverage. Provided *in situ* data products include collections of *in situ* data, reanalysis and trends from data, elaboration in space and/or time of *in situ* data and model output for a given parameter. Many of these *in situ* ocean physics data are used in the Copernicus Marine Service computer models, forecasting and prediction services.

Search, discover, visualise and download the EMODnet Physics offer at: emodnet.ec.europa.eu/geoviewer/#!/

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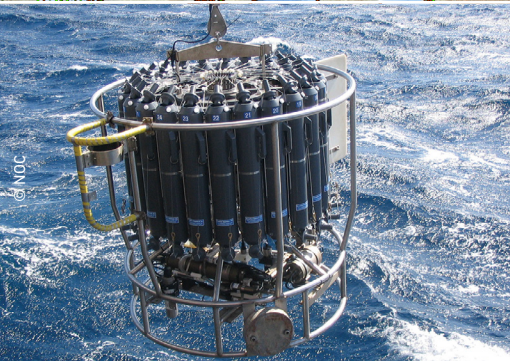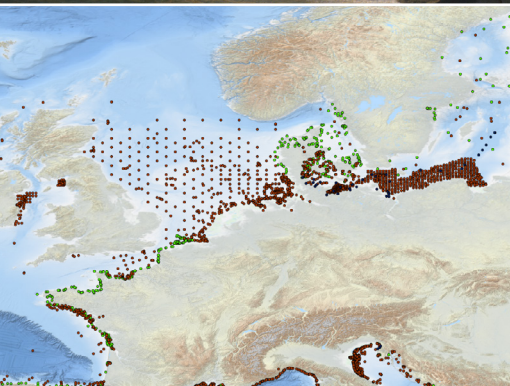
Ocean chemistry

A good understanding of seawater chemistry and its natural variability in a given region is fundamental in detecting short-, medium- and long-term changes in the environmental ecosystem, including those due to human pressures, 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 data and data products on four key marine biogeochemical themes, namely: Eutrophication (chlorophyll, dissolved gases, fertilisers, organic matter, silicates), Ocean acidification (alkalinity, acidity, pH of the water column, carbonate chemistry in sediment pore waters, partial pressure (pCO_2) and fugacity (fCO_2) of carbon dioxide in the water column, total dissolved inorganic carbon (TOC_2) concentration in the water column), Contaminants (antifoulants, hydrocarbons, heavy metals, polychlorinated biphenyls, pesticides and biocides, radionuclides) and Marine Litter (beach macrolitter, seafloor macrolitter, floating microlitter).

A flagship activity of EMODnet is the first pan-European Marine Litter Database (MLDB) developed and managed by EMODnet Chemistry experts, in collaboration with the MSFD's Marine Litter Technical Group (TG ML) and in close cooperation with relevant stakeholders in the EU, such as the European Commission's Joint Research Centre, Regional Sea Conventions, EU Member States, and International Council for the Exploration of the Sea. The database contains data of beach / seafloor macrolitter and floating/sediment microlitter from a variety of sources, with data being used for Marine Strategy Framework Directive Good Environmental Status assessments.

In EMODnet Chemistry, data from over 500 data originators are collected, harmonised and validated by a network of 66 data centres. The EMODnet Central map viewer enables users to visualise the abundance, spatial distribution and temporal variation of *in situ* ocean chemistry parameters.

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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 and for assessing ecosystem health of maritime basins.

Measuring or observing marine life on a large scale is difficult. Marine biodiversity data are often collected with limited spatial and temporal scope and are scattered over different organisations in small datasets for a specific species group or habitat. In addition, as data are collected by multiple organisations, using different standards, technologies and conventions, it is challenging to combine them.

EMODnet assembles these individual datasets and processes them into interoperable data products for assessing the environmental state of ecosystems and sea basins. As such, EMODnet provides access to data and data products on marine biodiversity and related parameters spanning the full ocean ecosystem, from bacteria and viruses to marine mammals. This includes species temporal and spatial occurrences,

biotic measurements, and abiotic parameters. These data products illustrate the temporal and geographic variability of occurrences and abundances of marine phytoplankton, zooplankton, macro-algae, angiosperms, fish, reptiles, 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.

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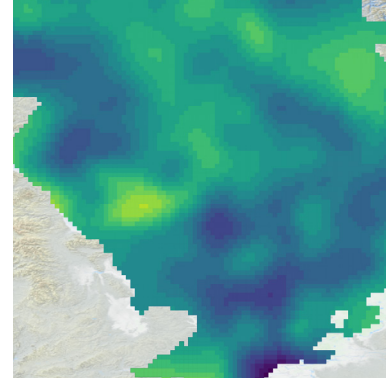
Seafloor habitats

Understanding the occurrence and distribution of different seafloor habitats around Europe is important for effective planning, conservation and sustainable development of the marine environment. 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.

EMODnet offers the EU's most comprehensive data and data products related to European seabed habitats, assembling data from various sources, ensuring they are described in a standardised and harmonised way according to recognised classification systems, and made available to be discovered and accessed.

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.

EMODnet's seabed habitat datasets and data products provide information on benthic (seafloor) ecosystems and biodiversity in European seas and adjacent regions. Understanding the occurrence and distribution of different seafloor habitats, and how these are changing, is important for the private sector e.g., for the siting and environmental impact assessments related to offshore installations, effective planning, conservation and sustainable development of the marine environment.

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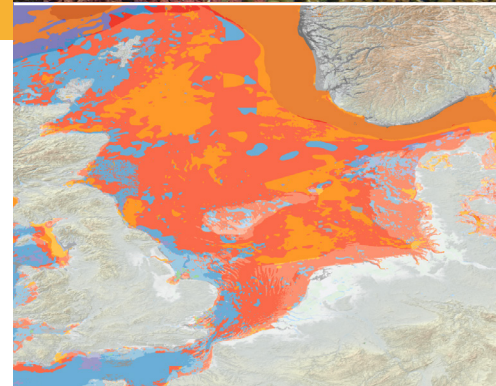
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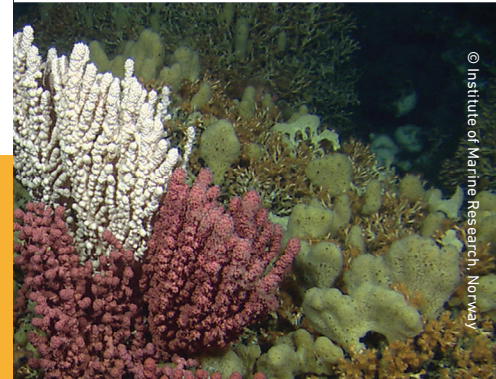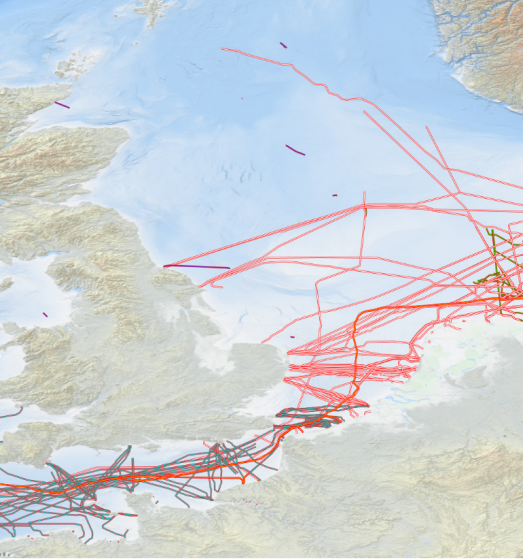
Human activities

Pressure on Europe's marine space and resources is 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 not only provides access to marine environmental data but also a wealth of data and information describing the geographical position, spatial extent and attributes of a wide array of human activities at sea. EMODnet provides transboundary information on aggregate extraction, algae production, aquaculture, cables, desalination plants, cultural heritage, dredging sites, environment, fisheries, maritime spatial planning (including National Maritime Spatial Plans), military areas, nuclear power plants, ocean energy facilities, oil and gas, other forms of area management/designation, pipelines, vessel density traffic, waste disposal, and wind farms.

Data and data products are available for the present time and as historical maps so that the evolution of human activities and trends can be assessed.

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Sea-basin Checkpoints

ARCTIC

BALTIC

MED SEA

ATLANTIC

BLACK SEA

NORTH SEA

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The EMODnet Sea-basin Checkpoint activity (2013-2018) was a unique user-driven method for assessing the quality, adequacy, availability and completeness of the current observation monitoring data in EMODnet, and other sources, at the level of the European regional sea-basins. The first two checkpoints were initiated in the Mediterranean Sea and the North Sea in 2013; with checkpoints for the Arctic, Atlantic, Baltic Sea and Black Sea being launched in 2015.

By stress-testing the data against specific end-user challenges (e.g. marine protected areas, windfarm siting, predicting the fate of an oil spill at sea, etc.), the Checkpoints evaluated how well Europe's observing and monitoring capacity and data collection frameworks provided data to meet the needs of users. In doing so, data gaps and duplications as well as significant bottlenecks were highlighted.

The findings, conclusions and recommendations from the different Sea-basin Checkpoints' as well as an integrated summary report on the synthesis of results of the EMODnet Sea-basin Checkpoint data stress tests can be found and downloaded at emodnet.ec.europa.eu/en/checkpoints.

The integrated summary report noted that *"The EMODnet Checkpoint concept is unique and innovative as it incorporates the user perspective."* In addition, *"The EMODnet sea-basin checkpoint assessments have generated a wealth of insights on adequacy of the current marine data collection and management landscape in Europe."*

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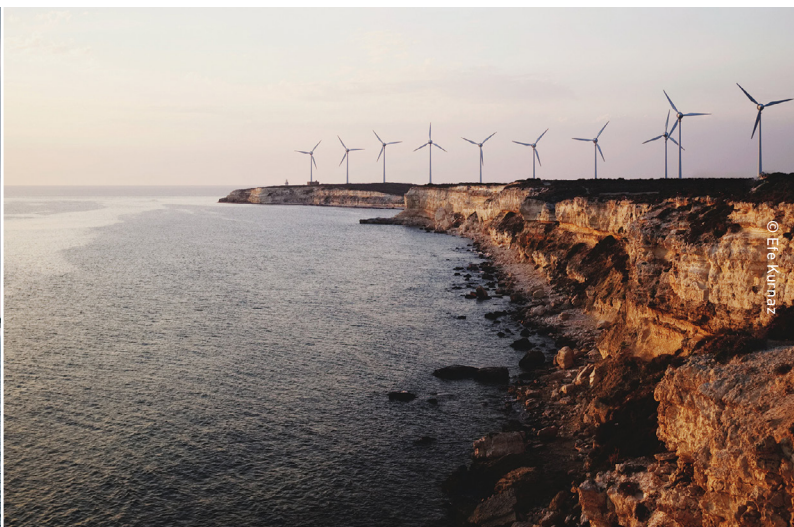
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There is a wealth of marine data collected in Europe by public and private users, such as by governmental organisations carrying out environmental monitoring and fisheries data collection for legislative purposes, academic researchers taking ocean observations to study the marine environment, private companies taking baseline marine environmental data and operational data, civil society and citizen science collection efforts and more. In recent years, EMODnet has made huge advances in sourcing, ingesting and facilitating access to data from many sources.

However, numerous data remain hidden or unusable. There are many and diverse reasons for this, largely depending on why the data was collected and by whom; these may be related to commercial sensitivity, security, business competition or concerns related to liability.

Nevertheless, an increasing number of 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 providing an EU service for *in situ* marine data submission and ingestion. It works directly with 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 e.g., resolution, parameter and spatial/temporal coverage.

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

Visit emodnet.ec.europa.eu/en/contribute-data-emodnet

Data ingestion project

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