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# EMODNET PHYSICS: TACKLING NEW CHALLENGES

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## Abstract

EMODnet Physics, one of the thematic portals, is developing a combined array of services and functionalities (facility for viewing and downloading, dashboard reporting and M2M communication services) to obtain, free of charge data, meta-data and data products on the physical conditions of the oceans from many different distributed data bases.

The work of the EMODnet Physics partners ([www.emodnet-physics.eu](http://www.emodnet-physics.eu)) is built on the EuroGOOS network of observing platforms and the SeaDataNet protocol for accessing archived data from national oceanographic data centres. The collection of physical parameters is largely an automated process which allows the dissemination of near real time information. The infrastructure for storing and distributing these data is shared with the Copernicus Marine Environment Monitoring Service, CMEMS. A memorandum of understanding with CMEMS, defining the roles of both parties, was signed in August 2016.

The portal provides access to data and products of: wave height and period; temperature and salinity of the water column; wind speed and direction; horizontal velocity of the water column; light attenuation; sea ice coverage and sea level trends. EMODnet Physics is continuously enhancing the number and type of platforms in the system by unlocking and providing high quality data from a growing network.

In this paper, we provide, an overview of EMODnet Physics progresses up to date and planned activities such as to include river and underwater noise data, and new platforms and parameter oriented plot products.

**Keywords:** Oceanography, Physics, Near Real Time, historical dataset, interoperability

## 1. Introduction

Access to marine data is of vital importance for marine research and a key issue for various studies, from climate change prediction to off shore engineering. Giving access to and harmonising marine data from different sources will help industry, public authorities and researchers find the data and make more effective use of them to develop new products, services and improve our understanding of how the seas behave.

The European Commission, represented by the Directorate-General for Maritime Affairs and Fisheries (DG MARE), is working on services for assembling marine data, metadata and data products and facilitating their access and re-use. European Marine Observation and Data Network (EMODnet) is a long-term programme to deliver a marine observation infrastructure offering the most effective support to the marine and maritime economy whilst supporting environmental protection needs. The EMODnet data infrastructure is developed through a stepwise approach in three major phases. Currently EMODnet is the 3<sup>rd</sup> and final phase of development with 8 thematic portals in operation providing access to marine data from the following themes: bathymetry, geology, physics, chemistry, biology, seabed habitats, human activities and coastal mapping.

In the following sections, we provide an overview of EMODnet Physics progress and planned activities such as to include river and underwater noise data and new platforms and parameters oriented plot products.

## 2. EMODnet PHYSICS

EMODnet Physics, one of the eight thematic portals, has developed a combined array of services and functionalities (facility for viewing and downloading, dashboard reporting and M2M communication services) to obtain, free of charge data, meta-data and data products on the physical conditions of oceans from many different distributed data bases.

The work of the EMODnet Physics partners ([www.emodnet-physics.eu](http://www.emodnet-physics.eu)) is built on the EuroGOOS network of observing platforms and the SeaDataNet protocol for accessing archived data from national oceanographic data centres. The collection of physical parameters is largely an automated process which allows the dissemination of near real time information. The infrastructure for storing and distributing these data is shared with the Copernicus Marine Environment Monitoring Service, CMEMS. A memorandum of understanding with Copernicus, defining the roles of both parties, was signed in August 2016. By means of joint activities with its three pillars, SeaDataNet, CMEMS, EuroGOOS and with relevant organizations and associations within the sector, EMODnet is undergoing significant improvements and expansion.

The portal is providing a single point of access to recent and past data and products of: wave height and period; temperature and salinity of the water column; wind speed and direction; horizontal velocity of the water column; light attenuation; sea ice coverage and sea level trends; and it is adding new parameters such as river data and underwater noise.

## 2.1 Data flow

The EMODnet Physics data system is updated three times a day. Generally, near real time (NRT) datasets are managed by the EuroGOOS ROOSs and the CMEMS INSTAC<sup>1</sup>. For each EuroGOOS Region there is a Regional Data Assembly Centre (RDAC) closely cooperating with the INSTAC and connecting organisations operating monitoring platforms. The INSTAC architecture is decentralised. However, quality of the products delivered to users must be equivalent wherever the data are processed. The monitoring operators are called 'production units (PUs)'. A PU is responsible for its observing system, which collects controls and distributes data according to its own rules. An RDAC is responsible for assembling data provided by PUs and provides a unique data access point to bundle available data into an integrated dataset for validation and distribution (whereby validation is following common EuroGOOS DATAMEQ - EMODnet harmonized procedures). Each RDAC validates the dataset consistency in their area of responsibility, typology of data and typology of parameter. Routinely (e.g: every hour), each RDAC distributes all its new data on a regional FTP portal. The data file format is an implementation of NetCDF OceanSITES format.

NRT data for past 60 days are made available in daily datasets; older data are made available in both "monthly" datasets (every month the latest 30 days data are reorganized into the "monthly" dataset file). Each platform can provide one or more parameters. Operational platforms provide data time series as soon as data is ready – e.g. a fixed platform delivers data daily (at least), an ARGO float delivers almost weekly. Periodically (depending on the type of platform and data network) the monthly dataset files are updated with delayed mode data (the system is always linking the last updated datasets). Reprocessed data consist of a single-dataset file for each platform covering the last 20-30 years of measurements and it is made available after qualifying and reprocessing data (these products are the result of the joint collaboration and activities of the EuroGOOS-ROOSs, CMEMS INSTAC and SeaDataNet NODCs).

European historical validated data is organised in coordination and cooperation with SeaDataNet and the network of National Oceanographic Data Centres (NODCs). During operations, quality control is performed automatically on the data that is made available in real-time and near real-time. A further validation and quality control takes place when the data are passed to data centres for long-term storage and stewardship. At the end of the process, a CDI (Common Data Index) is published and provides the user with the metadata of the processed dataset.

<sup>1</sup> NRT data flow from HF Radar, under water noise sensors, river stations is managed by EMODnet Physics directly, NRT data flow from not European platforms are managed by local infrastructures (e.g. IMOS, IOOS, etc).publications/documents/bluegrowth\_en.pdf

## 2.2 EMODnet Physics dynamic map

The machinery described in the previous paragraph feeds the EMODnet Physics portal and its dynamic map, i.e. [www.emodnet-physics.eu/map](http://www.emodnet-physics.eu/map). This is the central tool for users to search, visualize and download data, metadata and products. For near real time (NRT) data, the map allows viewing/retrieving measurement points, values of data and quality of data within a specified time, i.e. last 7 days, last 60 days, and older data (the system is pre-set to show platforms that provided at least one dataset for the past 7 days). The geographical area (space window) defines the area of interest within which the measurement points, values of data and quality of data are presented. Information about the data originator, curator etc. is also provided. The tool serves to visualize and retrieve data products such as time plots for specific parameters (e.g. monthly averaged temperature for data acquired during the specified time window). The map also provides the user with links to the EMODnet Physics products.



Fig. 1. The EMODnet Physics map page.

## 2.3 Platform metadata and data plots

For each connected platform, a dedicated platform page is available. These pages provide the user with metadata, plots, download features, platform products e.g. monthly averages or wind plots, more info and links, as well as statistics on the use of the data from that platform. Data quality information is available in connection to the data. According to the typology of the platform both the platform page sub-sections and layout may change: e.g. in case of a HF Radar the page is presenting the bidimensional data for the sea surface current direction and intensity, as well as a current rose once the user specifies (clicks on) a position. If the user selects an ARGO, the page shows the profiles as recorded during the cycles; a tide gauge shows sea level as well as sea level means and trends. Quick download and widgets to include the plots in third-party portals are also available and described.

## 2.4 Products and products page

While the map is providing the measuring capacity and the platform pages, the products page shows a specified parameter as recorded by all the same platform type. These products are available for ARGO, drifting buoys, Ferryboxes and ships, HF Radars. They are based on operational data and are managed by a sliding window of 60 days. In general, the user can select two time windows: 7 days and 60 days.

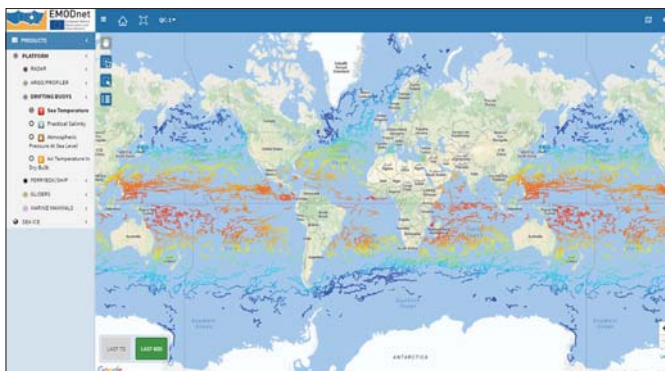


Fig. 2. "Spaghetti plot", i.e. sea surface temperature as recorded by drifting buoys for past 60 days - <http://www.emodnet-physics.eu/map/Products/V2/PRODUCTS.aspx?PRODTYPE=RT&type=DB&param=TEMP>.

Based on the CMEMS - SEAICE\_GLO\_SEAICE\_L4\_NRT\_OBSERVATIONS\_011\_001 product, EMODnet Physics is generating Sea Ice products. These are both for operational (daily information on the ice is also made available on the WMS/WFS service) and (re) analysis use (e.g. long term time-series and trends). The Permanent Service for Mean Sea Level Monitoring, PSMSL, sea level trends and the Marine Mammals Exploring the Oceans Pole to Pole, MEOP, database containing data on water column temperature and salinity as recorded by marine mammals, in particular from seals, is also integrated and available in the EMODnet Physics portal.

EMODnet Physics is working including data from underwater noise and river flow. The activity will focus on the definition of the data model, data infrastructure, naming conventions and demonstration of how this data can be collected in near real time, organized, and processed (reprocessed data integrated by model output and satellite data when needed) into innovative and useful products.

## 2.5 Data policy

Data is open and free<sup>2</sup> and, in agreement with its pillars, EMODnet Physics is applying the following general policy.

Download without authentication:

- Latest 60 days of operational data;
- Operational data from platforms contributing to international programs (e.g. ARGO);
- Data already available free and open/explicit request from the provider (e.g. SOCIB data);

Download with authentication (CMEMS Service Level Agreement):

- Data older than 60 days (European Coastal platforms);
- Reprocessed/delay mode data;

Download with authentication (SDN Service Level Agreement) :

- CDI - historical data hosted by NODCs.

## 2.6 Machine to Machine services

EMODnet Physics is developing interoperability services to facilitate machine-to-machine interaction and to provide further systems and services with European seas and ocean physical data and metadata. Interoperability services are provided by a GeoServer infrastructure that is OGC compliant. The WMS and WFS layers offer information about which parameters are available (where and who is the data originator, etc.). EMODnet Physics also provides SOAP - web services which allow linkage to external services with near real time data stream and facilitate a machine-to-machine data fetching and assimilation. Lately, EMODnet Physics developed plot widgets<sup>3</sup> to embed a parameters plot/chart into an external portal.

<sup>2</sup> Some data may require negotiation/specific agreements.

<sup>3</sup> Widget syntax: [www.emodnet-physics.eu/Map/Charts/PlotDataTimeSeries.aspx?paramcode=PPPP&platid=ZZZZ&timerange=YY](http://www.emodnet-physics.eu/Map/Charts/PlotDataTimeSeries.aspx?paramcode=PPPP&platid=ZZZZ&timerange=YY); where PPPP is the parameter (e.g. TEMP = sea temperature), ZZZZ is the platform ID (e.g. 8427 is Arkona) and YY is either 7 or 60 (days)



### 3. Conclusions

EMODnet Physics partnership has dedicated important efforts to build gateways to national, regional and thematic data repositories. A comprehensive network has been developed and the actual project directly involves about one hundred institutions from all over Europe. EMODnet Physics is supporting actions on the adoption of common Quality Assessment - Quality Control protocols, by participating at dedicated meetings and projects. The marine data from diverse sources are made more visible, accessible and interoperable.

Data and data products are accompanied by metadata covering information on ownership, data quality and data quality check procedures, as well as links to get more information on methods used for their constructions. Furthermore, EMODnet Physics has created relationships to provide data access to- and preview for- coastal data in non-European areas (e.g. NOAA platforms for the US, IAPB platforms for the Arctic area, IMOS for Australia and others).

The portal is now covering all European Seas as well as the global ocean and it incorporates data from supplementary physical monitoring systems: Argo (all the Argo data are available), gliders, and emerging measurement systems (i.e. HF radar). It provides access to about 20,000 platforms and all available data and metadata have the same standards and formats (e.g. NetCDF, csv).

On top of these data, the EMODnet Physics portal provides a combined array of services and functions to users, for viewing and downloading data (both manually and machine-to-machine), meta-data and data products on the physical conditions of European sea basins and oceans.

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