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Reanalysis and short-term forecasting of environmental conditions in the Black Sea using CMEMS and EMODnet

ΔΗΜΟΚΡΙΤΕΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΘΡΑΚΗΣ | DEMOCRITUS UNIVERSITY OF THRACE

Myrintzou Vasiliki, DUTH
Nikolaos Kokkos, DOMI Dev. P.C.

DOMI Development P.C

17 April 2026, Tbilisi

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The European Earth Observation Programme

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CMEMS is the **Copernicus Marine Environment Monitoring Service**

Atmosphere

Marine

Climate Change

Land

Security

Emergency

It is funded by **EU** and operated by **Mercator Ocean** in Toulouse, France

It is a service providing **full, free and open access marine data** to regular and systematic reference on the state of the **Blue** (physical), **White** (sea ice) and **Green** (biogeochemical) ocean, on a global and regional scale.

Blue Ocean

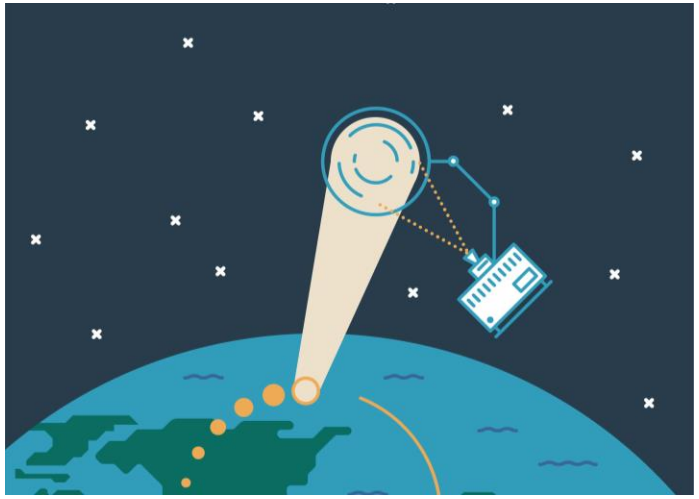
describes the **physical state of the ocean**, such as sea surface temperature, sea level, currents, waves, and winds.

White Ocean

deals with the **monitoring of the poles** and to the critical life cycle of any kind of floating, melting or freezing sea-ice.

Green Ocean

describes the **biogeochemical processes**, the transfer of simple chemical substances between ocean life and the ocean environment. Such as chlorophyll-a concentrations, ocean nutrients, and primary production.

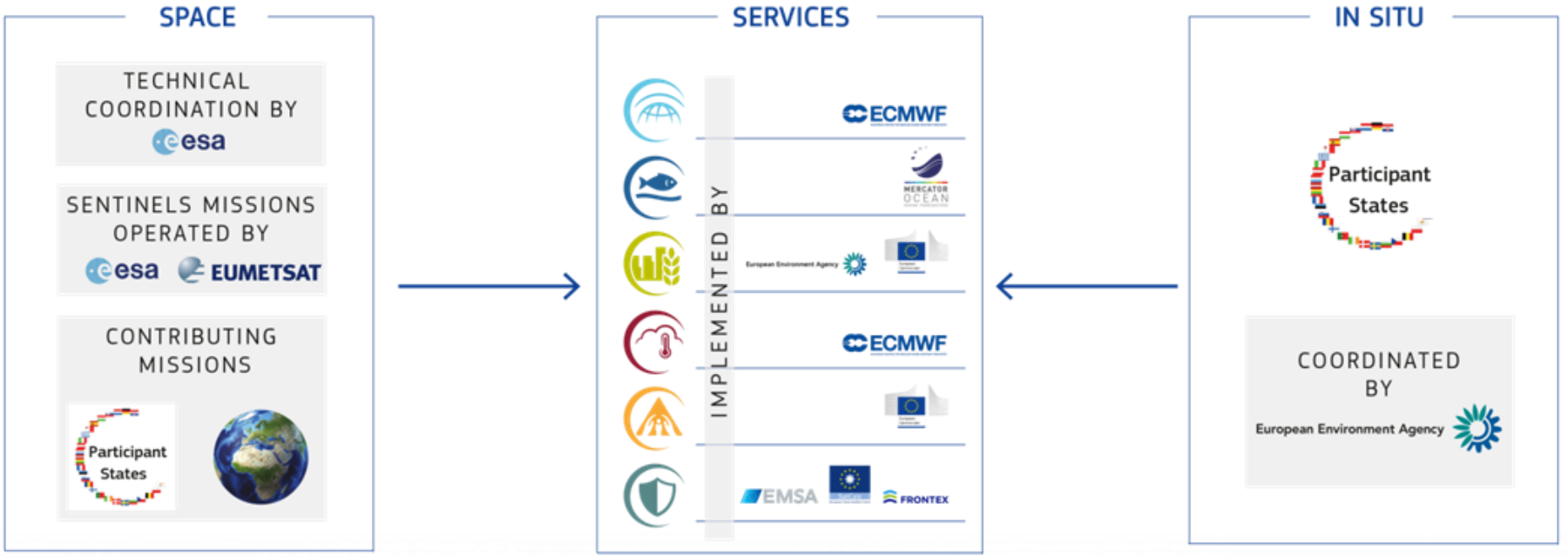


It is **highly dependent** on the timely availability of comprehensive **satellite measurements**, with sufficient space and time coverage of parameters such as surface temperature, ocean color, sea surface height and sea ice,

as well as information from circulation, waves and biogeochemical **models** validated **from measurements received from instruments in the sea** (in-situ).

COPERNICUS marine service encompasses **3 main components**:

SPACE , **INSITU** and **SERVICES**



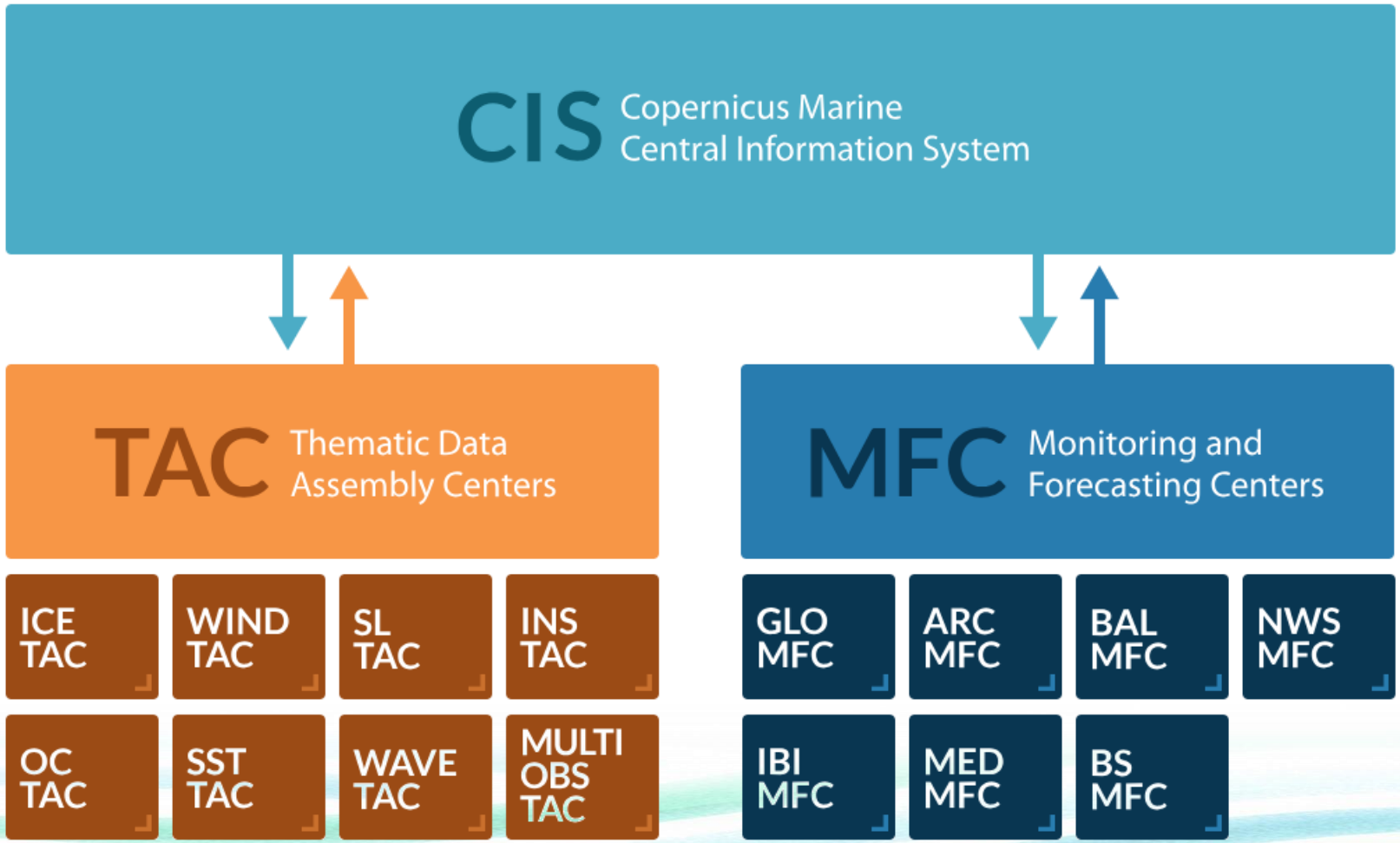
includes the ESA Sentinels

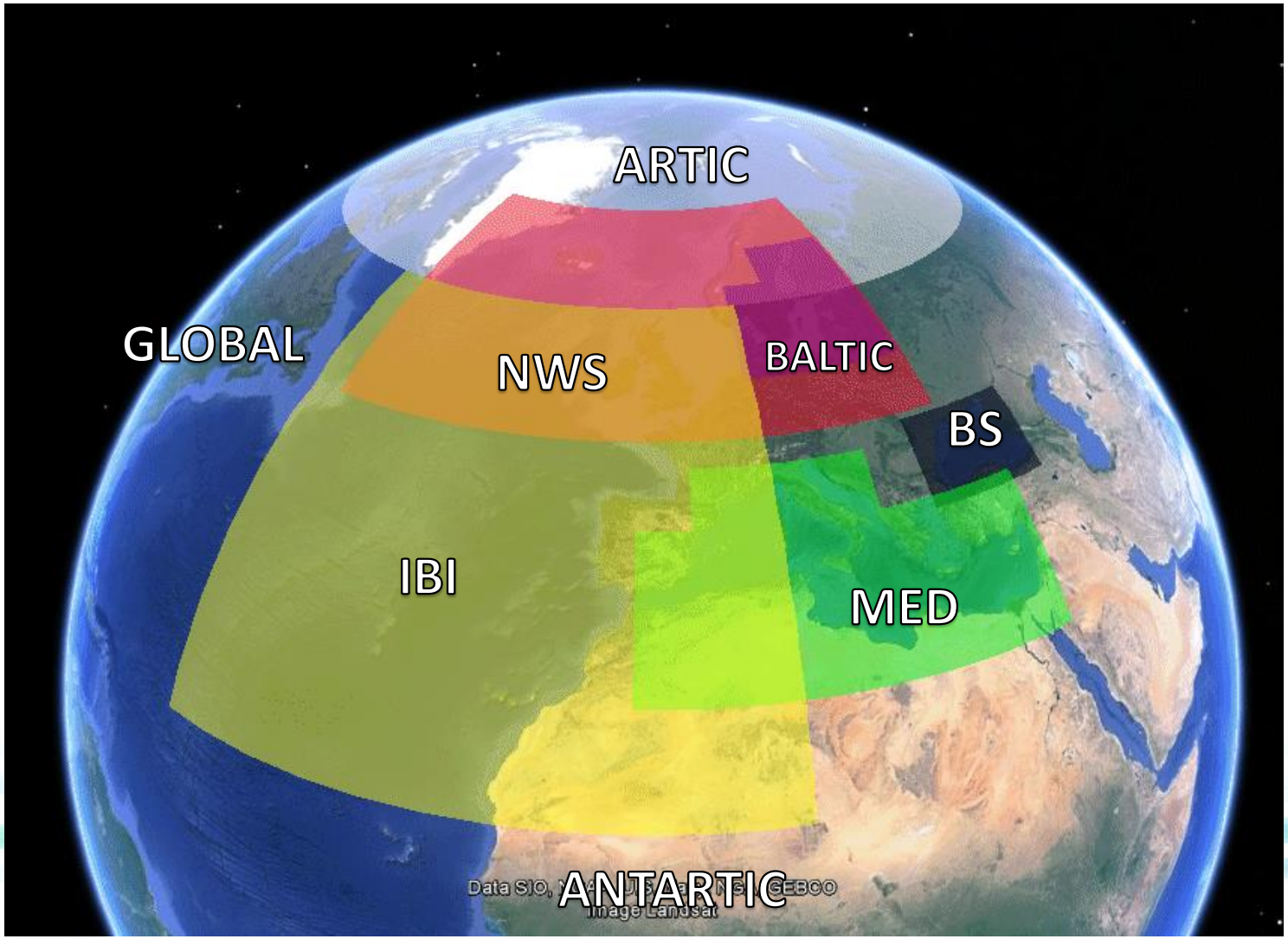
includes all data products (reanalysis, forecasts, satellite data, etc)

includes monitoring networks as buoys, drifters, gliders, etc.

CMEMS relies on a distributed architecture of:

- **8 Thematic Data Assembly Centers** (TACs) **process data acquired from satellite ground segments and insitu platforms, Satellite and InSitu Observations** into real-time (today) and reprocessed (20 years historic) products.,
- **8 Monitoring and Forecasting Centers** (MFCs) **run ocean numerical models assimilating the above TAC data** to generate reanalyse (20 years in the past), analyse (today) and 10-day forecasts of the ocean
- and a **Central Information System** (CIS).


CIS Copernicus Marine Central Information System
TAC Thematic Data Assembly Centers
MFC Monitoring and Forecasting Centers
ICE TAC
WIND TAC
SL TAC
INS TAC
OC TAC
SST TAC
WAVE TAC
MULTI OBS TAC
GLO MFC
ARC MFC
BAL MFC
NWS MFC
IBI MFC
MED MFC
BS MFC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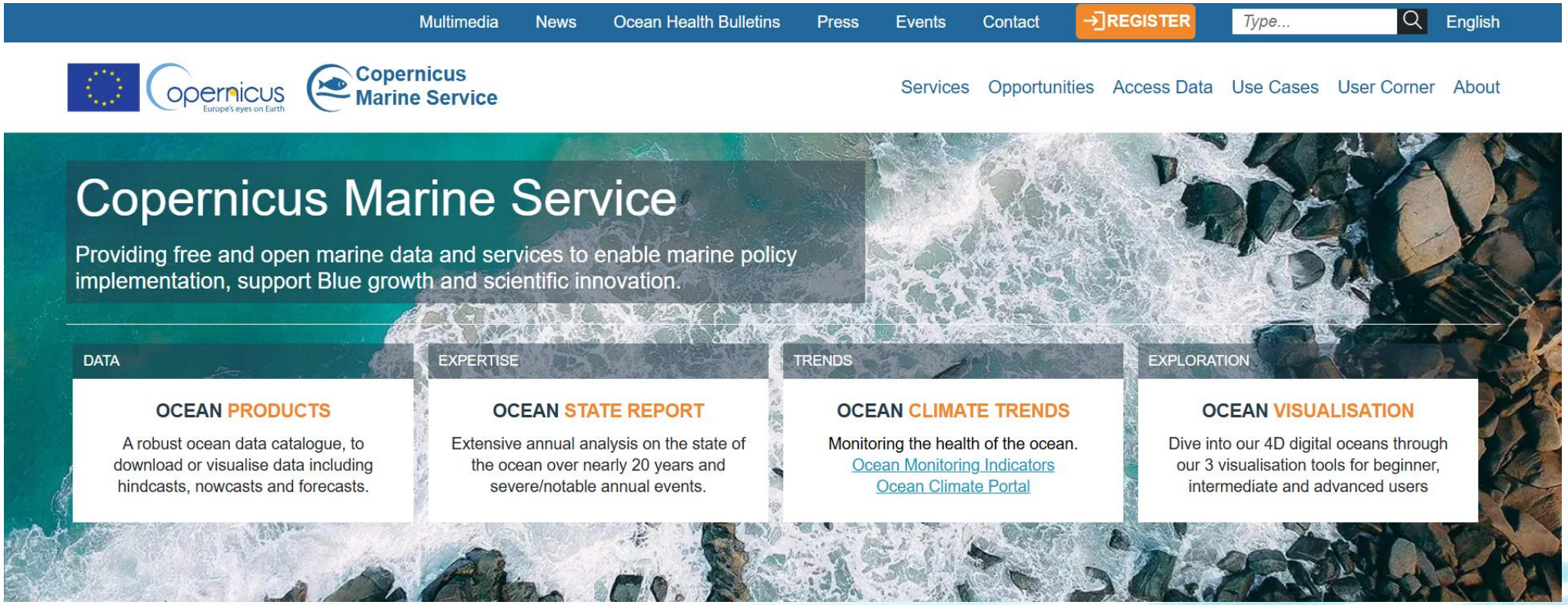
marine.copernicus.eu



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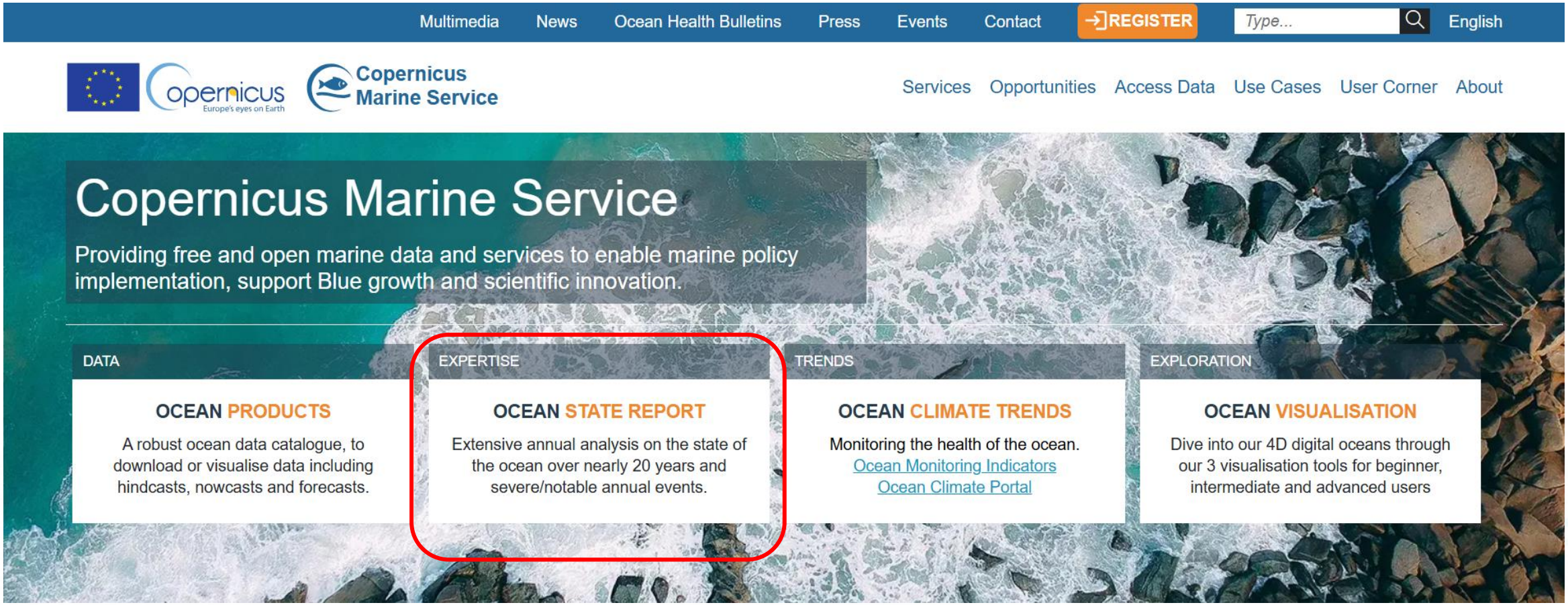
CMEMS Ocean State Report



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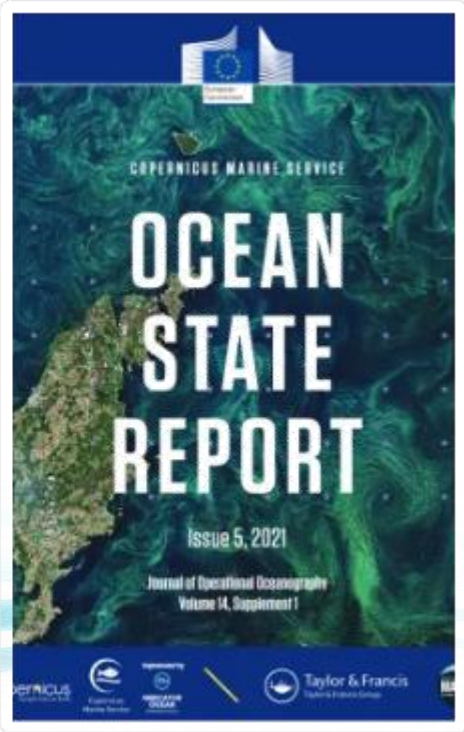
CMEMS Ocean State Report

It provides a **comprehensive assessment of the state of the global ocean and European regional seas** for the ocean scientific community as well as for policy and decision-makers.



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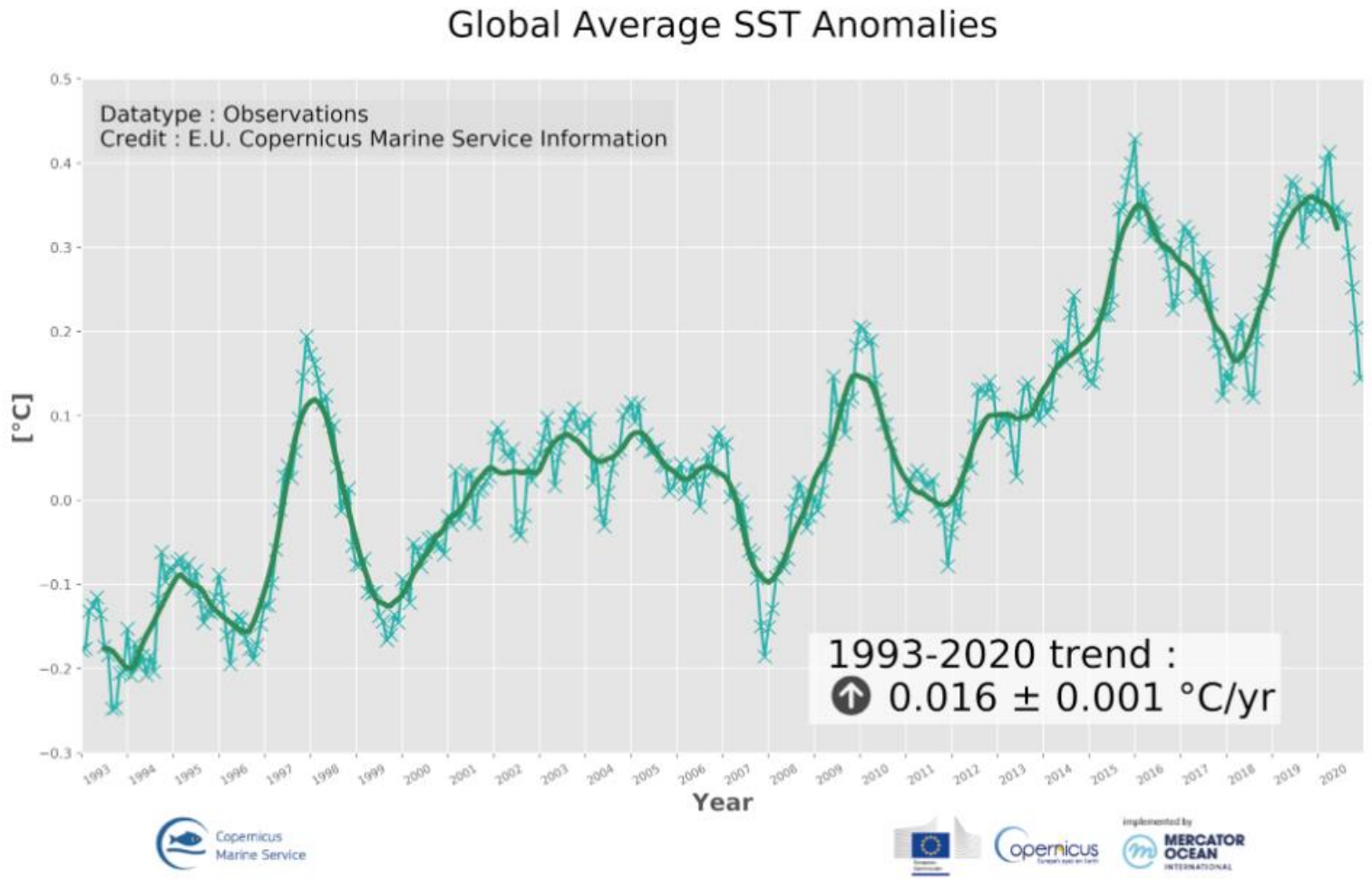
CMEMS Ocean State Report



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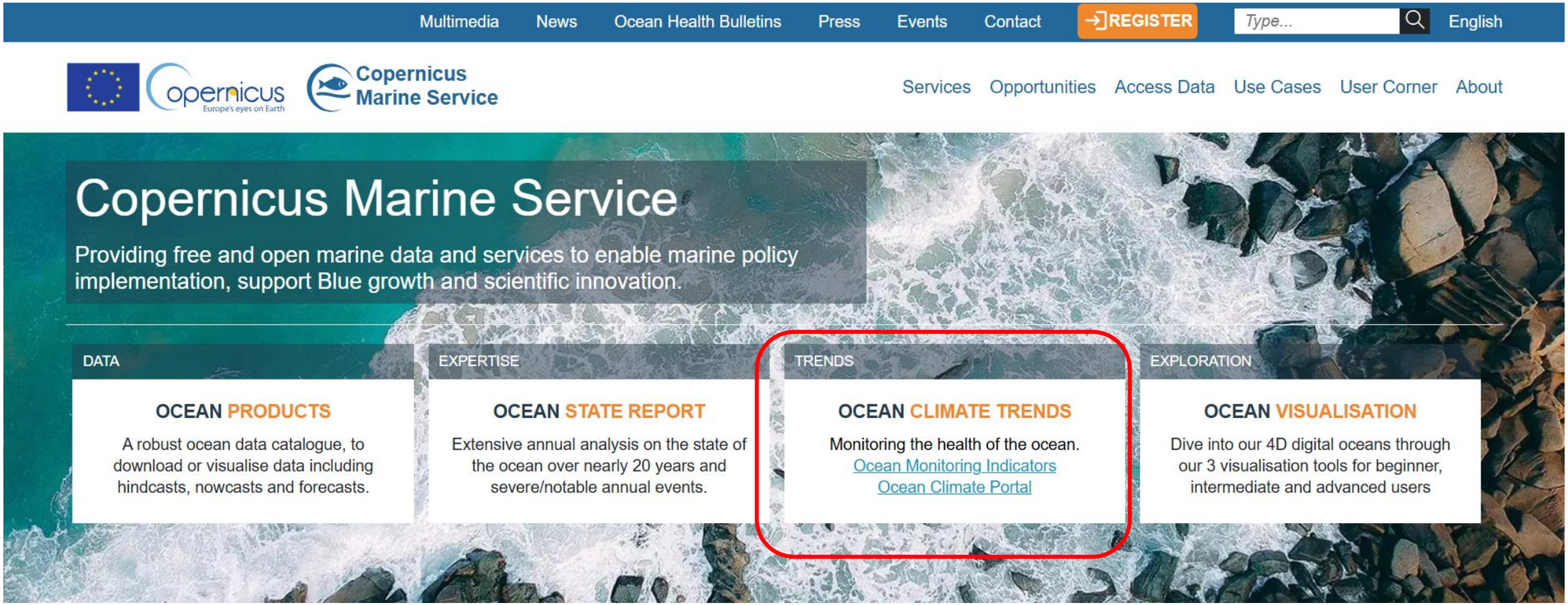
CMEMS Climate Trends



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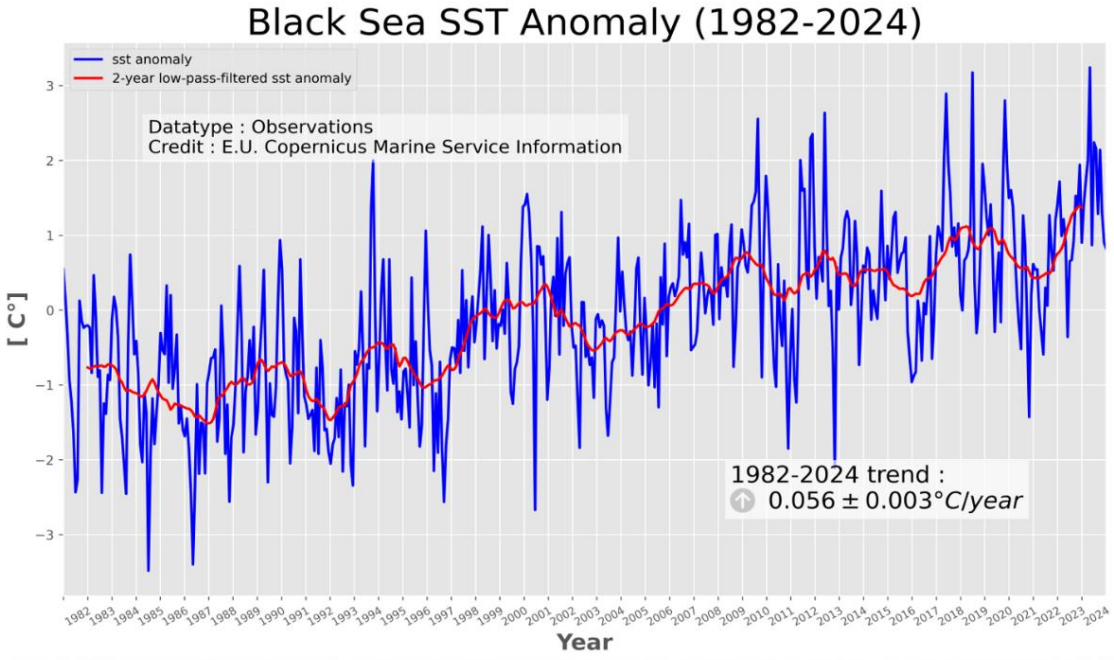
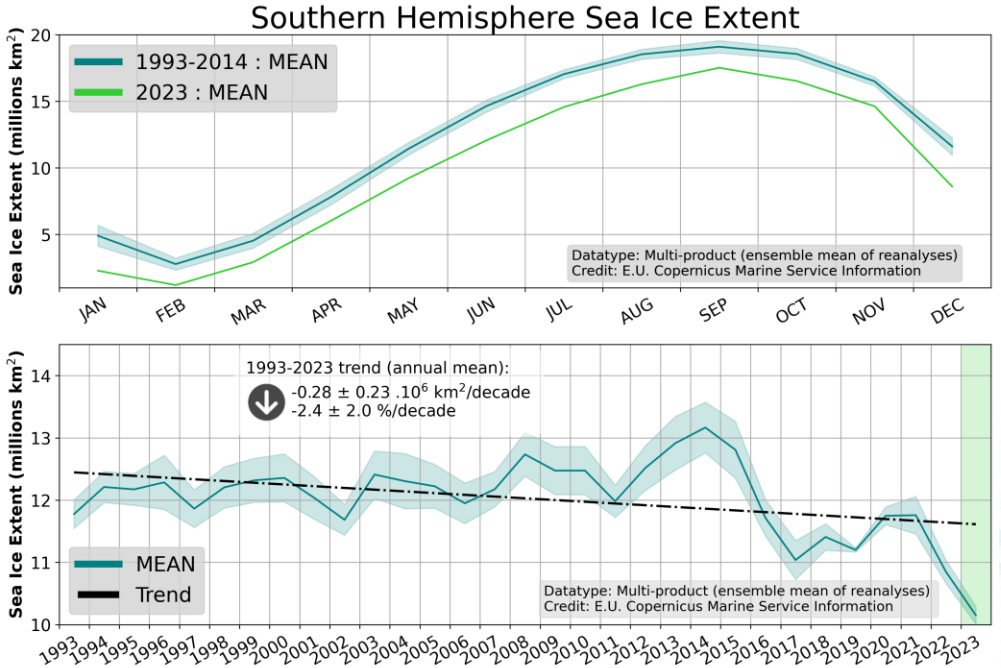
CMEMS Climate Trends

It provides downloadable **trends and data sets covering the past quarter of a century**. These are key variables used to track the vital health signs of the ocean and changes in line with climate change.





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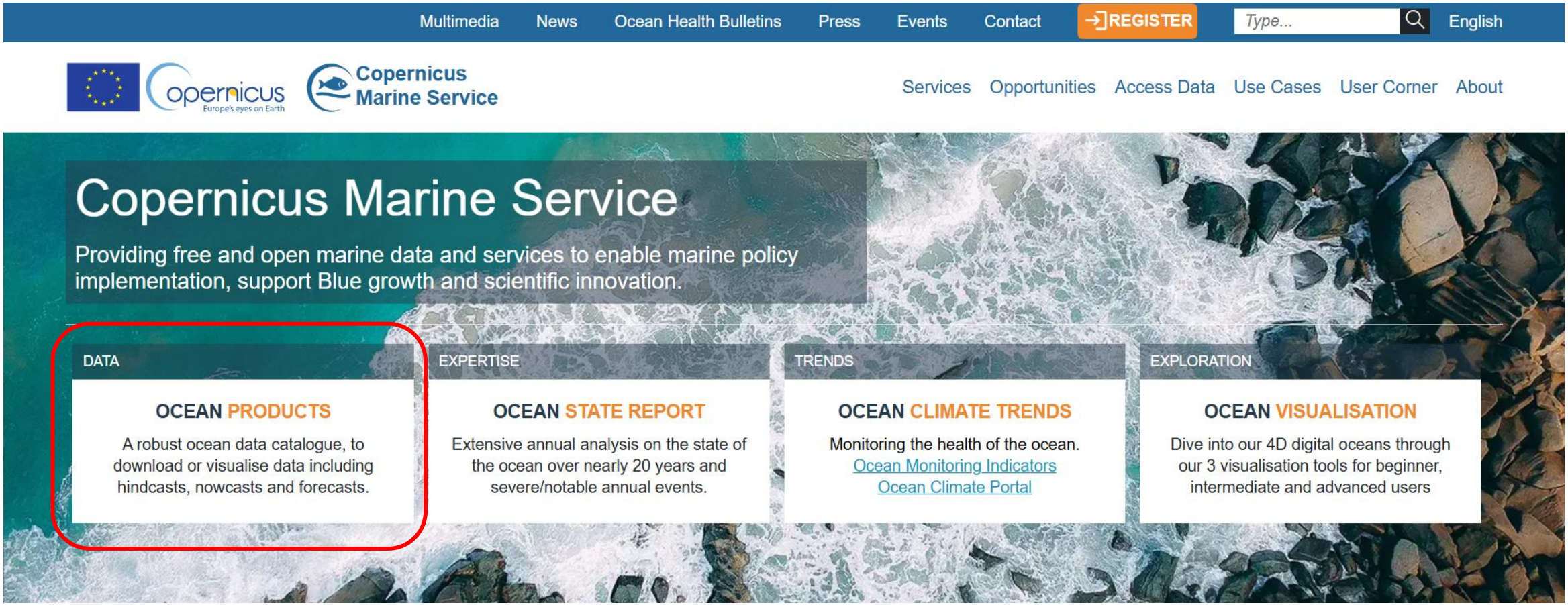
CMEMS Ocean Products



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Areas

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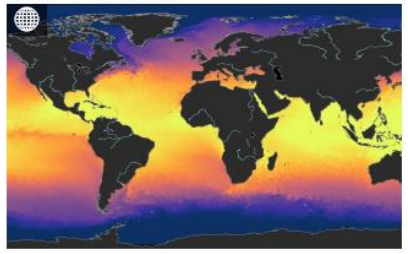
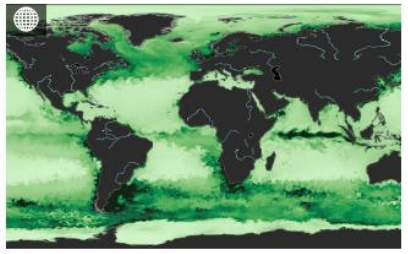
Products 306 in Copernicus Marine Service

MOST POPULAR



Global Ocean Physics Analysis and Forecast

GLOBAL_ANALYSISFORECAST_P... 001_024



Global Ocean Biogeochemistry Analysis and Forecast

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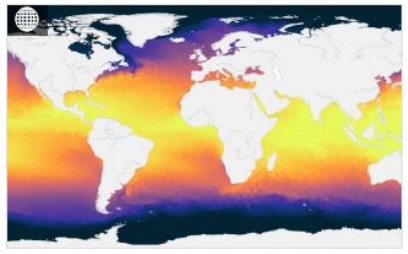

Global Ocean Physics Reanalysis

GLOBAL_MULTIYEAR_PHY_001_030

Mediterr Analysis

MEDSEA_A

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FREE-TEXT SEARCH

Free text

TIME RANGE

mm/dd/yyyy mm/dd/yyyy

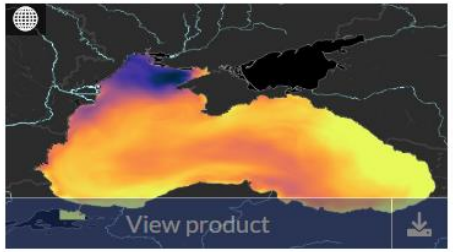
Covering full interval

WITH DEPTH 6

DEPTH RANGE

UNIVERSE

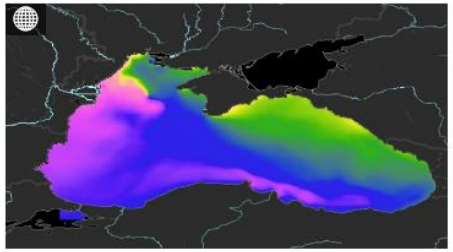
Products 55 in **Copernicus Marine Service**



Black Sea Physics Analysis and Forecast

BLKSEA_ANALYSISFORECAST_PHY_007_001

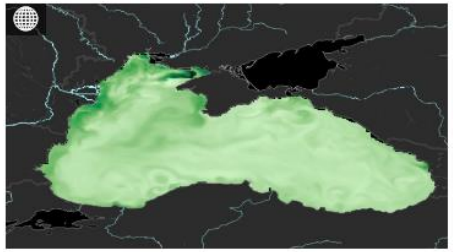
Models



Black Sea Waves Analysis and Forecast

BLKSEA_ANALYSISFORECAST_WAV_007_003

Models



Black Sea Biogeochemistry Analysis and Forecast

BLKSEA_ANALYSISFORECAST_BGC_007_010

Models

CMEMS Ocean Products for the Black Sea

These data products are divided into:

- **Models (13 products)**
  - **Analysis and Forecast** data from numerical models
  - **Reanalysis of historic** data from assimilated numerical models
- **Insitu (12 products)**
  - **NRT** observations from on-site sensors
  - **Delayed** observations from on-site sensors
- **Satellite (31 products)**
  - **NRT** data
  - **Reprocessed** data

How to view available CMEMS parameters and data online

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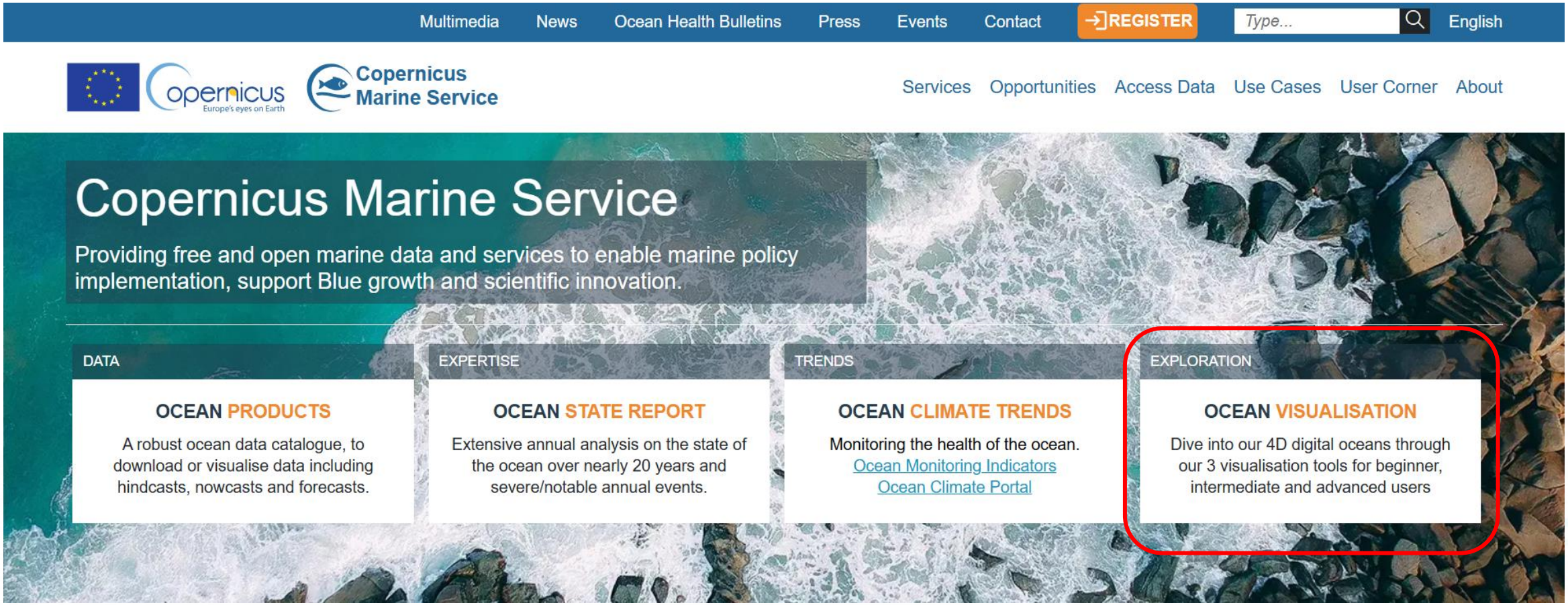

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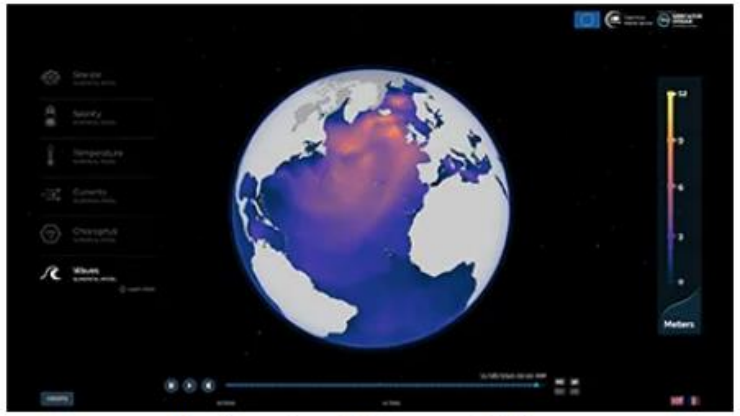
CMEMS Ocean Visualisation

MYOCEAN LEARN

(BEGINNER) GLOBE

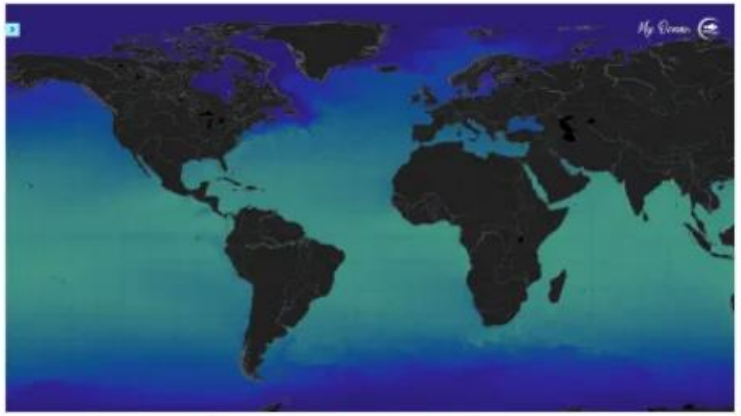


Understand key variables

Explore MyOcean Learn

MYOCEAN LIGHT

(INTERMEDIATE) PLANISPHERE

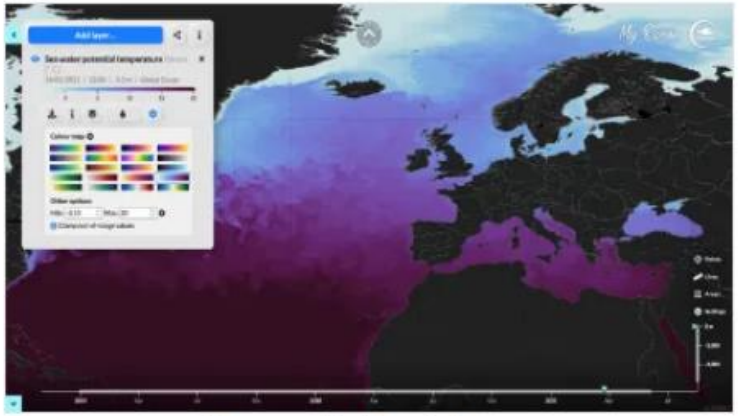


Access key variables

Explore MyOcean Light

MYOCEAN PRO

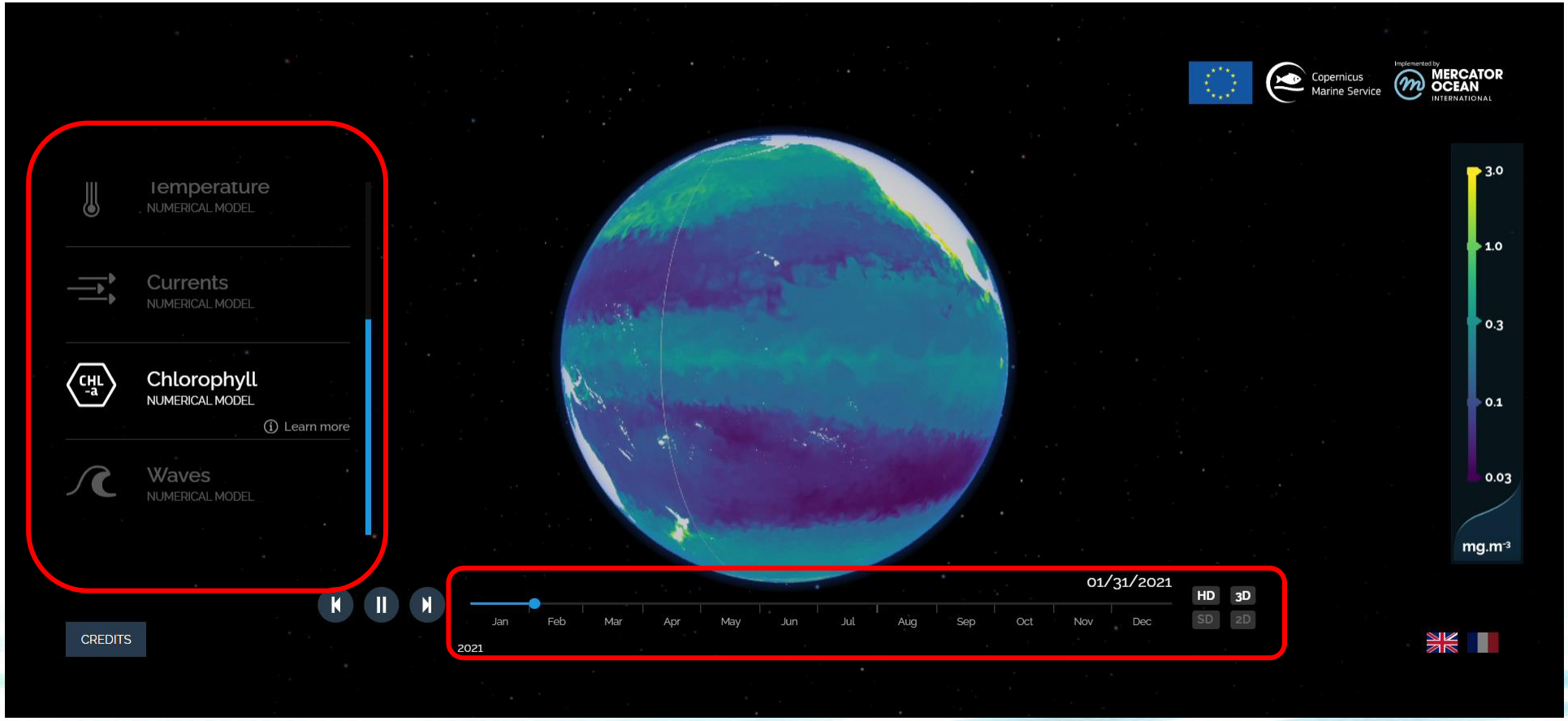
(EXPERT) PLANISPHERE



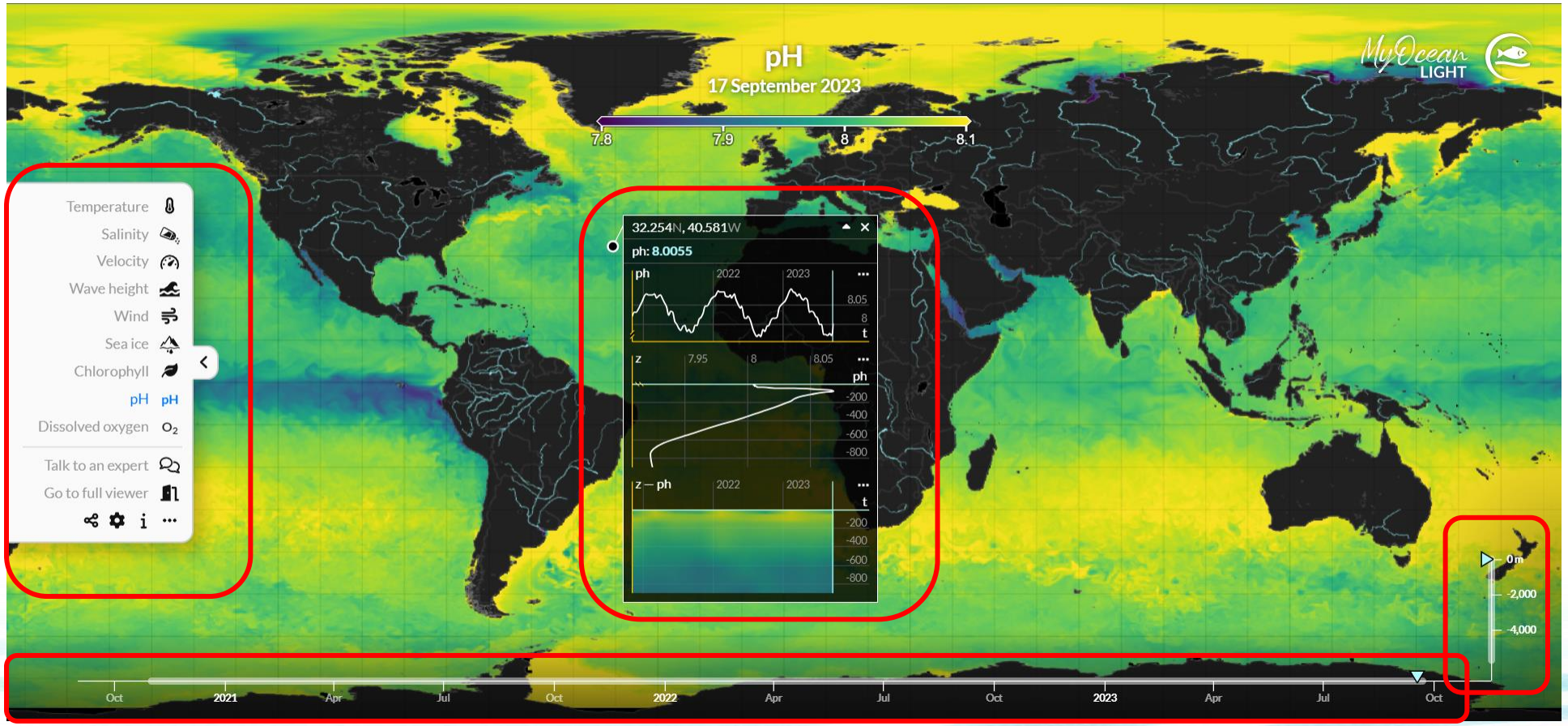
Access full catalogue

Explore MyOcean Pro

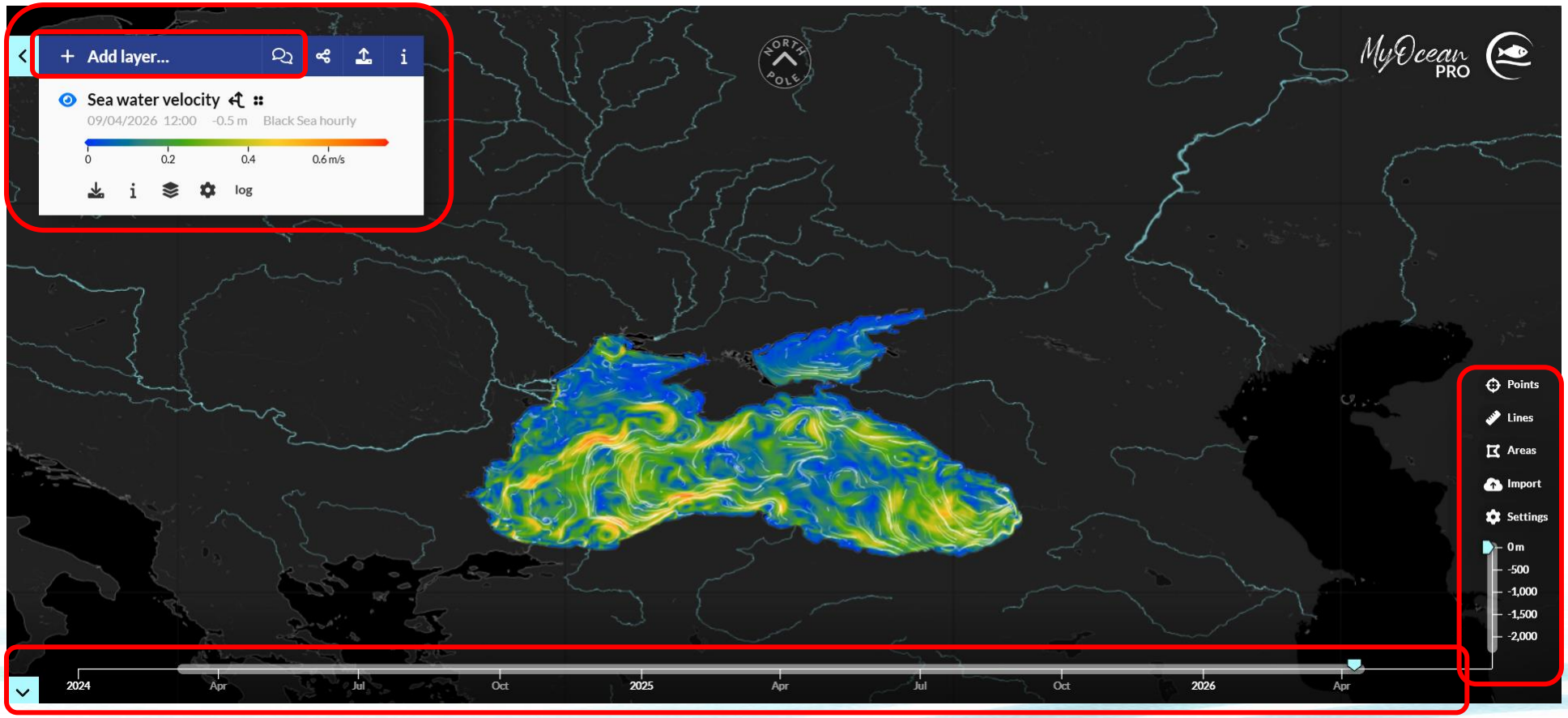
CMEMS Ocean Visualisation - MYOCEAN Learn



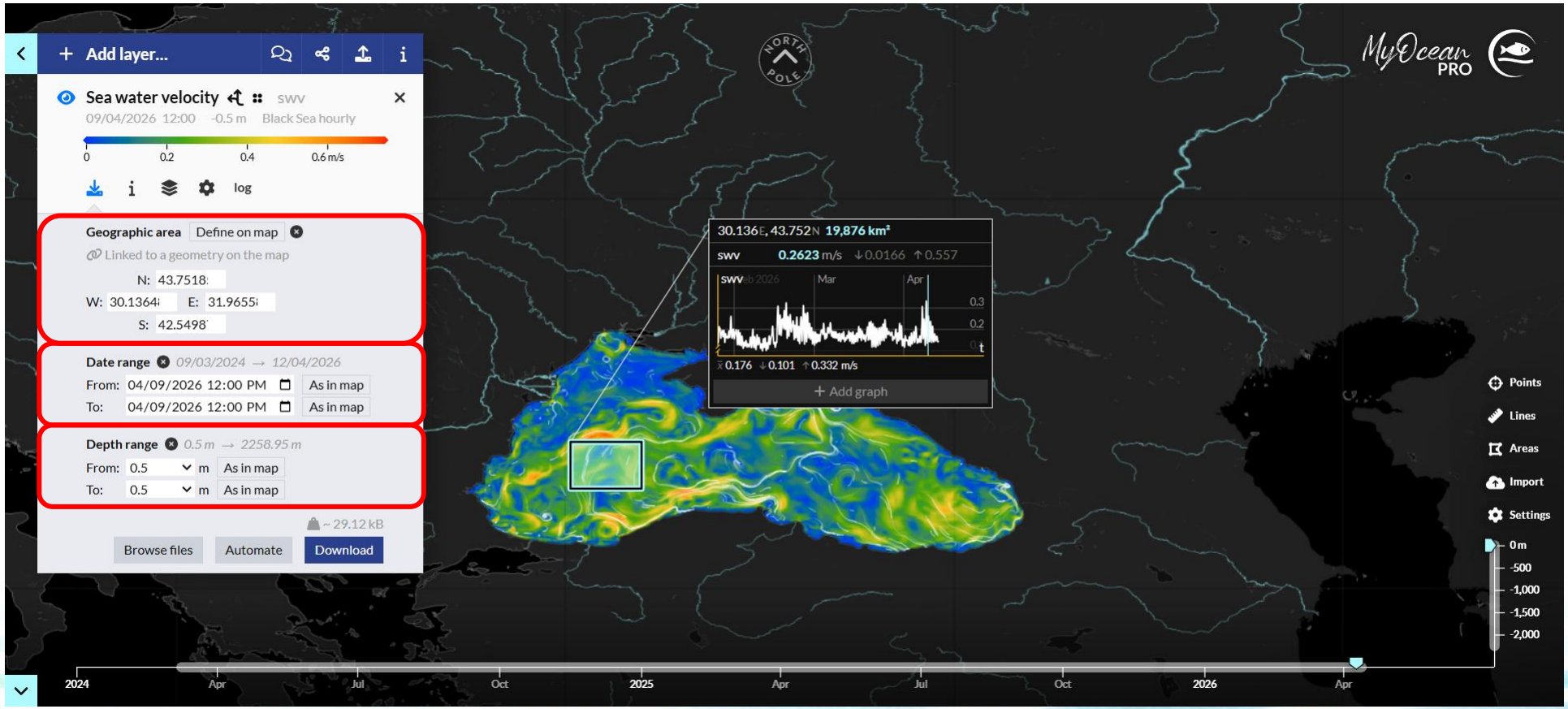
CMEMS Ocean Visualisation - MYOCEAN Lite



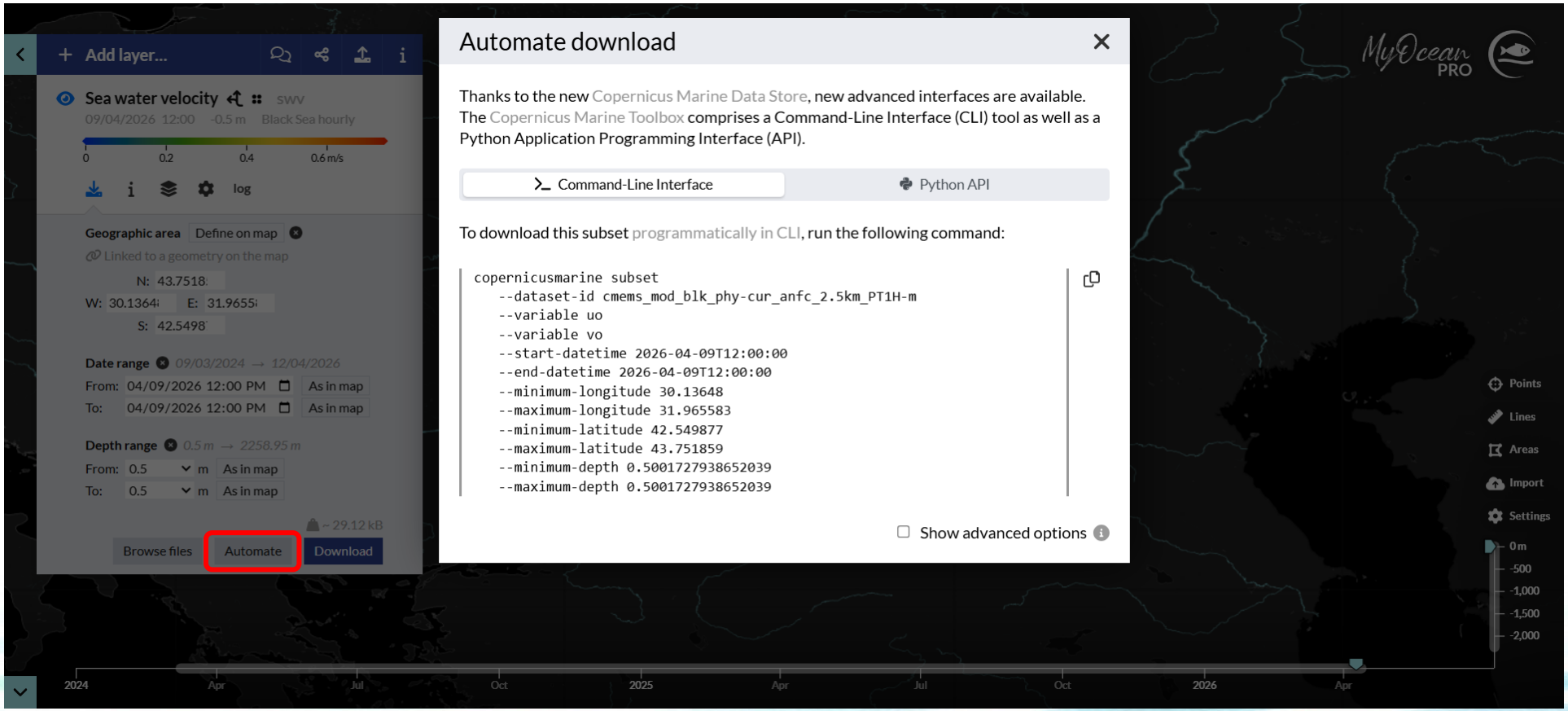
CMEMS Ocean Visualisation - MYOCEAN Pro



CMEMS Ocean Visualisation - Download Data



CMEMS Ocean Visualisation - Download Data - API Request



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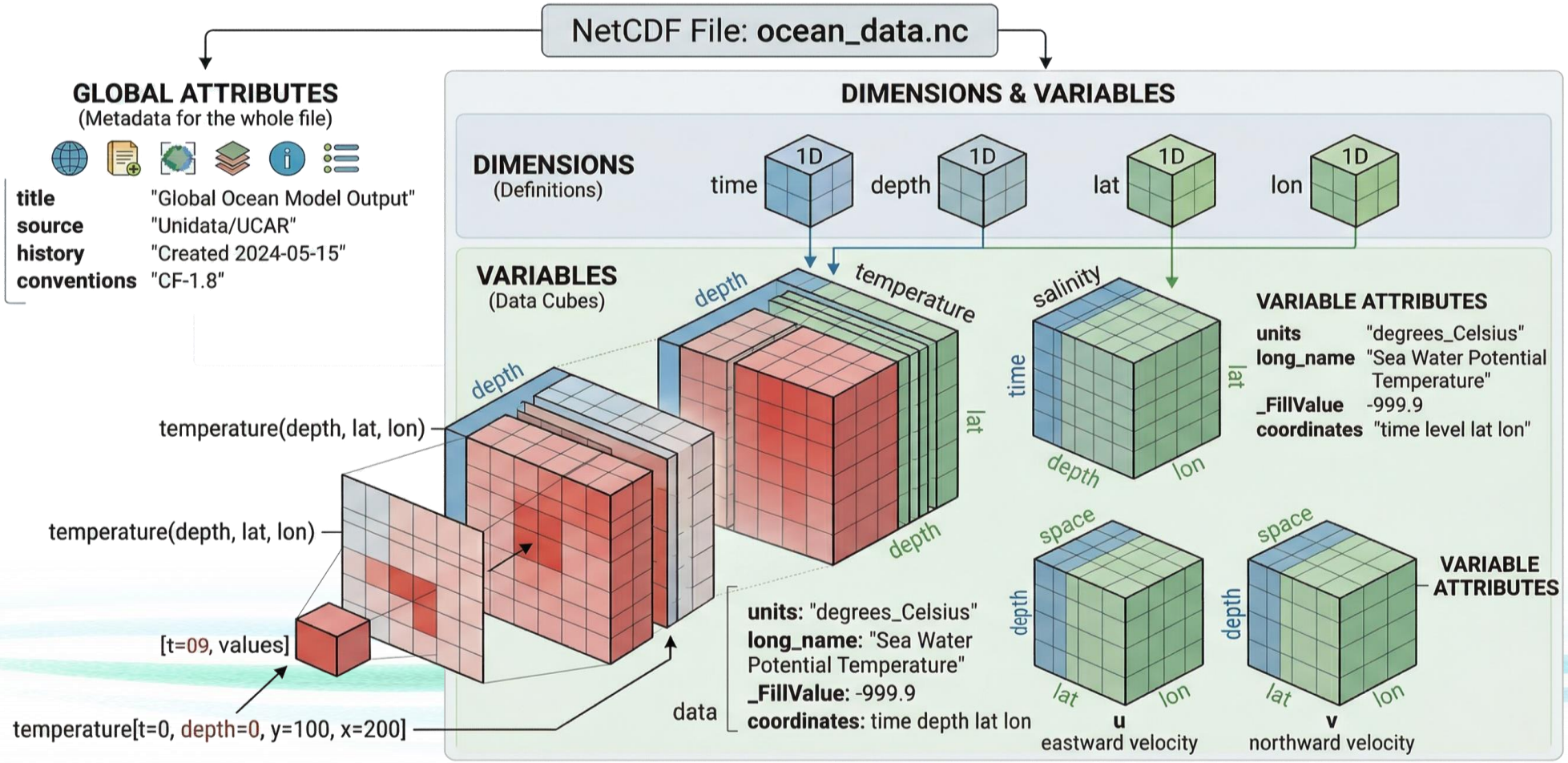
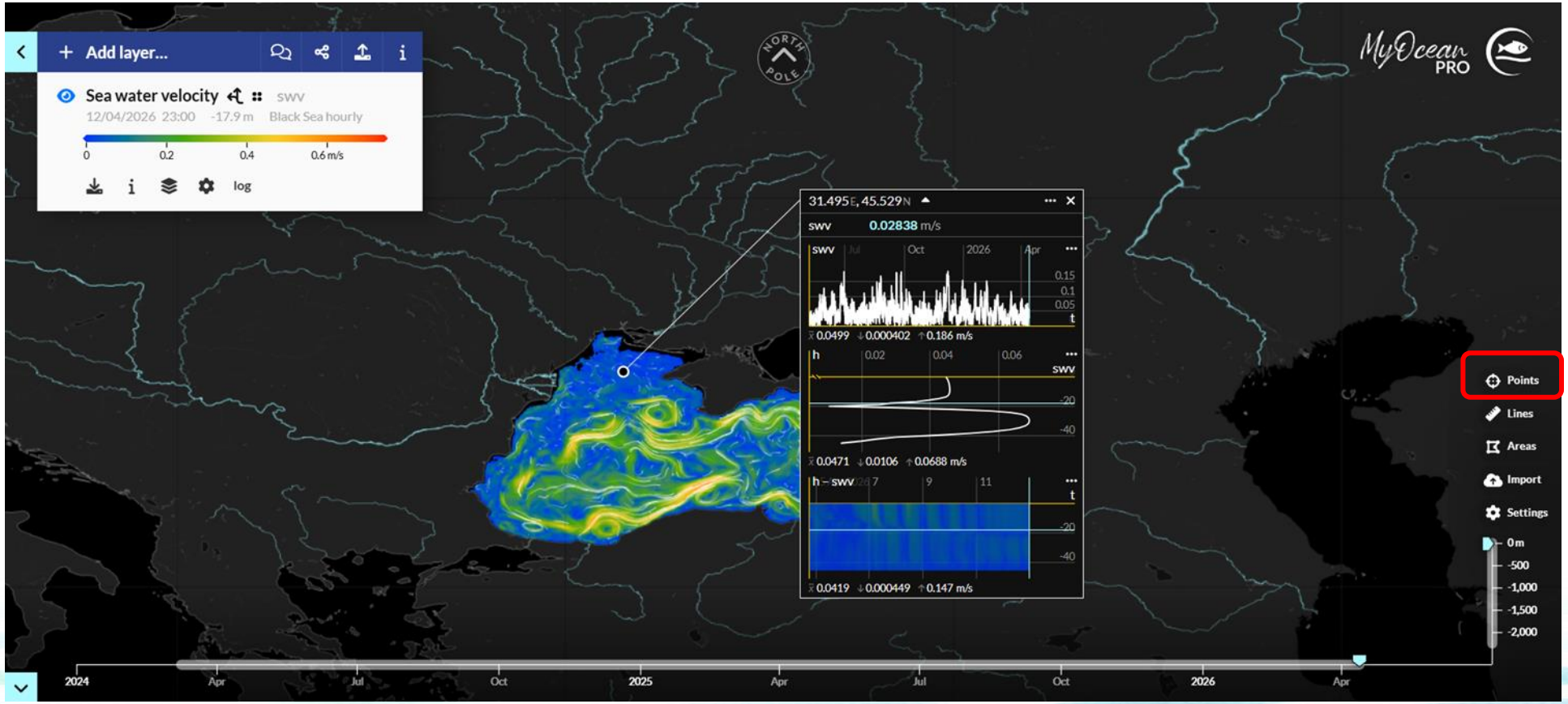
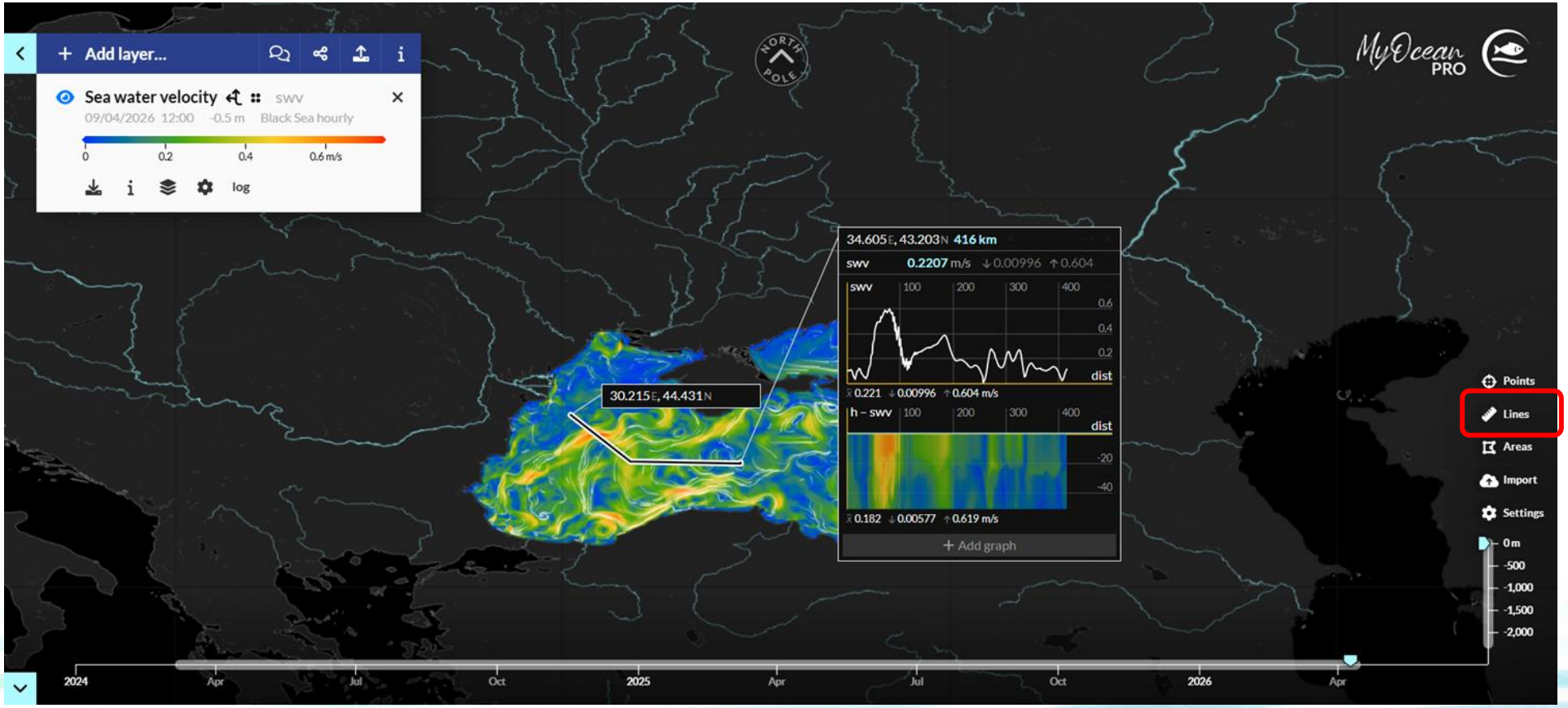
CMEMS Ocean Visualisation - Download Data - netCDF files



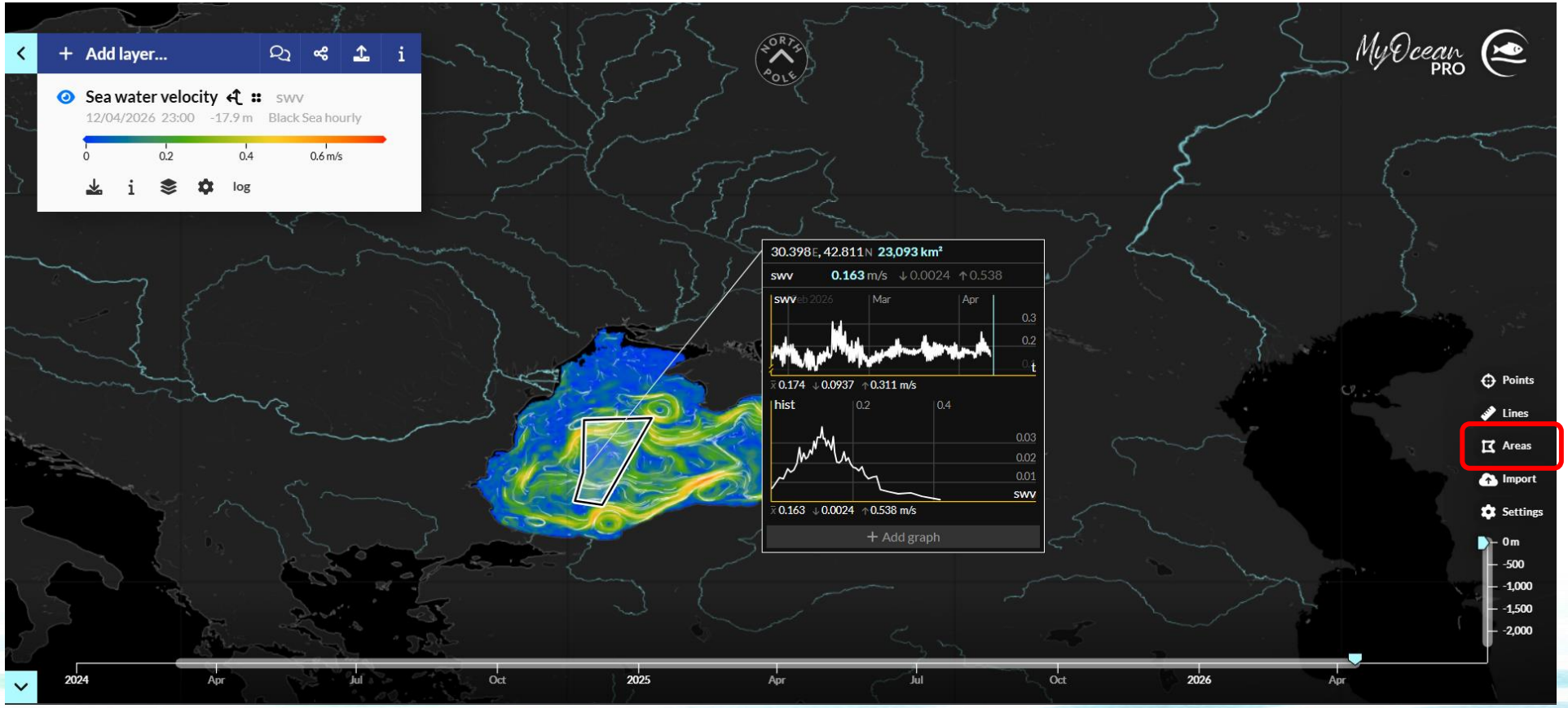
CMEMS Ocean Visualisation - Point Graph



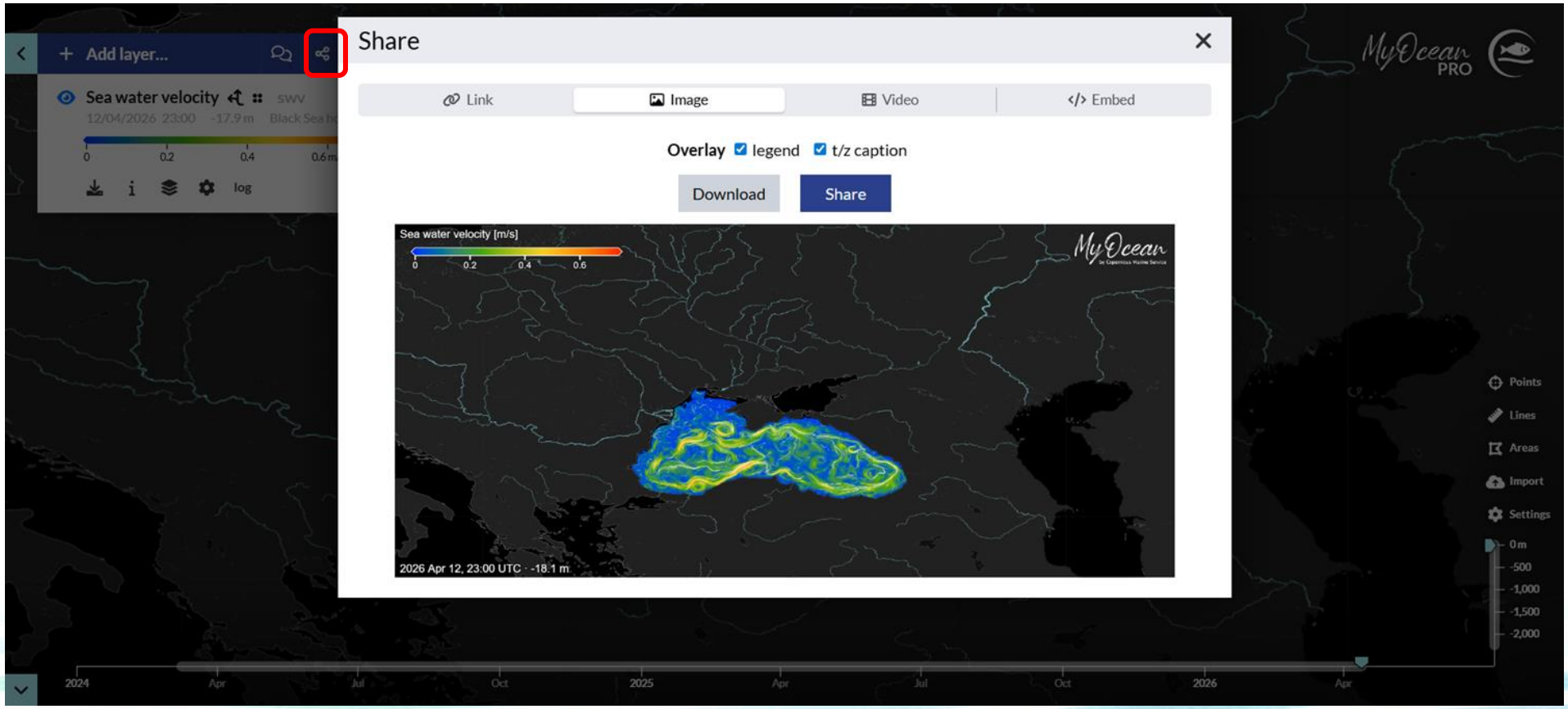
CMEMS Ocean Visualisation - Line Graph



CMEMS Ocean Visualisation - Area Graph



CMEMS Ocean Visualisation - View Export



What is EMODnet?

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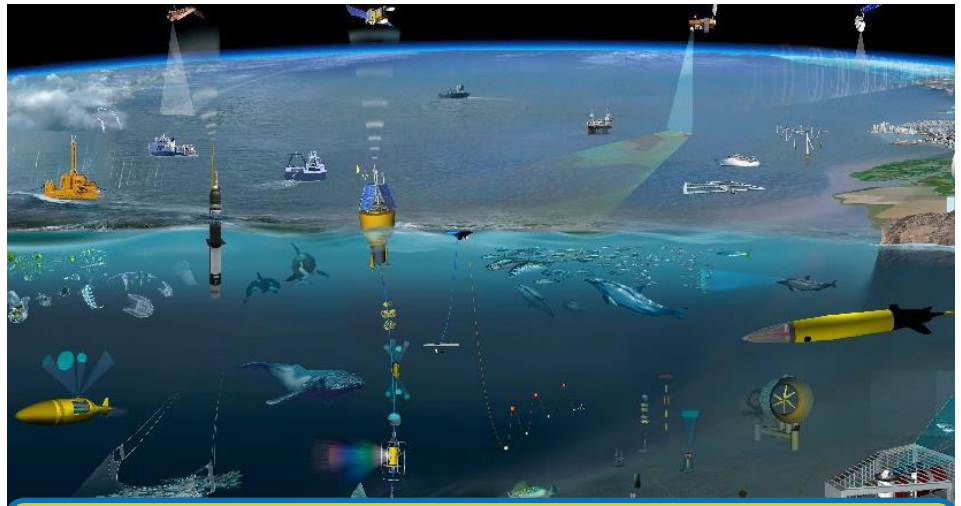
The Challenge in marine data sharing and exchange

- **Reliable** and **accessible marine data** are key to supporting good research, and EU ocean policies, initiatives, and sustainable Blue Growth.
- The costs of marine data collection by European organizations is circa 1.4 billion Euro per year: ~ 1.0 billion for in-situ; ~ 0.4 billion for remote sensing.
- Existing marine data management infrastructures (SeaDataNet, EurOBIS, EGDI, ICES, CMEMS, and others) connected to EMODnet, already make a substantial amount of marine data **discoverable, accessible,** and **reusable.**
- However, still, a lot of valuable marine data **does not arrive in these infrastructures**, **preventing its distribution through EMODnet and limiting its use.**

Ocean Observation



In Europe, we spent circa 1.4 Billion Euro a year in marine data acquisition (1.0 BE in-situ; 0.4 BE remote sensing)

Published in Frontiers in Marine Science 2020 (source: Glynn Gorick and the NeXOS project)
Future Vision for Autonomous Ocean Observations

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EMODnet European Marine Observation and Data Network

EMODnet comes where Copernicus fails

- An **EC marine data service**, funded by the European Commission 16 years ago,
- Become **European authority and regional best practice** in the marine data domain,
- **Specializes in the insitu data**, all of the ocean observations that are collected in or around the water (it can involve the seabed and below or the air just above the water),
- **Delivered by a network of > 120 leading organisations**, working in collaboration with national, regional and EU marine data management initiatives and infrastructures;
- It is a **key marine knowledge initiative** working with Copernicus Marine Service **provides the back-bone for the European marine data space**, the European Digital Twin Ocean and a key contributor to the Global Ocean Data Ecosystem and digital commons.

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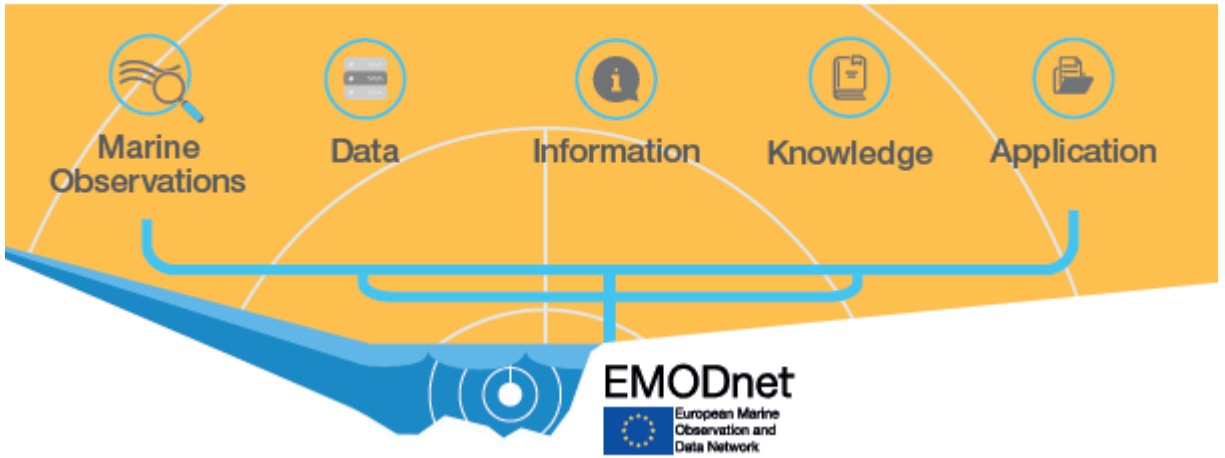
EMODnet – Added Value



Offers:

- FAIR pan European data
- data products like maps, High Res. DTMs that can be used anywhere

  - ❑ Collect data once, use many times.
  - ❑ Assemble, standardise, harmonise, quality control, integrate.
  - ❑ Visualize and make data come alive.
  - ❑ reduce uncertainty;
  - ❑ increase productivity and cost effectiveness;
  - ❑ add value and impact to your data;
  - ❑ stimulate innovation.

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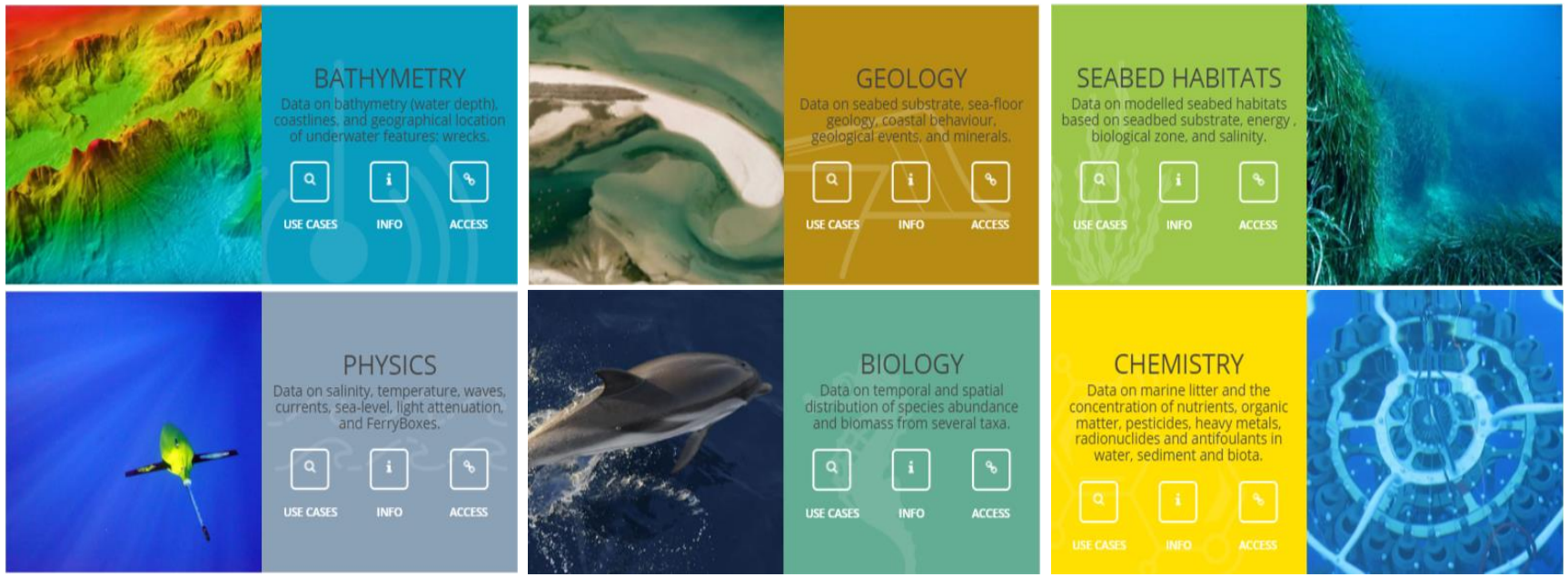
EMODnet European Marine Observation and Data Network

EMODnet themes-portals

Until recently EMODnet provided access to European marine data across **7 discipline-based themes-portals**:



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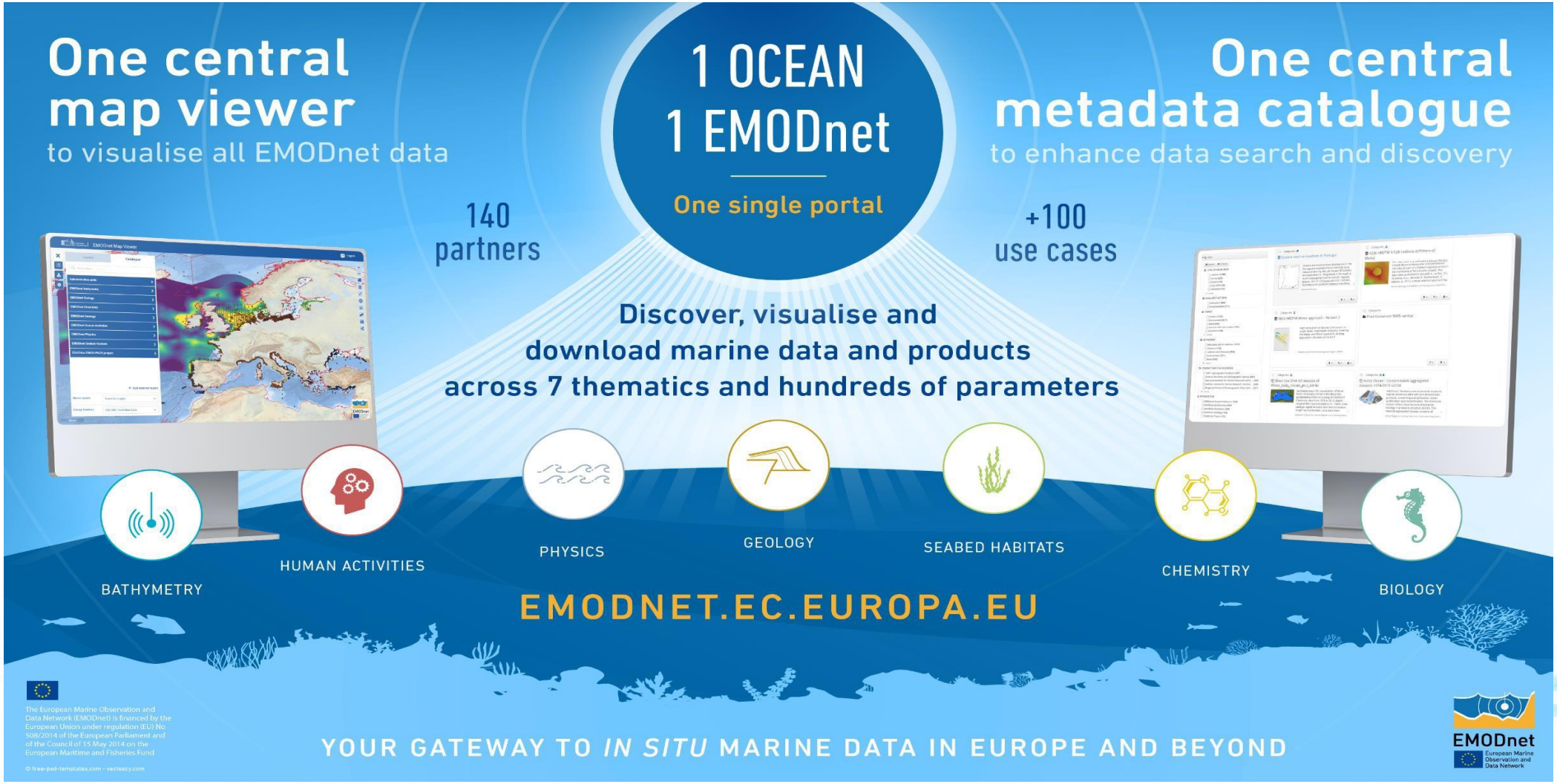
EMODnet European Marine Observation and Data Network

One single portal

https://emodnet.ec.europa.eu/en



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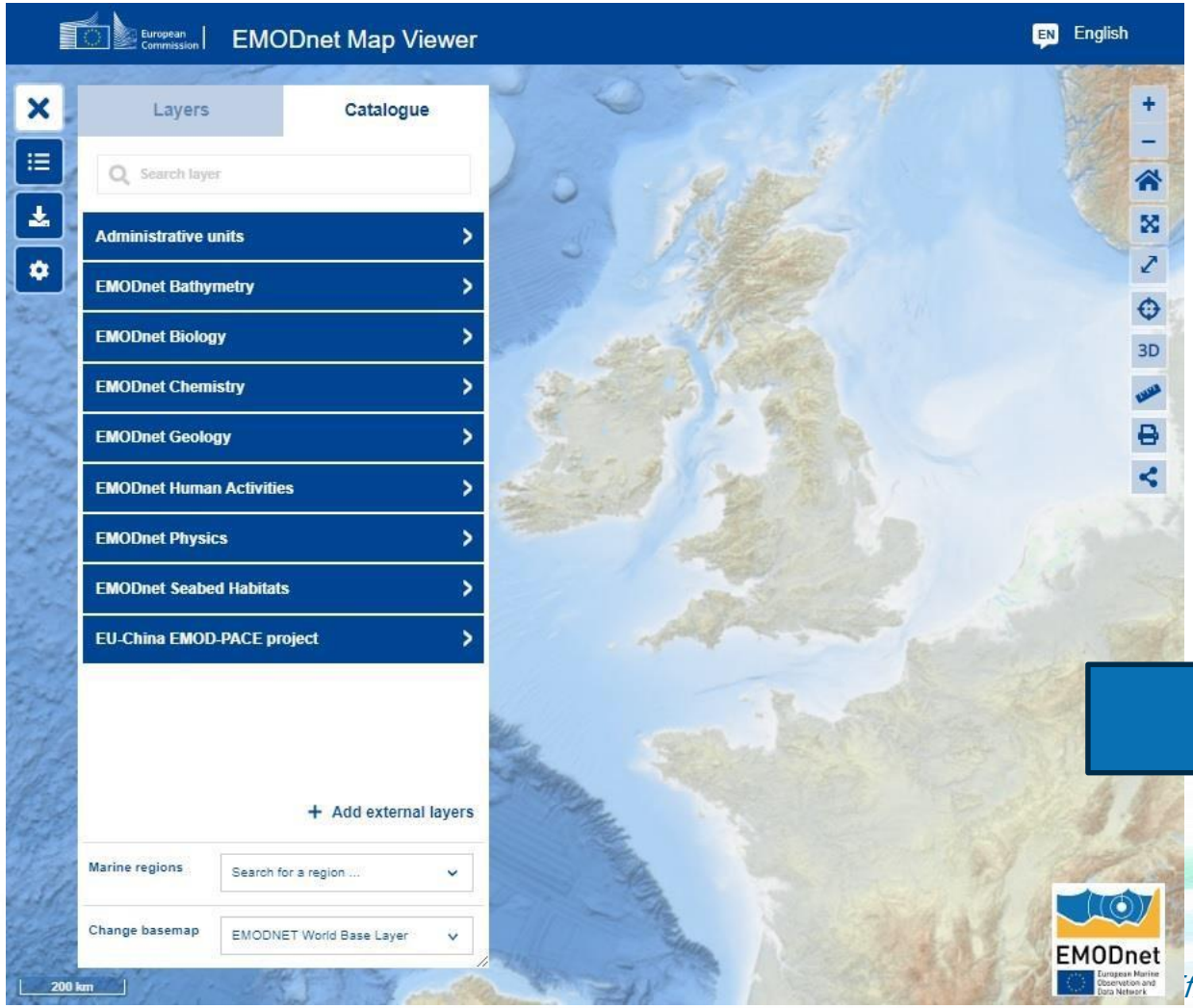
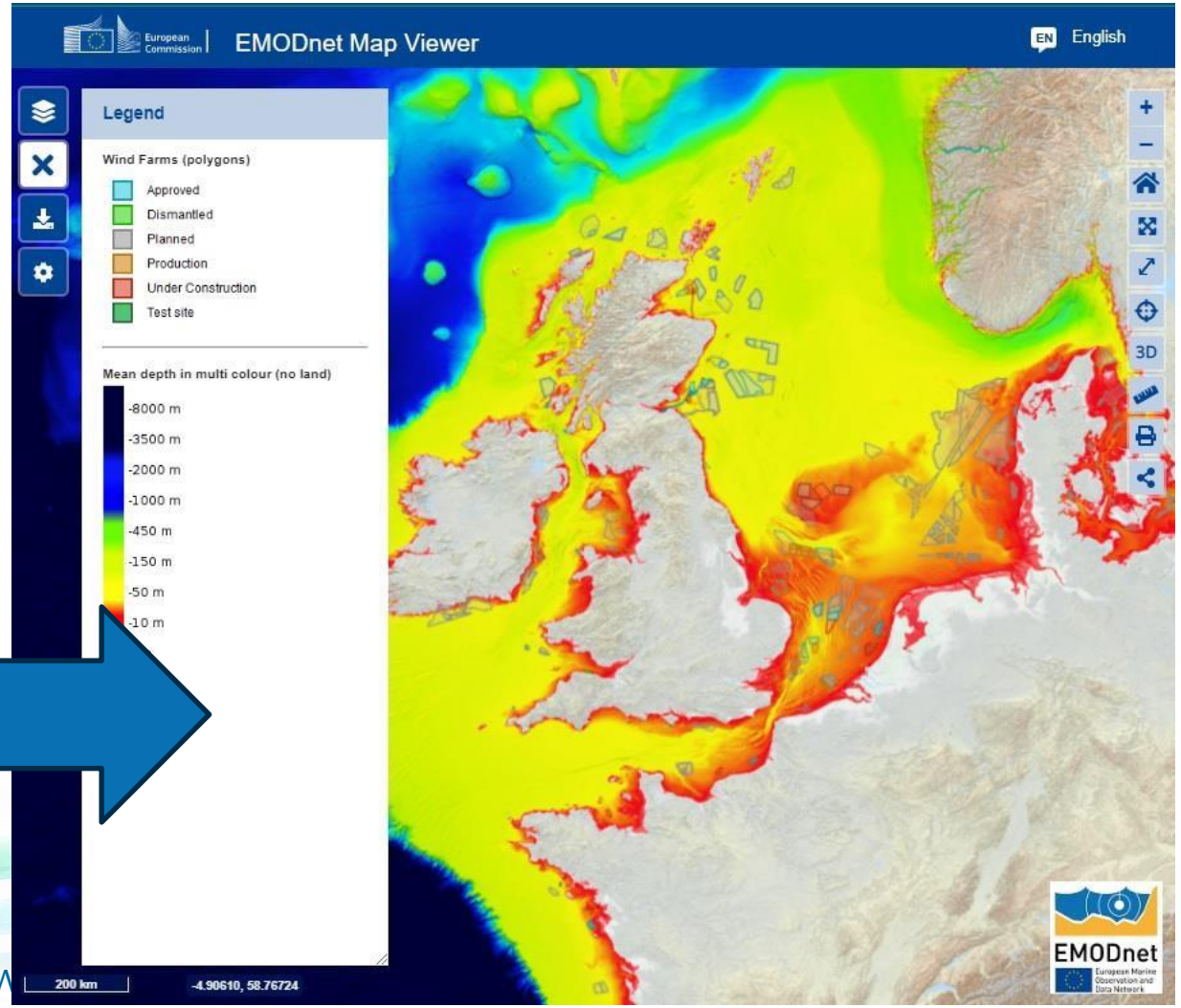
EMODnet European Marine Observation and Data Network

One central map viewer





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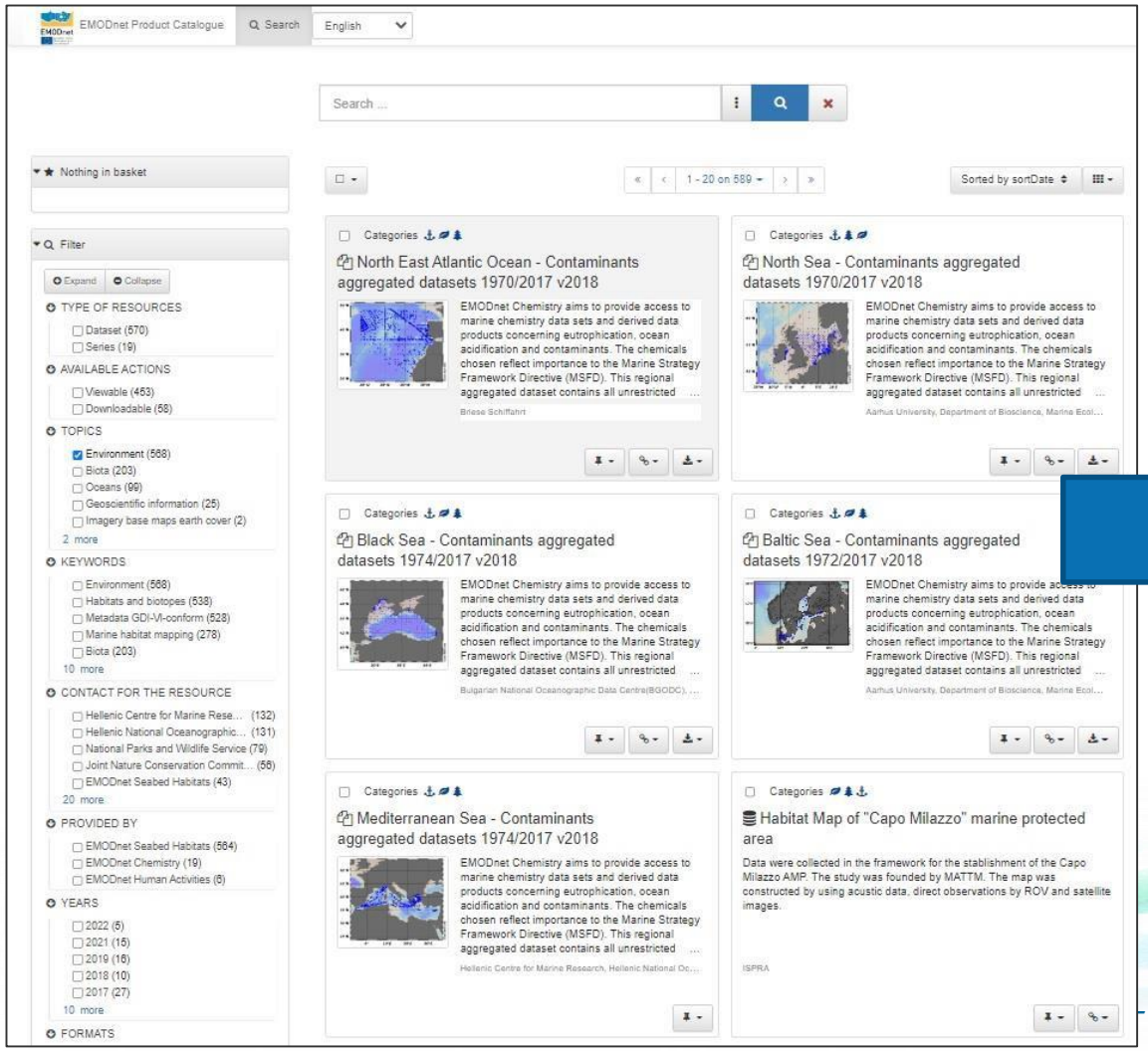
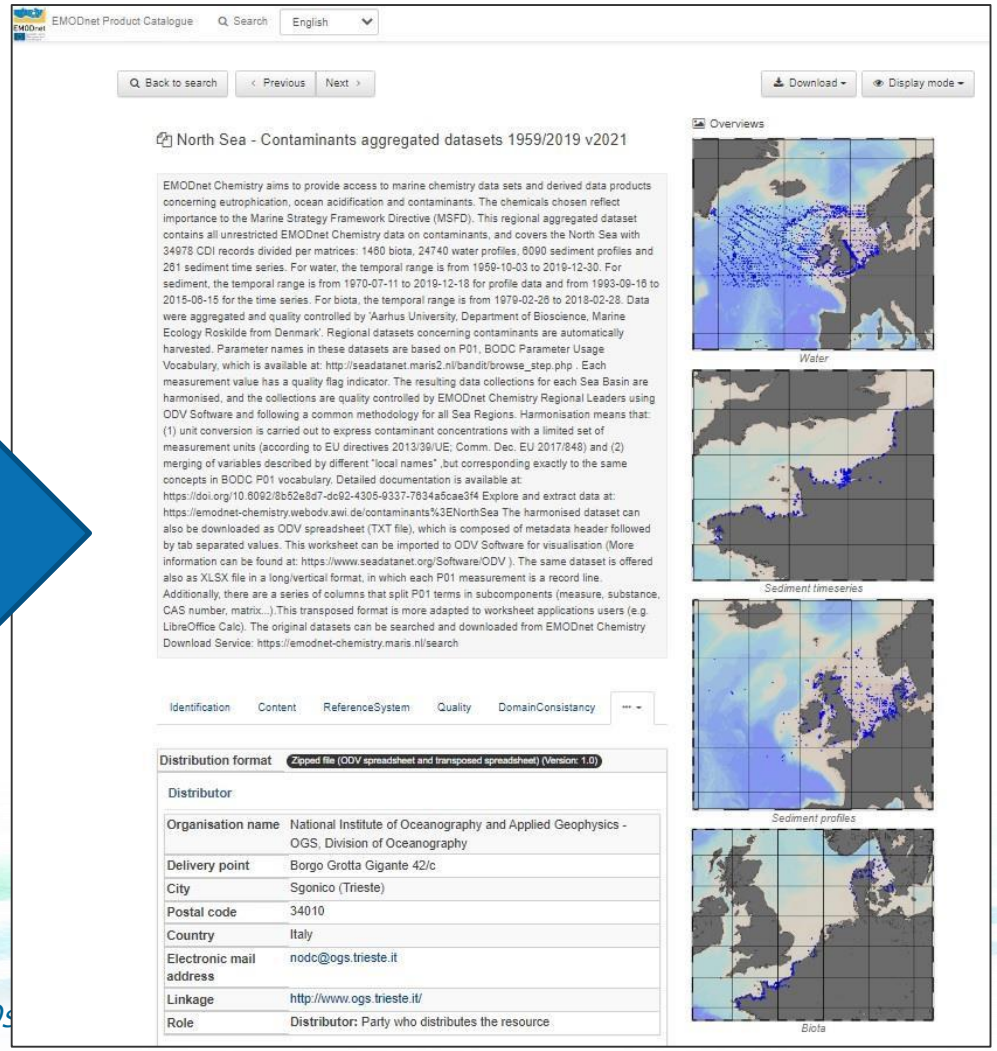
EMODnet European Marine Observation and Data Network

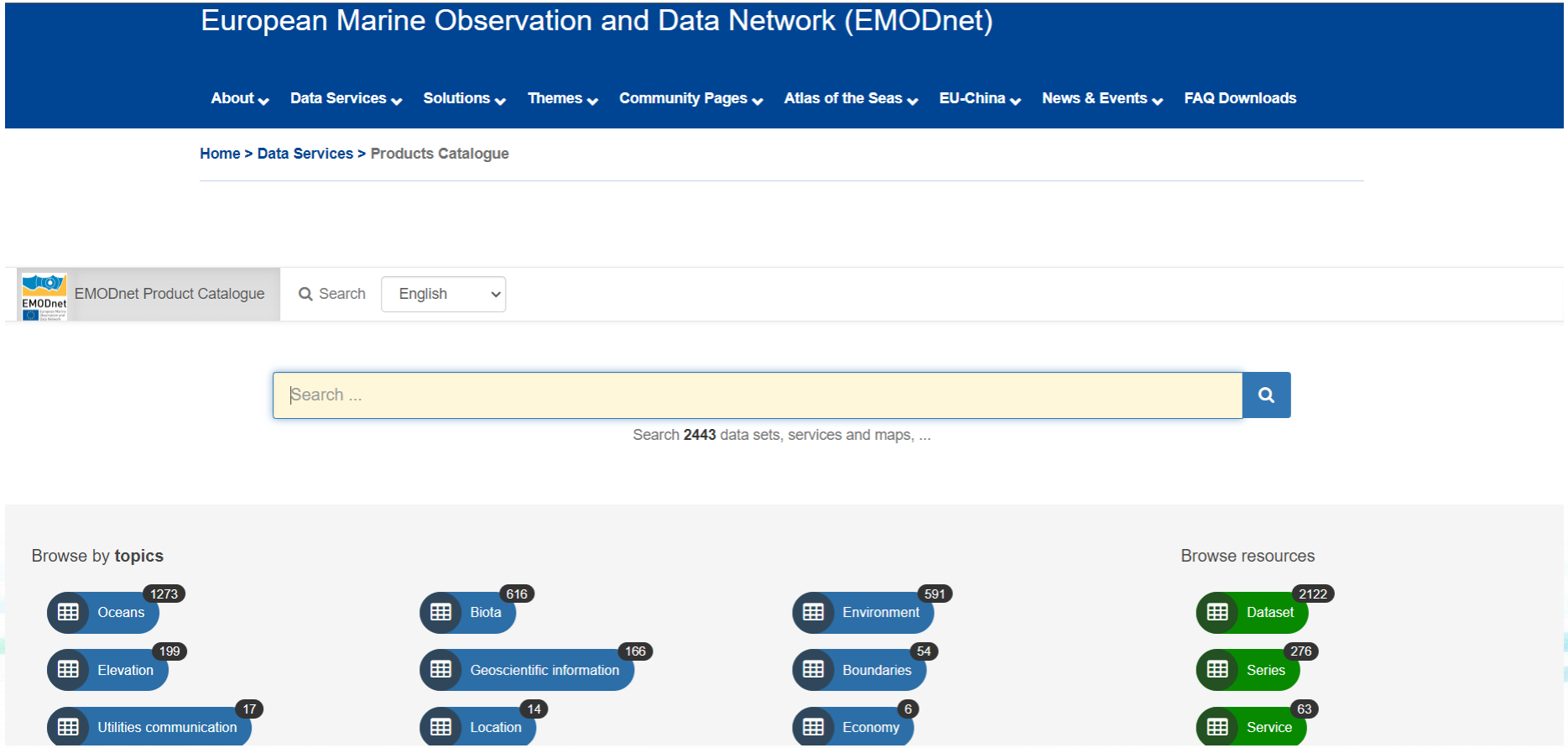
One central metadata catalogue





EMODnet Geonetwork

https://emodnet.ec.europa.eu/geonetwork/



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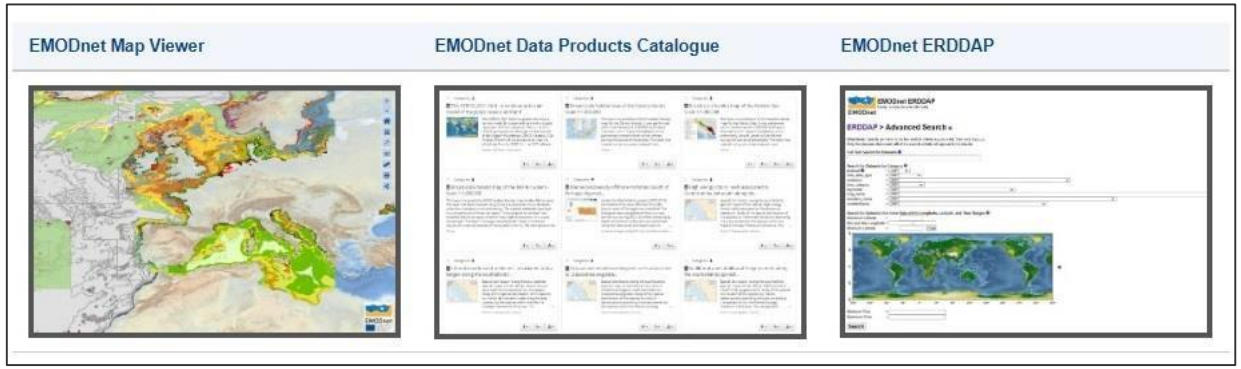
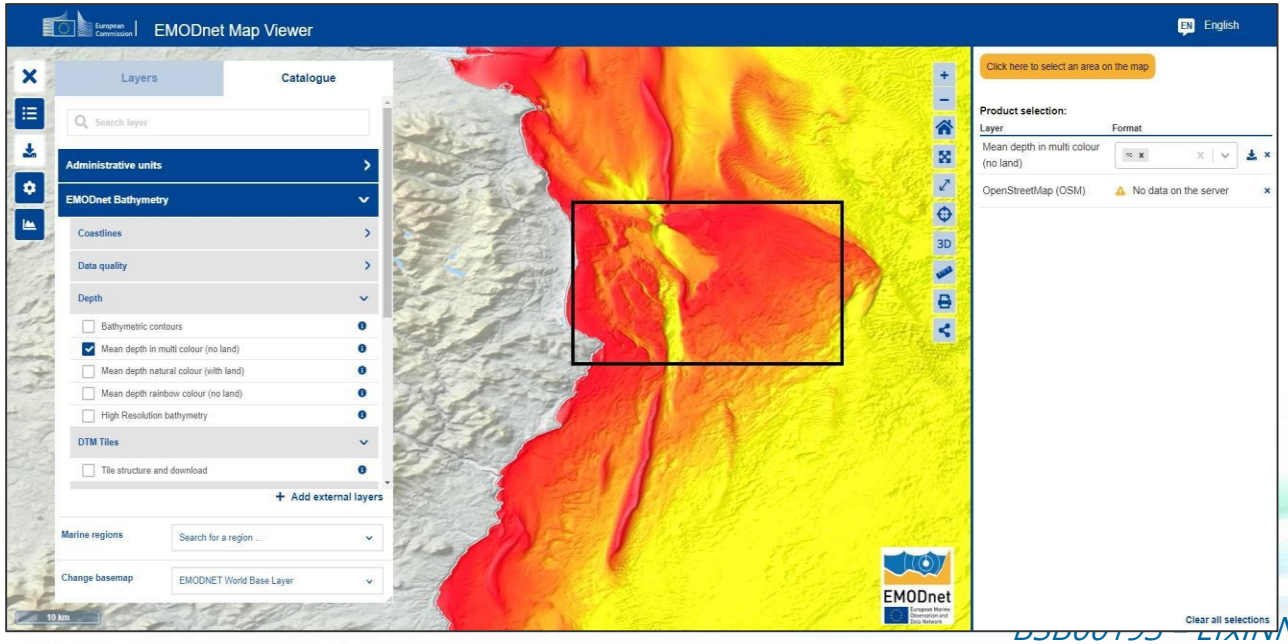
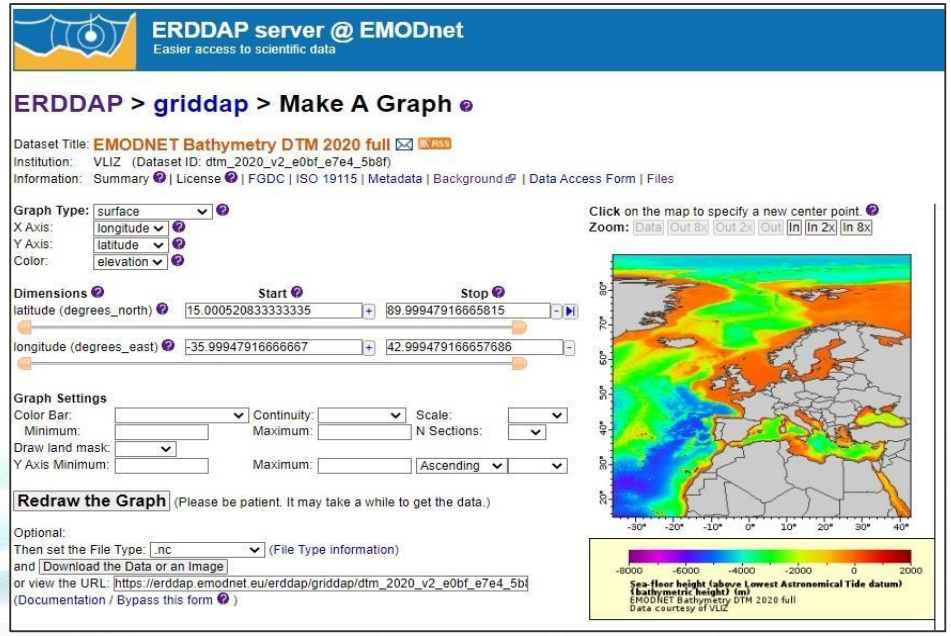
Integrated data services

Data Services directly accessible from EMODnet landing page







EMODnet Web Services

List of the base url's of all thematic portals:

- **Bathymetry** https://ows.emodnet-bathymetry.eu/ows
- **Biology** https://geo.vliz.be/geoserver/Emodnetbio/ows
- **Chemistry** https://geo-service.maris.nl/emodnet_chemistry/ows
- **Geology** https://drive.emodnet-geology.eu/geoserver/EMODnetGeology/ows
- **Human Activities** http://www.emodnet-humanactivities.eu/geoserver/emodnet/ows
- **Physics** https://prod-geoserver.emodnet-physics.eu/geoserver/emodnet/ows
- **Seabed Habitats** https://ows.emodnet-seabedhabitats.eu/geoserver/emodnet_view/ows

https://emodnet.ec.europa.eu/en/emodnet-web-service-documentation

WMS	*WFS*	*WCS*
GetCapabilities	GetCapabilities	GetCapabilities
GetMap	DescribeFeatureType	DescribeCoverage
Getfeatureinfo	GetFeature	GetCoverage

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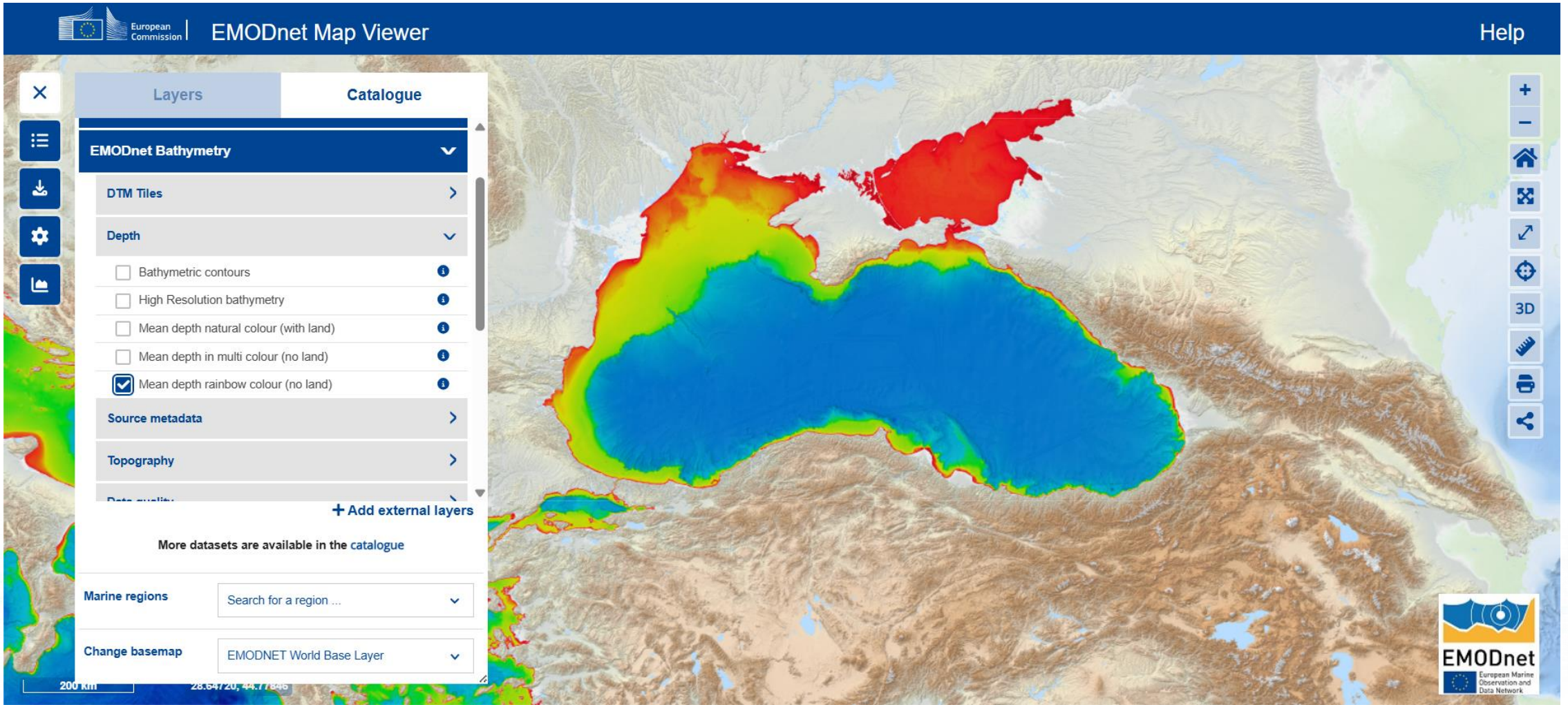
Black Sea - Bathymetry



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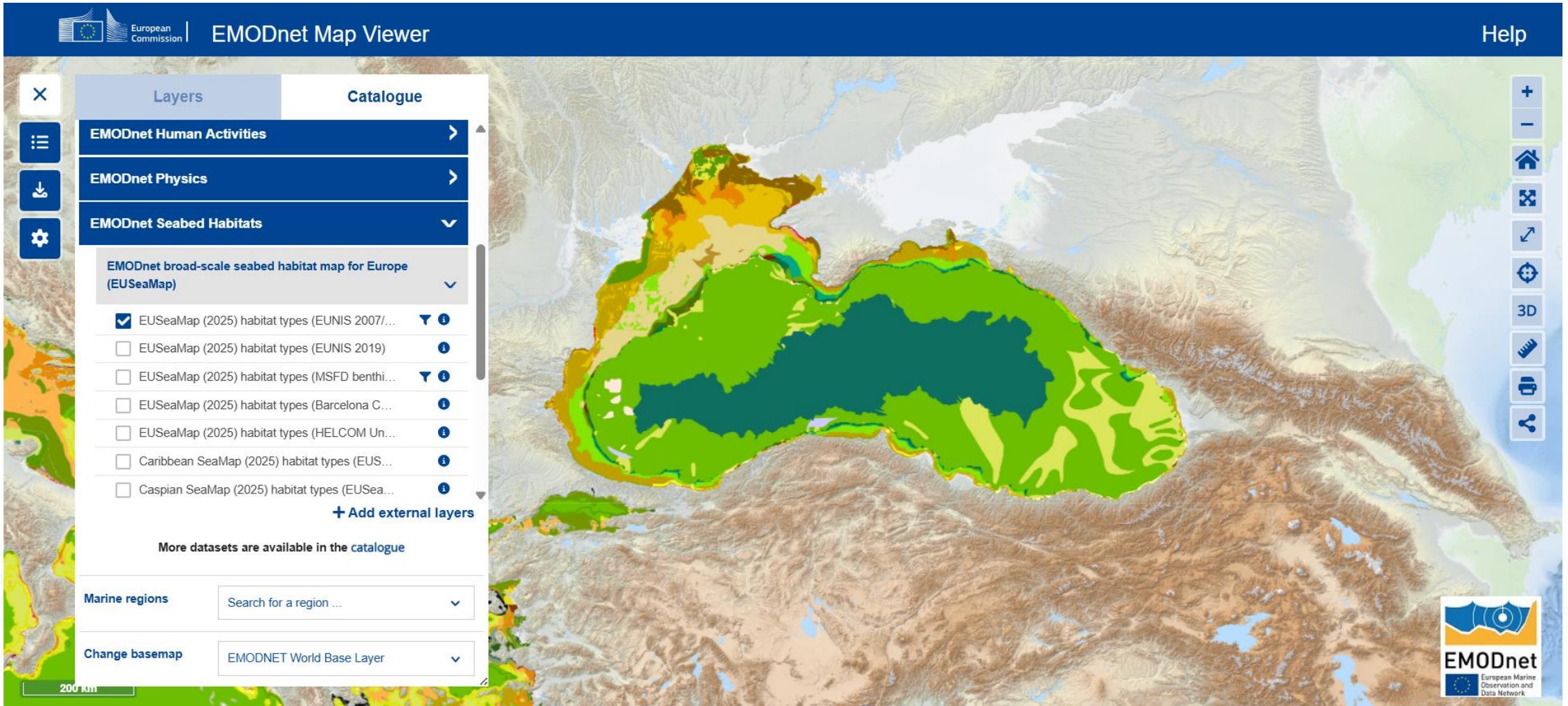
Black Sea – Seabed Habitats



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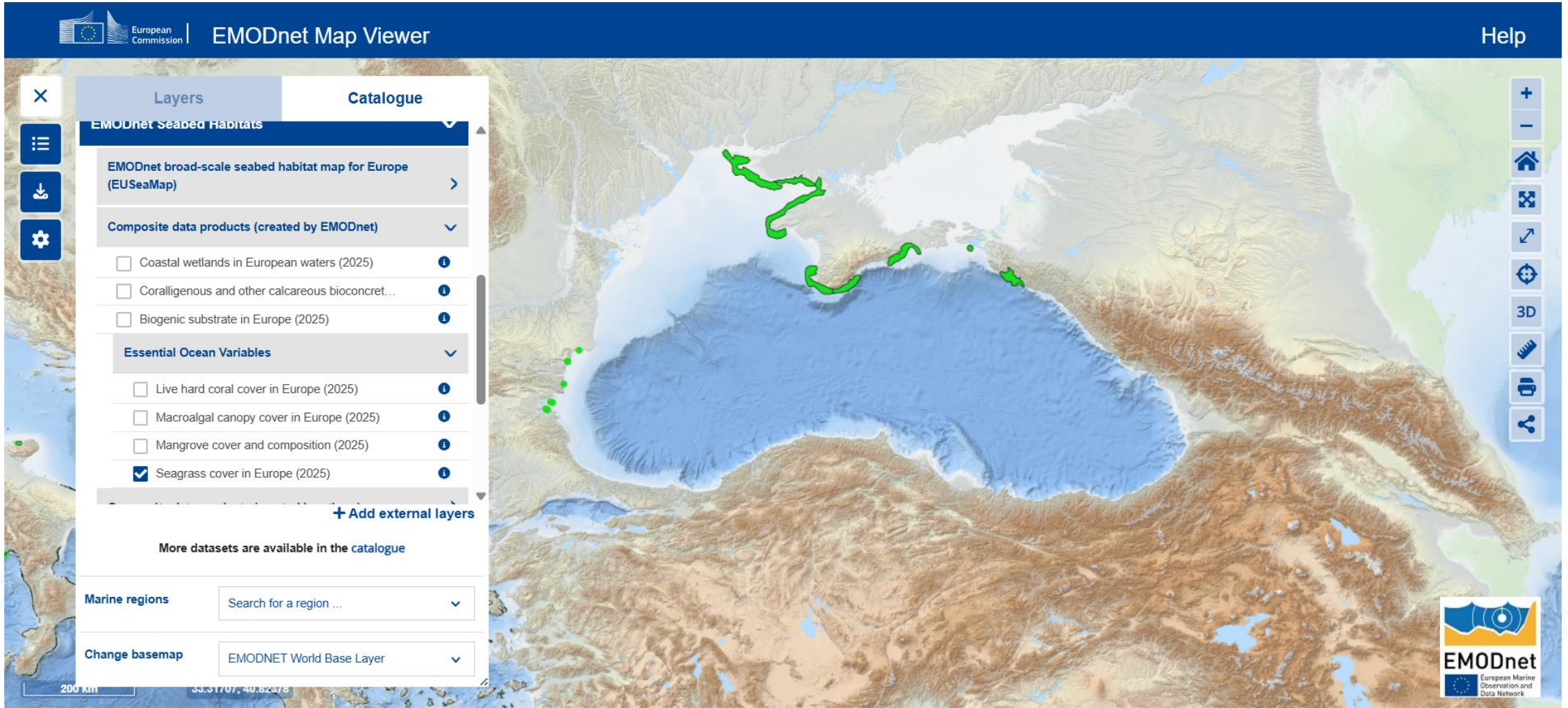
Black Sea – Seagrass cover



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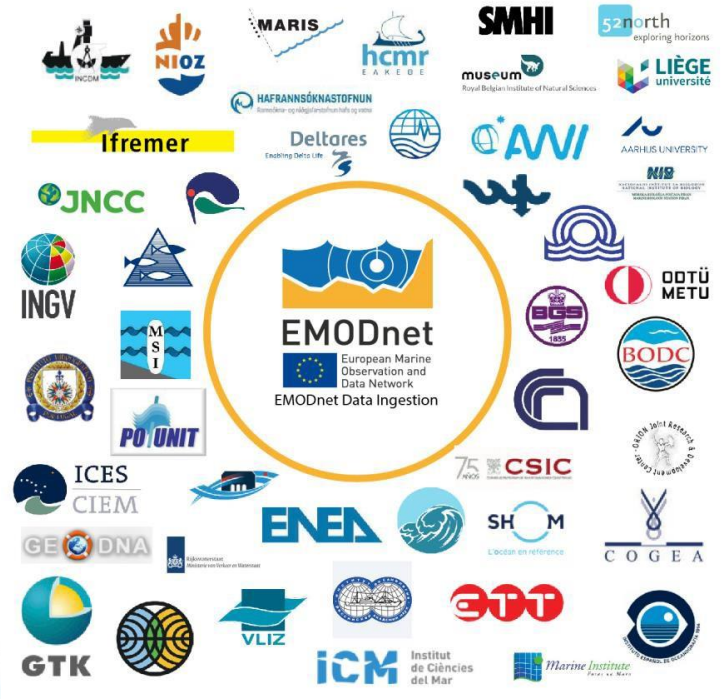
EMODnet Ingestion Ambassadors

Network of 50 National Data Centres, specialized marine centres, and all EMODnet thematic coordinators ensuring provision of trustable data and products.

BATHYMETRY

BIOLOGY

CHEMISTRY



GEOLOGY

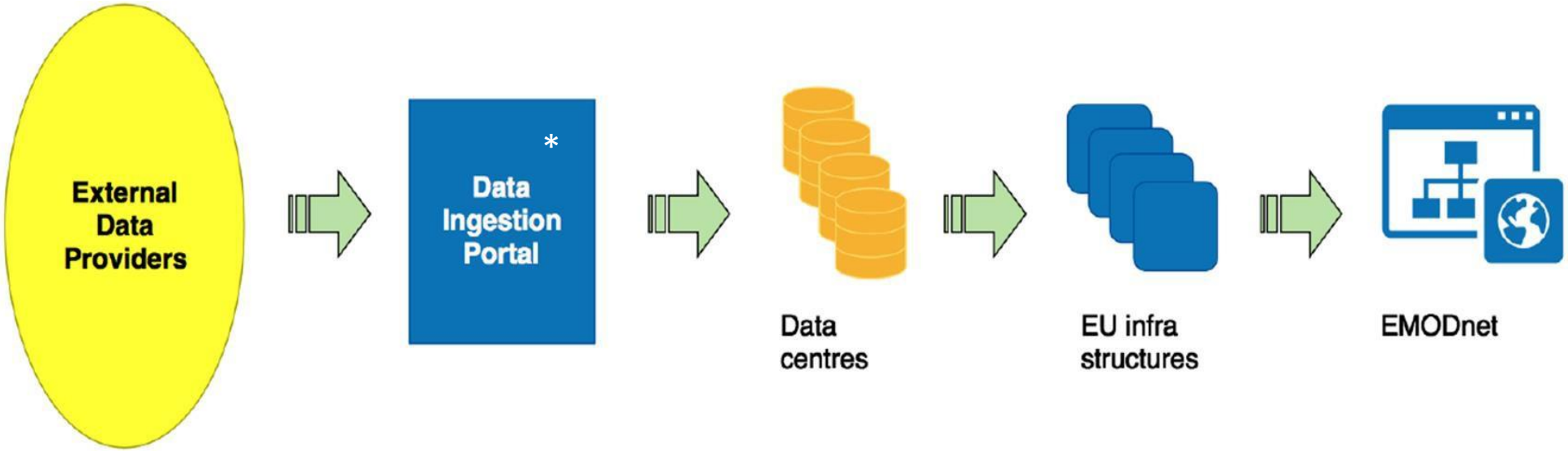
HUMAN ACTIVITIES

PHYSICS

SEABED HABITATS

Data Ingestion process

Use is made of **standards, best practices**, and **existing marine data management infrastructures**, data centres and pathways towards the **EMODnet**



Workflow from submission to elaborating and processing for publishing in EMODnet

* Migration to Central Portal, 2024

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Thank you!