EMODnet Thematic Lot n° 06

[Physics]

EMODnet Phase 2 – Final report

Reporting Period: 24/07/2013 – 23/07/2016

Date: 19/08/2016

Table of Content

List of abbreviations and acronyms

AR	ARGO
ACRI-ST	France
AMGI	Andrija Mohorovičić Geophysical Institute, University of Zagreb - Croatia
AML	Aberdeen Marine Laboratory, Marine Scotland - UK
ARSO	Slovenian Environment Agency - Slovenia
ASLO	Association for the Sciences of Limnology and Oceanology
AUTH	Aristotle University of Thessaloniki - Greece
AWI	Alfred-Wegener-Institut für Polar- und Meeresforschung - germany
AZTI	AZTI Tecnalia - Spain
BODC	British Oceanographic Data Centre
BOOS	Baltic Operational Oceanographic System
BSH	Bundesamt für Seeschifffahrt und Hydrographie – Germany
CDI	Common Data Index
CEA	CISC - Centre d'Estudis Avançats de Blanes, Consejo Superior de Investigaciones Cientificas - Spain
CEFAS	Centre for Environment, Fisheries & Aquaculture Science - UK
CETMEF	Centre d'Etudes Techniques Maritimes et Fluviales - France
CMCC	Centro Euro-Mediterraneo sui Cambiamenti Climatici - Italy
CMEMS	Copernicus Marine Environment Monitoring Service
CMR - CMRE	Centre for Maritime Research and Experimentation - Norway
CNR-IAMC	Instituto per l'Ambiente Marino Costiero - Italy
CNR-ISAC	Istituto di Scienze dell'Atmosfera e del Clima - Italy
CNR-ISMAR	Istituto di Scienze Marine - Italy
CNR-ISSIA	Instituto di Studi sui Sistemi Intelligenti per l'Automazione - Italy
CNRS	Centre national de la recherche scientifique - France
COSTADYN	Research Centre Dynamics of the Nearshore Zone - Russia Federation
CSIC	Consejo Superior de Investigaciones Cientificas - Spain
CTD	conductivity-temperature-depth
DAMSA	Danish Maritime Safety Administration - Denmark
DAMT	CAM - University of Cambridge, Department of Applied Mathematics and Theoretical Physics - UK
DB	Drifting Buoy
DBCP	data buoy cooperation panel
Deltares	Deltares, National Institute for Coastal and Marine Management – Netherlands
DMI	Danmarks Meteorologiske Institut, Danish Meteorological Institute - Denmark
EEA	European Enviroment Agency
EGU	European Geosciences Union

EMSA	European Marine Safety Agency
ENEA	Italian National Agency for new Technologies, Energy and Sustainable Economic Development - Italy
ENSTA	École Nationale Supérieure de. Techniques Avancées - France
EPA	Environmental Protection Agency, Department of Marine Research - Lithuania
EPOC	Environnements et Paléoenvironnements Océaniques et Continentaux, Université de Bordeaux - France
ESEO – CISC	Departemento de Ocenorafia Fisica, Consejo Superior de Investigaciones Cientificas - Spain
EUSKALMET	Euskalmet- Basque Goverment - Spain
FB	Ferrybox
FCOO	Defense Centre for Operational Oceanography – Denmark
FMI	Finnish Meteorological Institute - Finland
GI-UIB -	Geophysical Institute at University of Bergen - Norway
GL	glider
GLOSS	global sea level stations
GROOM	Gliders for Research, Ocean Observation and Management
HCMR	Hellenic Centre for Marine Research - Greece
HF	HF radar
HPA	Hamburg Port Authority - Germany
HRS	Hydraulics Research Limited, HR Wallingford - UK
HRW	HR Wallingford, UK
HZG	Helmholtz-Zentrum Geesthacht – Germany
ICES	International Council for the Exploration of the Sea - Denmark
IEO	Instituto Español de Oceanografía - Spain
IFM	Institute of Oceanography, University of Hamburg - Germany
IFREMER	Institut Français de Recherche pour l'Exploitation de la Mer - France
IH	Instituto Hidrografico - Portugal
IMB	Institute of Marine Biology, University of Montenegro - Montenegro
IMEDEA	Mediterranean Institute for Advanced Studies - Spain
IMR	Institute of Marine Research in Norway - Norway
IMS METU	Middle East Technical University Institute of Marine Sciences - Turkey
INGV	Istituto Nazionale di Geofisica e Vulcanologia - Italy
INRH	Institut National de Recherche Halieutique - Morocco
INSITU TAC	in situ temathic assembly centre
INSU	Institut National des Sciences de l'Univers - France
INTECMAR	Instituto de Tecnología y Ciencias Marinas - Spain
IOBAS	Institude of Oceanology - Bulgarian Academy of Science - Bulgaria
IODE	International Oceanographic Data and Information Exchange

IOLR	Israel Oceanographic and Limnological Research, National Institute of Oceanography - Israel
IOPAS	Institute of Oceanology, Polish Academy of Sciences - Poland
IPIMAR	Portuguese Institute of Sea and Fisheries - Portugal
IRCA	Icelandic Road and Coastal Administration - Iceland
IRD	L'Institut de recherche pour le développement - France
ISPRA	Istituto Superiore per la Protezione e la Ricerca Ambientale - Italy
IST	Instituto Superior Técnico - Portugal
IUP	University of Bremen, Institute of Environmental Physics - germany
IZOR	Institut za oceanografiju i ribarstvo (Institute of Oceanography and Fisheries) - Croatia
JCOMM	Joint Technical Commission for Oceanography and Marine Meteorology
JCOMMOPS	JCOMM in situ Observing Platform Support Centre
KIELMS	University of Kiel Institute for Marine - Germany
KNMI	Koninklijk Nederlands Meteorolologisch Instituut – Netherlands
LEGMA	Latvian Environment, Geology and Meteorology Agency - Latvia
LI	UPC – Laboratorio de Ingeniería Marítima/Universidad Politécnica de Cataluña - Spain
LOCEAN	Laboratoire d'Oceanographie et du Climat - France
LOV	Laboratoire Oceanographique de Villefranche - France
LPO	Laboratoire de Physique des Oceans - France
MAGEST	MArel Gironde ESTuaire Consortium - France
MDK	Maritieme Dienstverlening en Kust, Agency for Maritime and Coastal Services, Coastal Division - Belgium
Mercator Ocean	Mercator Océan - France
MET	MET éireann - Irish Meterological Service - Ireland
MET NO	Norwegian Meteorological Institute - Norway
Météo France	Météo France - France
METEO GE	National Environmental Agency - Georgia
MeteoGalicia	MeteoGalicia - Spain
METNO	MetNo - Norwegian Meteorological Institute - Norway
METOFFICE	Met Office – UK
MI	Marine Institute - Ireland
MIO	Mediterranean Institute of Oceanography - France
MO	Mooring/ fixed Station
MONGOOS	Mediterranean Operational Network for the Global Ocean Observing System
MRI	Marine Research Institute - Iceland
MSI	Marine Systems Institute - Estonia
MUMM	Management Unit of the North Sea Mathematical Models - Belgium
MYO	My Ocean

NERC	Natural Environment Research Council - UK
NERSC	Nansen Environmental and Remote Sensing Center - Norway
NHS	Norwegian Hydrographic Service - Norway
NIB	National Institute of Biology Marine Biology Station - Slovenia
NIERSC	Nansen International Environmental and Remote Sensing Center - Norway
NIMRD	National Institute for Marine Research and Development - Romania
NIO	Northern Ireland Office - UK
NIVA	Norsk Institutt for Vannforskning, Norwegian Institute for Water Research - Norway
NMA	Norwegian Mapping Authority - Norway
NOC	National Oceanography Centre – UK
NOC/METOFFICE	National Oceanography Centre Southampton - UK
NODC	National Oceanographic Data Centre
NOOS	North West Shelf Operational Oceanographic System
NPI	Norwegian Polar Institute - Norway
NRT	Near Real Time
NWAHEM	North-West Regional Administration for Hydrometeorology and Environmental Monitoring - Russia
OC UCY	Oceanography Cente University of Cyprus - Cyprus
OGS	Istituto Nazionale di Oceanografia e di Geofisica Sperimentale - Italy
OILPLAT	Oil Platform - Private Industry
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
PdE	Puertos del Estado - Spain
PF	Profiling buoy
PLOCAN	Plataforma Oceanica de Canarias - Spain
PSMSL	Permanent Service for Mean Sea Level
RBI	Rudjer Boskovic Institute - Croatia
RBINS	Royal Belgian Institute of Natural Sciences, Operational Directorate Natural Environment (previously known as MUMM) – Belgium
Rijkswaterstaat	Rijkswaterstaat -Netherlands
ROOS	regional Oceanographic Operational System
RSM	request Status manager
SAMS	Scottish Association for Marine Science
SBR	Station Biologique de Roscoff - France
SDN	SeaDataNet
SHOM	Service Hydrographique et Oceanographique de la Marine – France
SMHI	Swedish Meteorological and Hydrological Institute - Sweden
SOCIB	Balearic Islands Coastal Observing and Forecasting System - Spain
SYKE	Finnish Environment Institute - Finland
UAC	Universidade dos Açores - Portugal
UBO	Univerisite de Bordeaux - France

UHMI	Ukrainian Hydrometeorological Institute - Ukraine
UKHO	United Kingdom Hydrographic Office - UK
UKM	United Kingdom Recent Marine Data - UK
UKMO/MF	Met Office/Meteo France - UK/France
UM5A	University Mohamed V-Agdal - Morocco
UMA	APDII - Department of Applied Physics I, University of Malaga - Spain
UMT-IOI	University of Malta, International Ocean Institute - Malta
UNIBO	Alma Mater Studiorum Università di Bologna - Italy
UN	Oldenburg - University of Oldenburg – Germany
UoA/IASA	University of Athens/ Institute of Accelerating Systems and Applications - Greece
UPC	Universidad Politécnica de Cataluña - Spain
UPT	Polytechnic University of Tirana - Albania
VMM	Flemish Environmental Agency - Belgium
WFS	Web feature Service
WMS	Web Map Service
WSAL	Waterways and Shipping Authority Lubeck - Germany
WSAW	Waterways and Shipping Authority Wilhelmshaven - Germany
WSOB	Waterways and Shipping Office Bremerhaven - Germany
WSOC	Waterways and Shipping Office Cuxhaven - Germany
WSOE	Waterways and Shipping Office Emden - Germany
WSOS	Waterways and Shipping Office Stralsund - Germany
WSOT	Waterways and Shipping Office Toenning - Germany
XBT	Expendable BathyThermograph
Xunta Galicia	Xunta Galicia - Spain

Executive summary

Provide an executive summary of the final report that can be read by a non-specialist (15 pages).

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**.**

Sharing observing data benefits everyone: changes in one country's water affect those of its neighbours. National data do not tell us all we need to know about the seas as a European and global system connected by shifting winds, seasonal currents etc.

Data sharing saves lives, improves livelihoods, encourages sustainable business practices and helps us act when disaster strikes. By sharing ocean observing data, the world becomes a safer, more interconnected, and economically viable place.

- Coast Guards uses real-time data & models in their maritime search planning software to save lives
- new observing technology and a tailored data portal help sea transport, sea-food chain industries (e.g. real time ocean acidification monitoring), coastal protection services (e.g. oil leak, flooding), etc.

In this context, the Global Ocean Observing System (GOOS) and the Group on Earth Observations (GEO) data sharing policies advocate for free and open availability of data. The World Meteorological Organization (WMO) is supporting near instantaneous exchange of weather information across the globe. One of the foundation pillars of the U.S. Integrated Ocean Observing System (IOOS) is to make data discoverable, available and useable and over 15,000 datasets are available - to anyone, anywhere - in real-time.

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. In particular, the 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 closing the 2nd phase of development with seven sub-portals in operation providing access to marine data from the following themes: bathymetry, geology, physics, chemistry, biology, seabed habitats and human activities.

The document is presenting the activities achieved by the EMODnet Physics thematic lot (MARE/2012/10 – Lot.6). EMODnet Physics provides a combined array of services and functionalities (facility for viewing and downloading, dashboard reporting and machine-to-machine communication services) to obtain free-of-charge data, meta-data and data products on the physical conditions of European sea basins and oceans. Moreover, the system provides full interoperability with third-party software through WMS services, Web Services and Web catalogues in order to exchange data and products according to the most recent standards.

EMODnet Physics builds on the EMODnet Physics portal developed under the ur-EMODnet preparatory actions (EMODnet Phase I from 2009-2013) and is based on the cooperation and collaboration with the three established pillars of the European Oceanographic Community:

- EuroGOOS and its Regional Operational Oceanographic Systems (ROOSs). EuroGOOS is a pan-European ocean observing network operating within the context of the Global Ocean Observing System of the Intergovernmental Oceanographic Commission of UNESCO (IOC GOOS). The ROOSs are responsible for the collection of data to fulfil the aims of the regional[1] service needs.

- Copernicus Marine Environment Monitoring Service (CMEMS)[2], and in particular with the In Situ Thematic Assembly Center (INSTAC). CMEMS is a European Commission programme (2015 – 2020) to provide operational monitoring and forecasting systems for global, Arctic and European regional seas based on satellite and in situ observations.

- SeaDataNet network of National Oceanographic Data Centres (NODCs). By means of a series of European founded research projects, the NODCs developed a pan European infrastructure for providing up-to-date and high quality ocean metadata, data and data products, and for developing and promoting common data management standards.

By means of joint activities with its three pillars and with the most 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.

---

[1]ROOSs are responsible for the collection of data in Arctic Ocean (Arctic ROOS), Baltic Sea (BOOS), Northwest Shelf Sea (NOOS), Ireland–Biscay–Iberia Seas (IBI ROOS) and the Mediterranean Sea (MONGOOS)

[2] http://marine.copernicus.eu/

EMODnet Physics is a dynamic system, continuously enhancing the number and type of platforms in the system by unlocking and providing high quality data from a growing network of providers. The portal provides users with following key services and functions:

1. **Landing page**, www.emodnet-physics.eu/portal, which presents the European Marine Observation and Data network background and introduces the EMODnet Physics scope and goals. The landing page also provides community news and meetings reports, as well as direct links to EMODnet Physics operational services and to other EMODnet Central and hence the other lots.
2. **Dynamic map facility for viewing and downloading,** www.emodnet-physics.eu/map, which 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 of 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 also 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). Sea level trends and ice coverage products are also accessible via the map interface.
3. **Dashboard**, www.emodnet-physics.eu/map/dashboard, which is a reporting service where users can view and export various statistics about the data portal content and usage. The EMODnet Physics dashboard represents a valuable tool to discover data availability and monitor performance of the infrastructure behind the portal. The tool also provides KPIs (key performance indicators) presenting how much data and how many platforms are made available on a daily base, and extracts statistics on page access and data downloads etc.
4. **Interoperability 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 OCG 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.

In 2013, EMODnet Physics was providing access to 429 fixed platforms and 3 ferrybox lines, it is now providing access to more than 12,000 platforms[3] (Table 3) giving more than 30,000 time series[4] (Table 2). In the same period (01/07/2013 to 01/06/2016), EMODnet Physics managed about 28,200 manual data download requests[5] (from the map page), more than 154,200 data download web service requests, and 3,110 CDIs requests[6].

Table 1 – Platforms on EMODnet Physics (01/06/2016)

	drifting buoy (DB)	Ferrybox and ship (FB)	glider (GL)	fixed platform and mooring time series (MO)	profiling float (PF)	Argo Float (AR)	Radar (RD)	TOTAL
platforms	4063	34	20	2570	644	4772	13	12116

Table 2 - Parameters time series (01/06/2016)

Temp.	Salinity	Currents	Light Attenuation	Sea Level	Atmospheric	Others	Chemical	Wave	Winds	Total
9754	**5059**	**281**	**77**	**2063**	**2876**	**7097**	**1495**	**607**	**949**	**30258**

Table 2 shows parameters time-series in terms of the EMODnet Physics parameter groups. It is worth to mention that each group may include more than one physical parameter (e.g. winds includes wind speed, wind direction) and where available the time-series at different water depth (e.g. temperature, salinity). Fulfilling tender requirements, the portal is providing the following types of measurements: 1) wave height and period; 2) temperature of the water column; 3) wind speed and direction; 4) salinity of

[3] http://www.emodnet-physics.eu/Map/dashboard/Section3.aspx
[4] http://www.emodnet-physics.eu/Map/dashboard/Section2SeaRegion.aspx
[5] http://www.emodnet-physics.eu/map/dashboard/ReservedAreaSection4.aspx
[6] http://www.emodnet-physics.eu/map/dashboard/Section22.aspx

the water column; 5) horizontal velocity of water column; 6) water clarity (light attenuation); 7) changes in sea-level.

The EMODnet Physics system is updated three times a day. Near real time (NRT), datasets are managed in a cooperation between the EuroGOOS ROOSs and the CMEMS INSTAC. For each EuroGOOS Region there is a Regional Data Assembly Centre (RDAC) closely cooperating with the INS TAC and connecting organisations operating monitoring stations. The INS TAC 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 its 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 at least daily, an ARGO 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 INS TAC 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.

The EMODnet Physics portal routinely (three times a day) collects new data files from all RDACs and makes these available for discovery, pre-viewing, download (NetCDF and ASCII csv), and machine-to-machine interoperability (WMS, WFS and web services). It is worth mentioning that EMODnet Physics portal does not apply any further quality control: that is RDAC's responsibility.

EMODnet Physics dynamic map page is the main graphical user interface to discover and download ocean metadata, data and products.

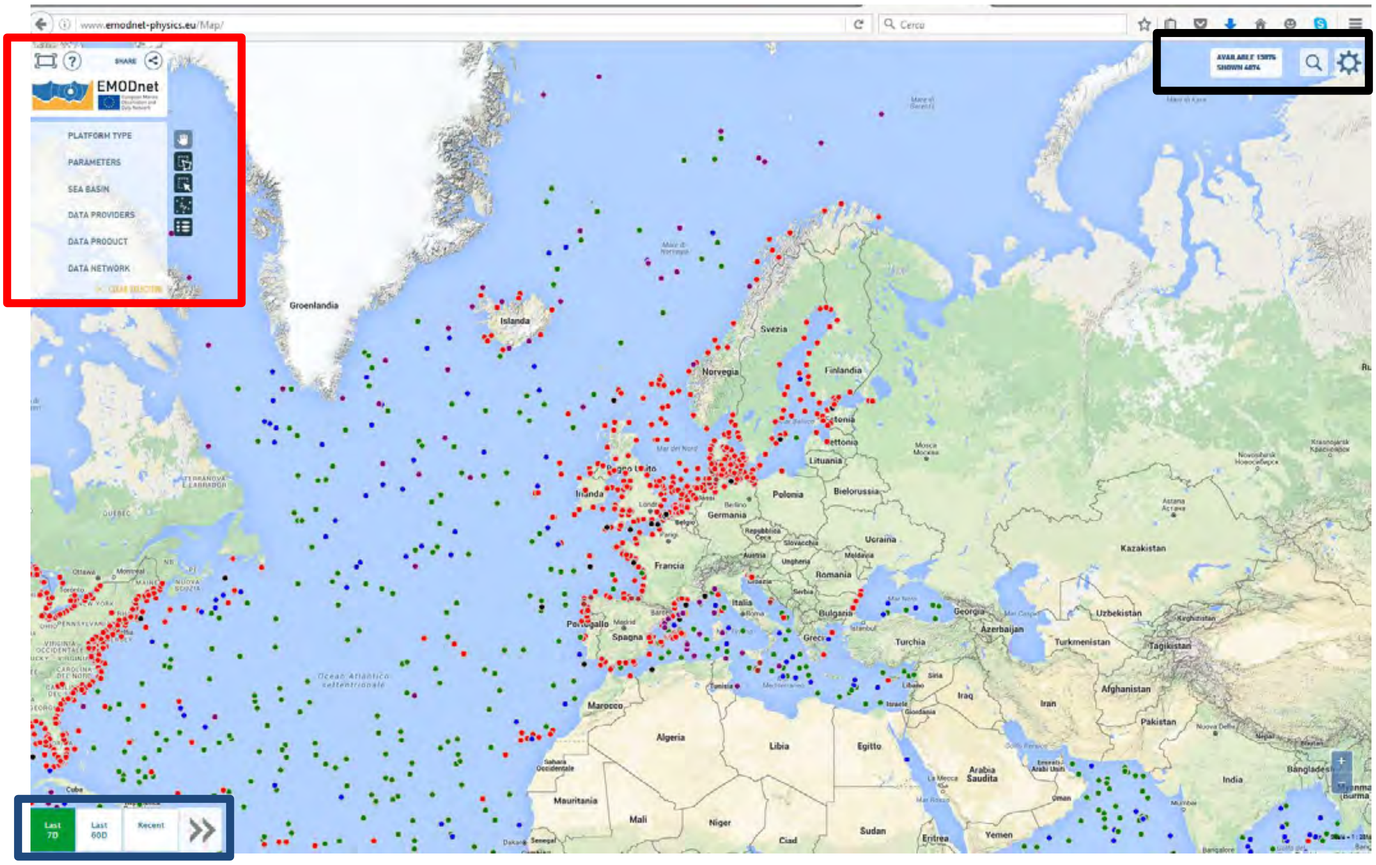


Figure 1. EMODnet map page

EMODnet Physics map page has three control-filter areas (red, blue and black) and each platform (circles) is interactive (Figure 1). The red area provides the user with filters (parameters, platform type, sea basin, etc.) to subset the selection and create a list of the selected platforms. It also provides links to Sea level trends, Ice and Ferrybox products. The blue box provides the user with a filter to define the time window of interest. The black box provides the user with search tools (by name, by latitude and longitude) and some external layers (e.g. bathymetry). To increase end user usability and match feedback from the survey, the Map page is constantly updated and optimised.

Top left – Logo and share features

	1. link to EMODnet Physics landing page 2. Full Screen 3. Help 4. Share Selection 5. link to EMODnet Central portal landing page

The “Share” feature is designed to let users share a selection; the portal creates a unique URL that can be copied and pasted and shared via emails/social networks etc.

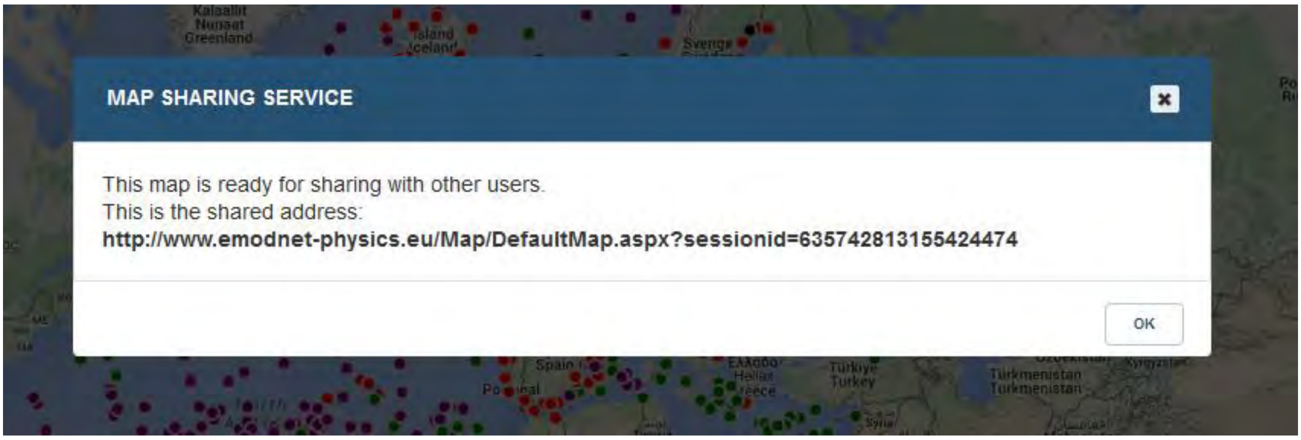
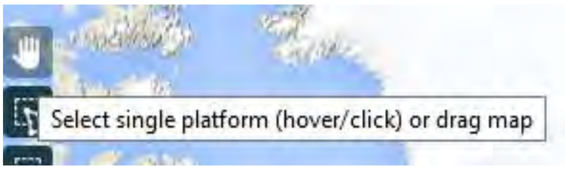
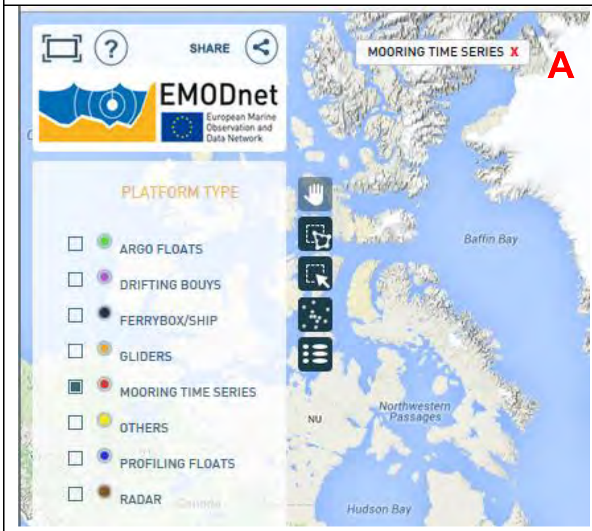


Figure 2. Example of the sharing feature link

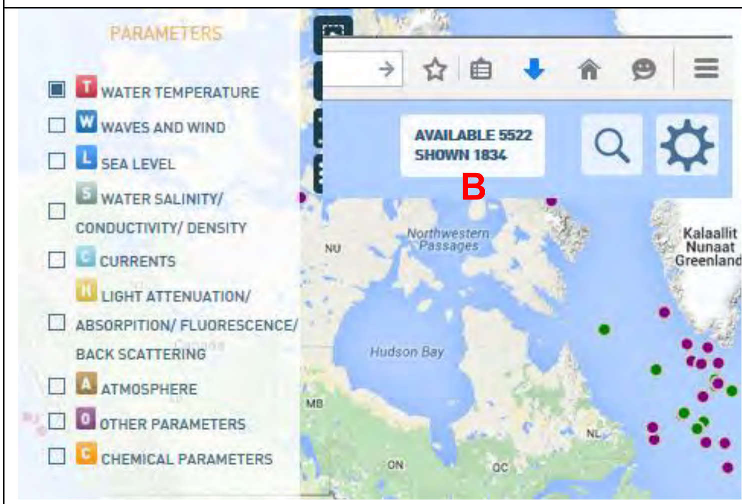
Top left – parameters and geographical filters

	1 to 5 are filters and 6 removes the applied filters 7 to 11 are control buttons to select and access a single platform or a group of platforms. 7. normal interaction 8. free boxing to select platforms 9. rectangular boxing to select platforms 10. create a list/select all the platforms with the applied filters

<table>
<tr>
<td></td>
<td>11. go to the selected platforms list

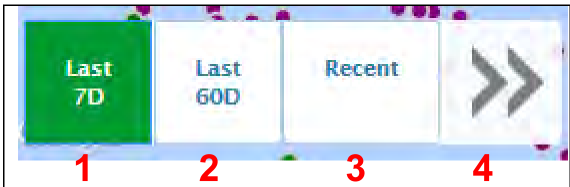
When pointing, a dialogue describes the feature

</td>
</tr>
<tr>
<td>
</td>
<td>Platform type are:

- ARGO
- Drifter
- Ferrybox (and Ship)
- Mooring and fixed stations
- Profiling buoys
- Radars
- (Others)

When a filter is applied a label appears (A) on the map</td>
</tr>
<tr>
<td>
</td>
<td>Parameters are:
- Sea water temperature
- Waves and winds
- Sea level
- Sea water salinity
- Currents
- Light attenuation
- Atmospheric parameters
- Chemical parameters
- Other (e.g. biological param.)

When a filter is applied the map also shows the number of platforms matching the applied filters (shown) vs. the total available platforms (B)</td>
</tr>
</table>

Bottom left – time filters

	Playing with "time filters" the user can select platforms that are providing data for 1. (default setting) last 7 days 2. Last 60 days 3. Recent (last 20 years) 4. More Applying filters 1 and 2, the map shows platforms and data that are freely accessible and downloadable, without credentials, by all users. Filter 3 shows platforms with data older than 60 days. These platforms are connected via the INSITU TAC of EuroGOOS ROOSs and CMEMS. As soon as the user logs in (CMEMS credentials), all data can be downloaded. Filter 4 opens a slider to select a time range. Most of the historical data are provided by the SeaDataNet networks of NODCs and to download these data the user is redirected to the SDN Request Status Manager.
	

Filters are grouped according to some classes, namely Platform Type, Parameters, etc. The logic of the filters is AND between classes and OR within a class. Figure 3 shows the following selection: (Ferrybox OR Mooring) AND (Water temperature OR Sea Level) AND (SMHI) AND (last 7 Days)

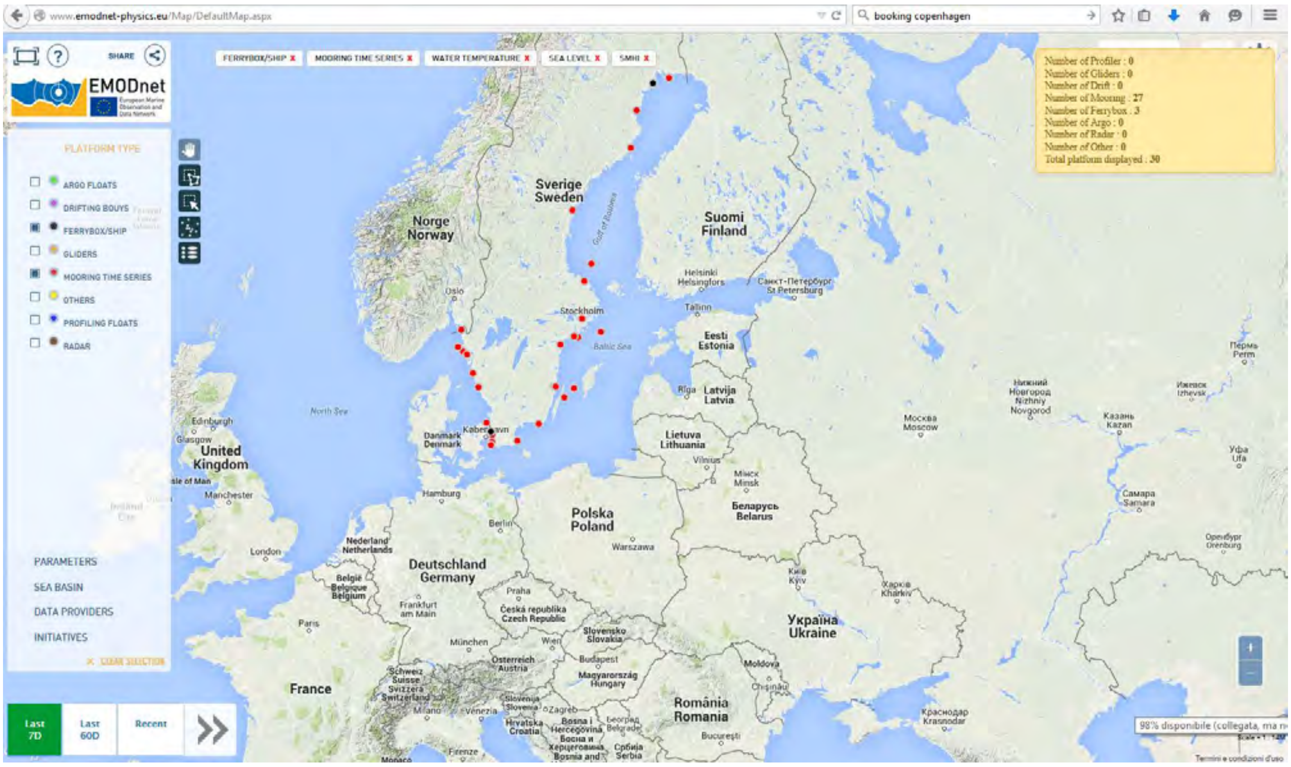
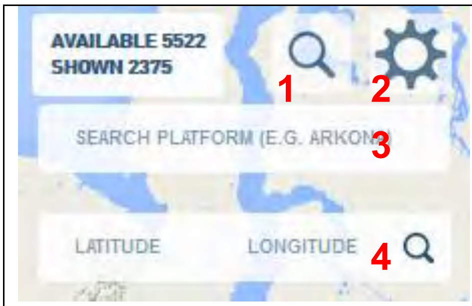
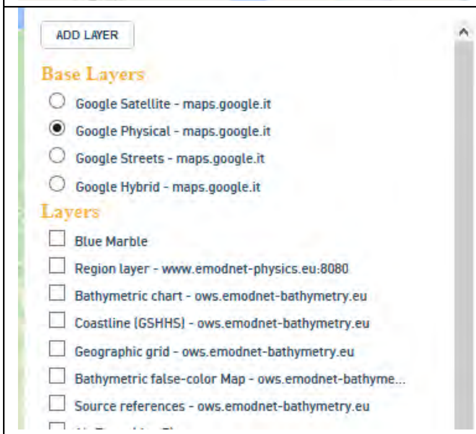


Figure 3. Example for the filters: Ferrybox + Mooring; Water temperature + sea level; SMHI; latest 7days.

Top right – search and options

 	1. search 2. options If the user clicks on 1, options 3 and 4 appear: 3. search by platform name 4. search by latitude and longitude
 	If the user clicks the “option”, he can play with the background map and add layers.

If the user points a platform, a window pops up showing the platform metadata (Figure 4). If the user clicks the platform, EMODnet Physics opens the platform page that was specifically designed according to the typology of the platform, to better match the interest of users of the data networks (ARGO, HFR, etc) and providers (Figure 5, Figure 6, Figure 7).

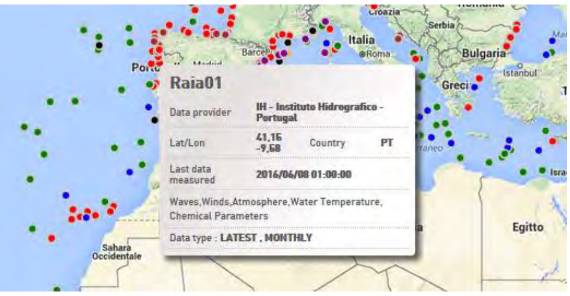


Figure 4. Platform metadata

Each platform has a unique EMODnet Physics internal reference ID and can be used to directly access the platform e.g. http://www.emodnet-physics.eu/Map/FeedPlatformInfo.aspx?id=8842

The page provides the user with metadata (left), plots, download features, platform products e.g. monthly averages (Figure 29) or wind plots (Figure 30), more info and links, as well as statistics on the use of the data from that platform.

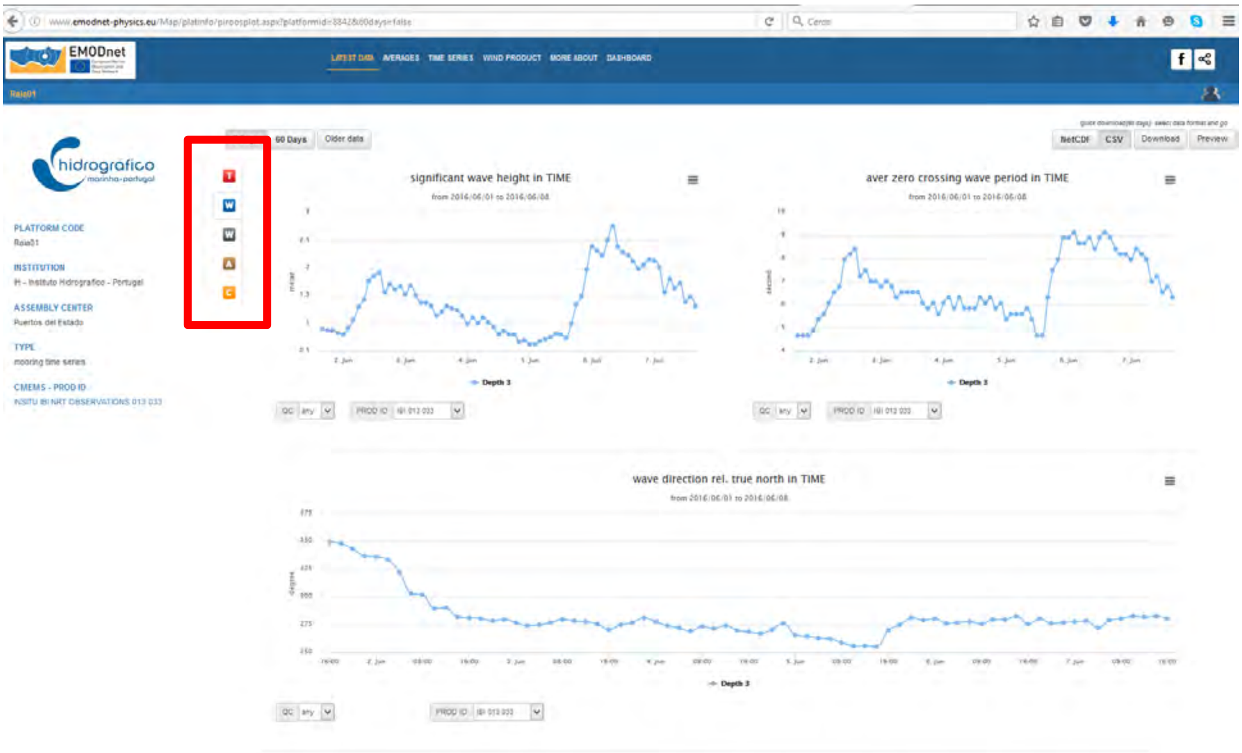


Figure 5. Fixed Station page. The user can pass from the parameter group plots to the other parameter group plots by clicking the parameter symbol (red box).

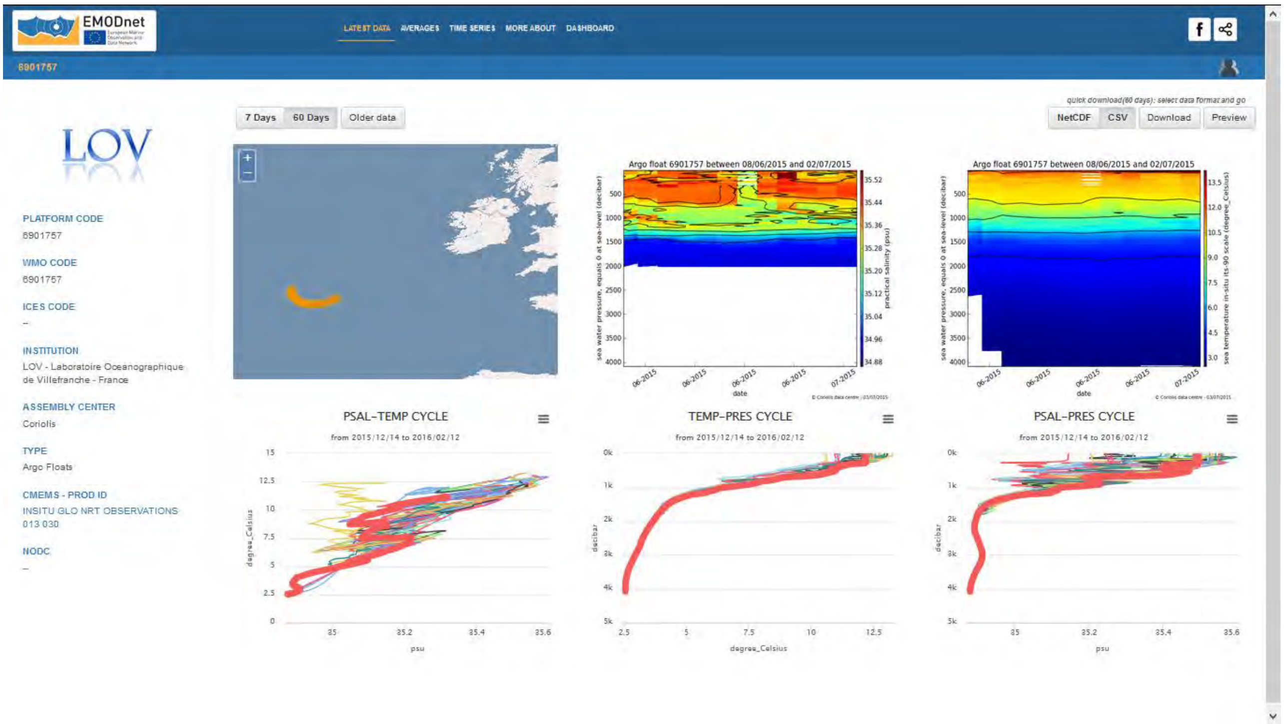


Figure 6. ARGO platform page

Figure 7. HF Radar platform page

Figure 8. Example of the monthly synthetic data from the EMODnet Physics (platform 62084) - http://www.emodnet-physics.eu/map/platinfo/pimeanmaxmin.aspx?platformid=7340. Once the monthly file is available, the system also supplies synthetic data (i.e. average, maximum and minimum) for the available parameters.

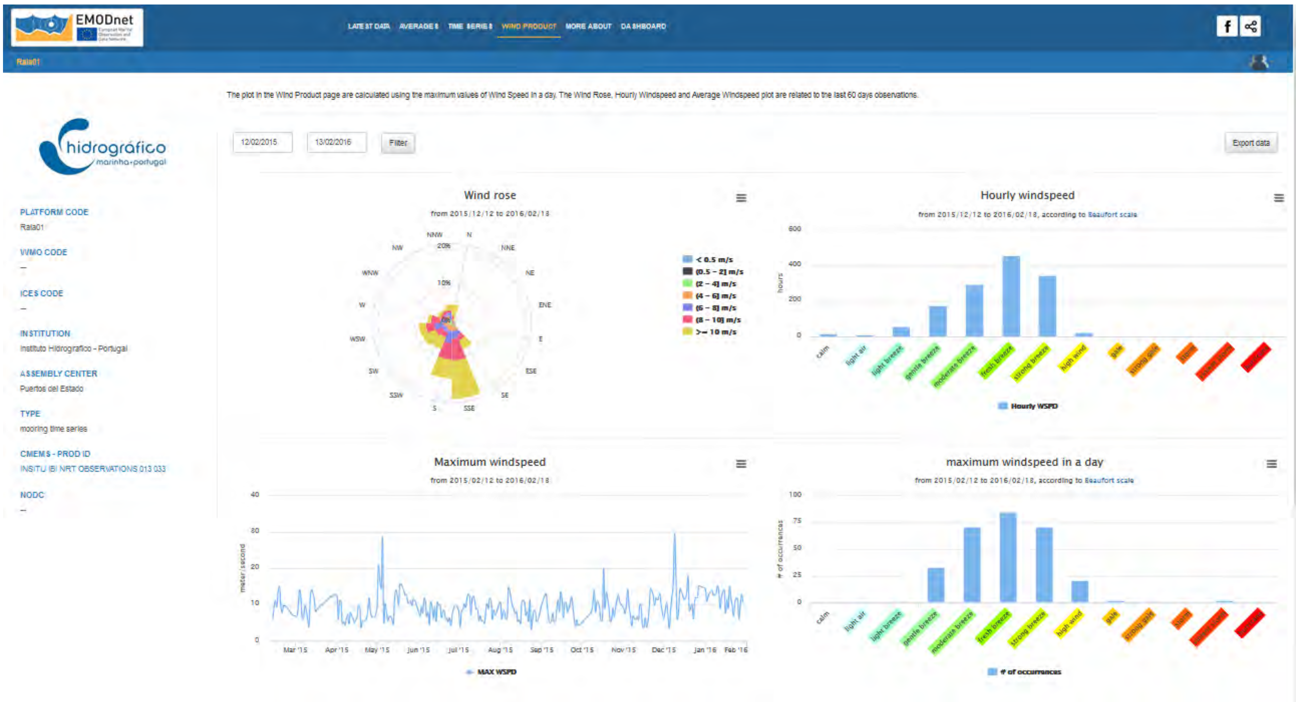


Figure 9. Wind plots

EMODnet Physics manages two type of products: platform products and other products. While the platform products are accessible via the platform page (e.g. averages or wind plots), the other products are presented on specific pages.

The “ferrybox” product shows the selected parameter values along the ferrybox route (Figure 10). If the user clicks the route the system opens the ferrybox page (Figure 11).

The ice product is based on the CMEMS - SEAICE_GLO_SEAICE_L4_NRT_ OBSERVATIONS_011_001[7] and the in situ platform in the Arctic area. The user can discover the ice parameter (sea ice concentration, sea ice edge, sea ice type) time series for past 3 years, as well as open and access to the displayed in situ platforms page (Figure 12).

[7] The OSI SAF delivers three global sea ice products in operational mode: sea ice concentration, sea ice edge, sea ice type (OSI-401 OSI-402 and OSI-403). The products are delivered daily at 10km resolution in a polar stereographic projection covering the Northern Hemisphere and the Southern Hemisphere. It is the Sea Ice operational nominal product for the Global Ocean. In addition, a sea ice drift product is delivered at 60km resolution in a polar stereographic projection covering the Northern and Southern Hemispheres. The sea ice motion vectors have a time-span of 2 days.

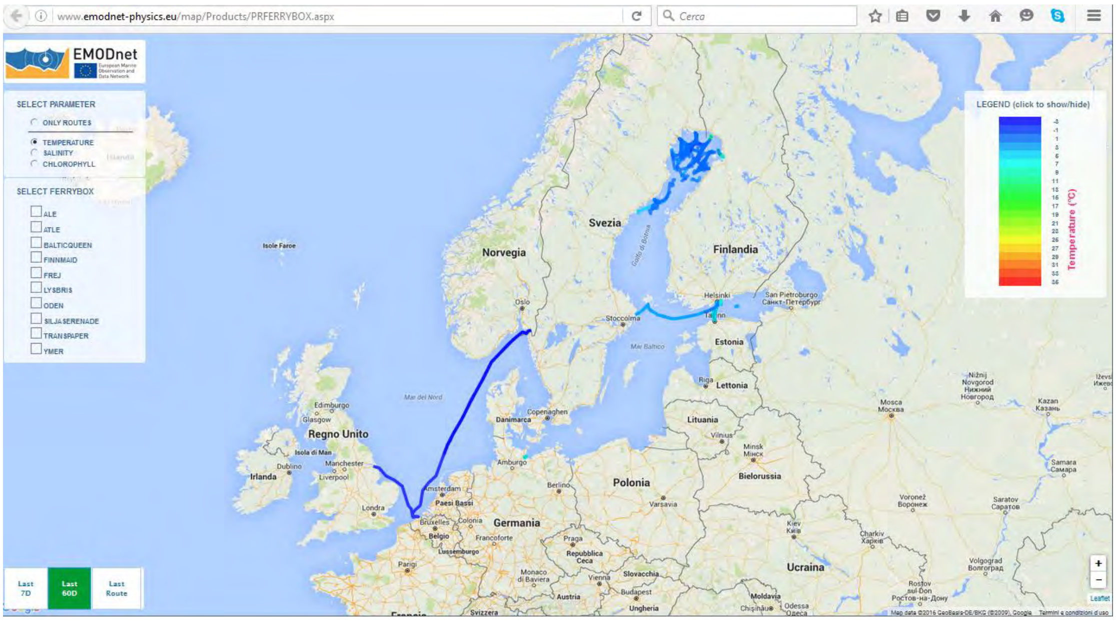


Figure 10. Ferrybox – parameter vs route plot.

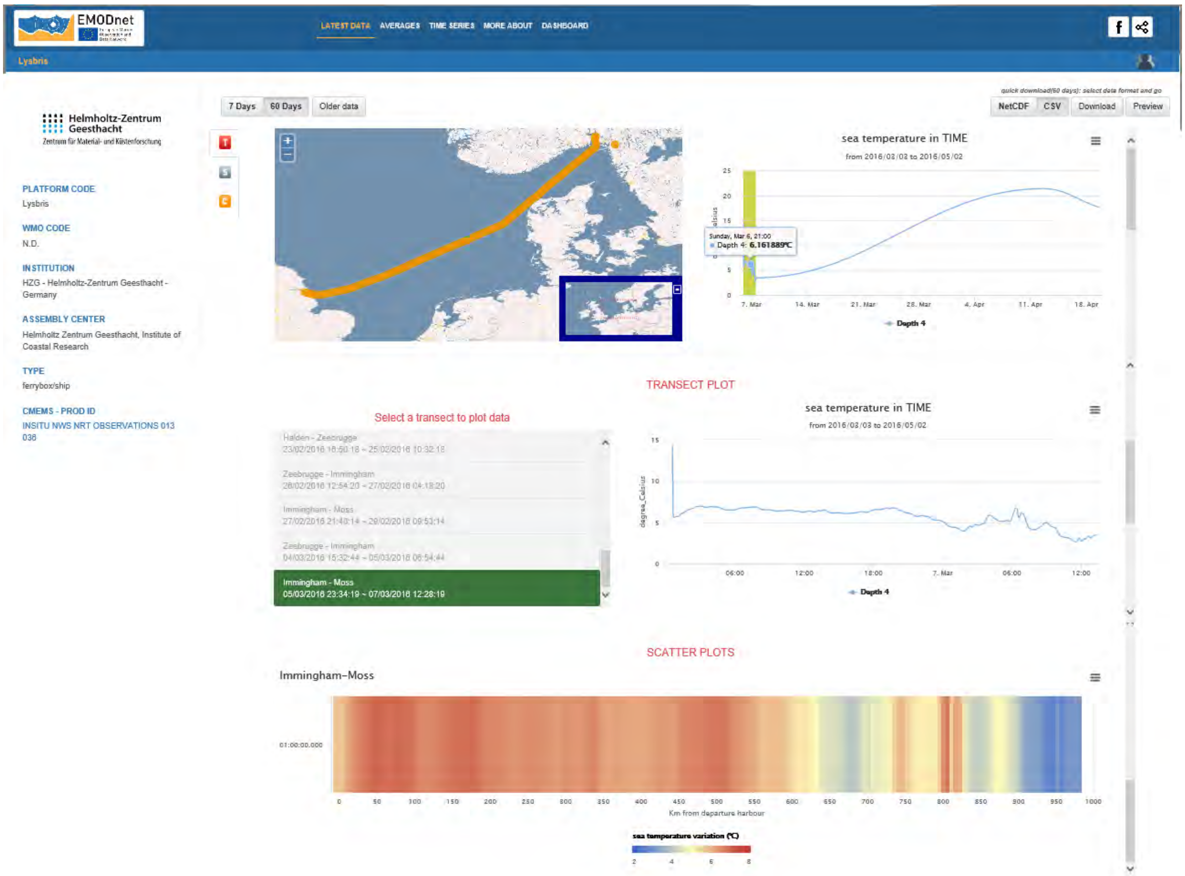


Figure 11. Ferrybox page.

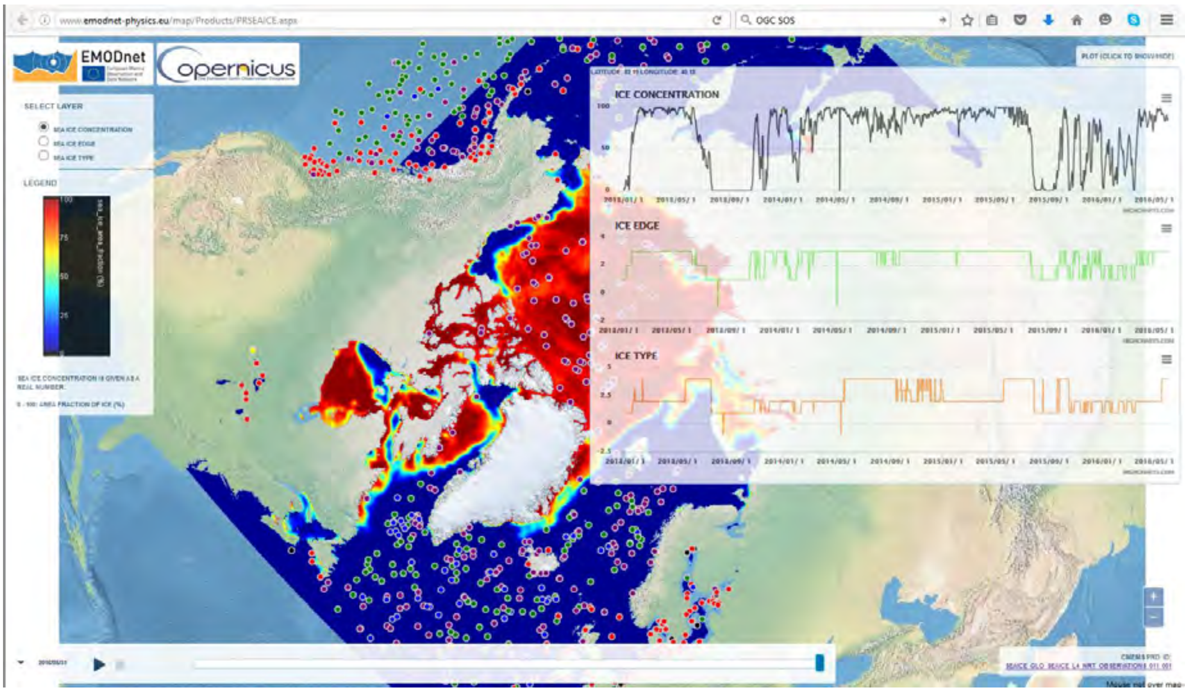


Figure 12. EMODnet Physics Ice product page. If the user selects a geospatial point the system shows the timeseries for the three parameters of the ice product (concentration, edge, and type).

The sea level trends page is based on the Permanent Service on Mean Sea Level (PSMSL)[8]. The mean sea level (MSL) trends measured by tide gauges are local relative MSL trends as opposed to the global sea level trend. These trends are not corrected for land movement. Tide gauge stations measure Local Sea Level, which refers to the height of the water as measured along the coast relative to a specific point on land. If the user clicks on one of the platforms, the system opens the platform page and shows both the monthly and annual sea level trends (Figure 13).

EMODnet Physics delivered an analysis of the Sea Level Indicators that is available on the portal[9].

[8] http://www.psmsl.org/products/trends/

[9] http://www.emodnet-physics.eu/portal/documents-and-services

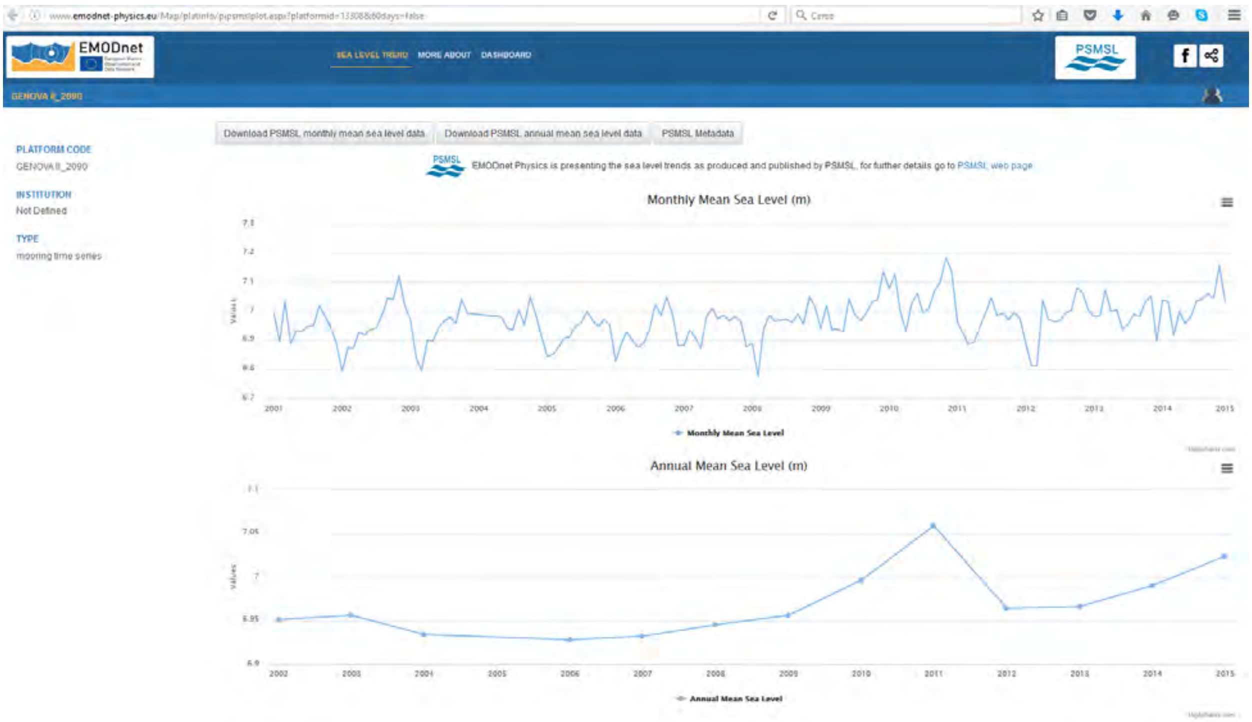


Figure 13. EMODnet Sea Level trends platform page.

While EMODnet Physics map page provides the graphical user interface to discover and download ocean metadata, data and products, EMODnet Physics interoperability services provide the user with machine-to-machine capabilities. By means of a GeoServer based infrastructure, EMODnet Physics is offering OGC compliant catalogues and services (WMS, WFS, etc.). Full services capabilities are described on the service landing pages:

- WEB SERVICE: www.emodnet-physics.eu/map/service/WSEmodnet2
- WMS: www.emodnet-physics.eu/map/service/GeoServerDefaultWMS
- WFS: www.emodnet-physics.eu/map/service/GeoServerDefaultWFS
- THREDDS: thredds.emodnet-physics.eu:8080/thredds/catalog.html
- SEXTANT: http://sextant.ifremer.fr/en/web/emodnet_physics/catalogue
- GEOSERVER: http://151.1.25.219:8181/geoserver/web/

These enable data discovery and download of currently more than 12,000 platforms providing both near real time and historical datasets (Figure 14), with more than 180,000 downloads during the past three years, with more than 140,000 page views during the past two years (Figure 15), EMODnet Physics is developing according to the evolving needs of its users. These results confirm the appropriateness of the chosen portal technology in terms of both speed of response and user-friendliness, as well as confirming the importance and need for continuous work on portal technology, graphical user interface, and machine-to-machine services updates. Within this framework, it is worth mentioning that EMODnet Physics and CMEMS agreed to sign a Memorandum of Understanding for the supply of coherent and complementary sustained services, avoiding duplication of efforts and facilitating access to CMEMS and EMODnet services by a wider community who needs in situ products.

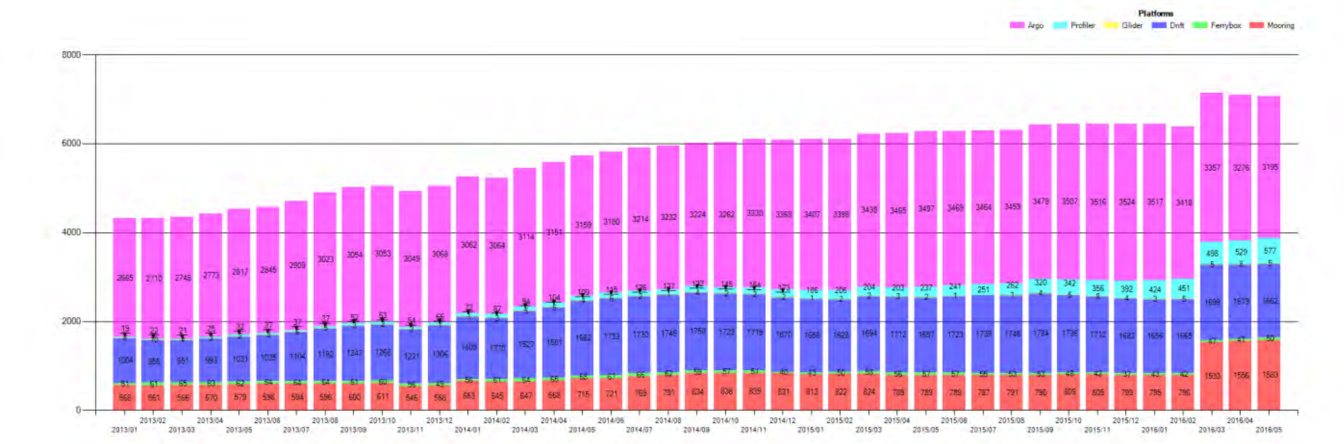


Figure 14. Connected platforms (monthly file datasets) since Jan 2013[10].

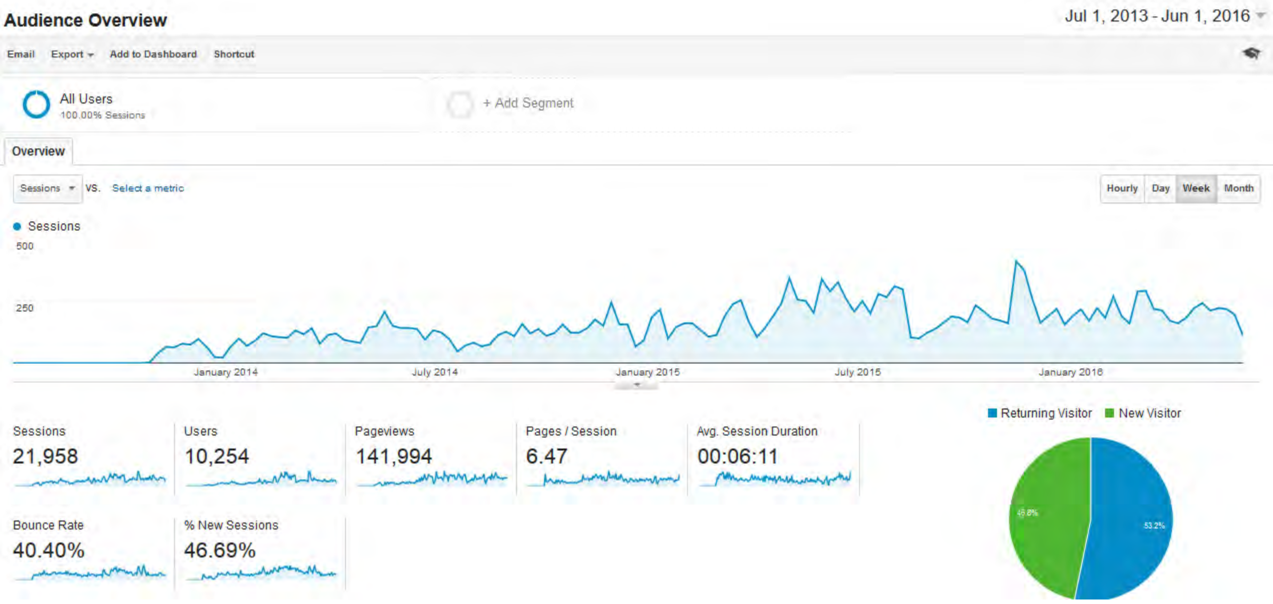


Figure 15. Google analytics of EMODnet Physics map page. The tracing was activated mid November 2014.

[10] http://www.emodnet-physics.eu/map/dashboard/Section19.aspx

Additionally, EMODnet Physics has been identified as the dissemination portal for an increasing number of key international projects and initiatives such as AtlantOS, JERICO-NEXT, FixO3, GOOS as well as an easy to use shopping window for CMEMS products and give more visibility to the CMEMS INSTAC. This is a game change and proves that the portal fulfils many user requirements. This approach also enables projects to avoid duplication of efforts from a portal/data display point-of-view and reduces the confusion among users and data providers by providing a single portal where projects and initiatives can display their data with sufficient and clear credit to the project, initiative and data provider.

Finally yet importantly, the International Oceanographic Commission urged greater engagement of EMODnet and GMES in the global GOOS (Global Ocean Observing System) and GEOSS (Global Earth Observation System of Systems) efforts, saying that

> *"interoperability [with a global system] will bring benefits to Europe through the provision of non-European data that may impact on forecasts or the health of European seas."*

In this context, EMODnet Physics is already indicated as the operational platform and exemplar on which GOOS has to build.

1. Introduction

Provide an introduction to set the stage: start date, main goals, background, consortium, key components and characteristics of the lot (max 2 pages).

The EMODnet Physics three-year contract formally started on 24th July 2013. The core consortium is ETT (Coordinator), MARIS, IFREMER, BODC and EuroGOOS (via SMHI).

The overall objective of the EMODnet Physics portal is to provide access to near real-time data and historical time series datasets on the physical conditions of European seas and oceans and to determine how well the data meets the needs of users from industry, public authorities and scientists. EMODnet Physics builds on the EMODnet Physics portal developed under the ur-EMODnet preparatory actions (EMODnet Phase I from 2009-2013) and is based on the cooperation and collaboration with the three established pillars in the European Oceanographic Community:

(i) EuroGOOS and its Regional Operational Oceanographic Systems (ROOSs). EuroGOOS is a pan-European ocean observing network operating within the context of the Global Ocean Observing System of the Intergovernmental Oceanographic Commission of UNESCO (IOC GOOS). The ROOSs are responsible for the collection of data to fulfil the aims of the regional[11] service needs.

(ii) Copernicus Marine Environment Monitoring Service (CMEMS)[12], and in particular with the In Situ Thematic Assembly Center (INSTAC). CMEMS is a European Commission program (2015 – 2020) to provide operational monitoring and forecasting systems for global, Arctic and European regional seas based on satellite and in situ observations.

(iii) SeaDataNet network of National Oceanographic Data Centres (NODCs). By means of a series of European founded research projects, the NODCs developed a pan European infrastructure for providing up-to-date and high quality ocean metadata, data and data products, and for developing and promoting common data management standards.

The EMODnet Physics portal provides 24/7 coverage of a combined array of services and functions to users, for viewing and downloading data, meta-data and data products on the physical conditions of European sea basins and oceans. The EMODnet Physics portal is fully integrated with, and complementary to, the marine core services of Copernicus and is interoperable with other portals that are ISO, OGC and INSPIRE compliant.

[11]ROOSs are responsible for the collection of data in Arctic Ocean (Arctic ROOS), Baltic Sea (BOOS), Northwest Shelf Sea (NOOS), Ireland–Biscay–Iberia Seas (IBI ROOS) and the Mediterranean Sea (MONGOOS)

[12] http://marine.copernicus.eu/

In particular, access to the NRT data stream is supported by the EuroGOOS - ROOSs and the CMEMS *in-situ* TAC system, whilst metadata discovery to the archived data is organised through the SeaDataNet network and infrastructure. The Coriolis infrastructure of IFREMER also plays an important role, providing access to the supplementary data from Argo floats (EuroArgo).

The general goals of EMODnet Physics in this phase are the strengthening of the existing structure and infrastructure and:

1. providing better access to additional data not as yet in the current system;
2. providing access to additional Ferrybox data;
3. better streamlining and optimising data flow;
4. fully exploiting opportunities to obtain additional parameters from existing data sites;
5. filling in gaps in time-series;
6. assisting the work on the completeness of stations, leading to a list of uniform station names that reduces duplication between ROOSs;
7. better uptime of services and synchronization of data sources between ROOSs and data centres.

EMODnet Physics achieved the addressed goals well and it is ready to further extend its scope to more physical parameters and offer new features to serve a wider community of end users.

In order to determine how well the data meet the needs of users from industry, public authorities and scientists, EMODnet Physics is paying particular attention to the work done by EMODnet Check Points: the adequacy of data can be assessed in a quantitative way only on the base of use cases. A preliminary analysis on possible contributions to Maritime Economic Activities is presented in Annex 1.

2. Highlights of the project

Provide a summary of the key achievements and/or events of interest to a wider audience you wish to highlight – this can be based on the indicators or any other of the reporting sections (max 1 pages, preferably a bullet list).

- EMODnet Physics recorded an impressive update of data and metadata products:
  In 2013, EMODnet Physics was providing access to 429 fixed platforms and 3 ferrybox lines. It is now providing access to more than 12,000 platforms giving more than 30,000 time series. EMODnet Physics successfully integrated and it is making discoverable and downloadable data from more than 4,500 ARGO, more than 4,000 drifting buoys, more than 430 European fixed stations, 13 European HF Radars, more than 20 European ferryboxes and it is now integrating GOSUD ship data. It successfully included more than 430 European fixed stations and created links to non-European fixed stations and moorings.
- For each platform, EMODnet Physics developed a specific visualisation tool to present data as sets of measurements (time series) to match users' needs.
- EMODnet Physics is integrating and making available a series of products:
  - ice maps (from CMEMS satellite products) together with in situ platforms position;
  - monthly average (maximum and minimum) of data at pre-defined depths;
  - wind plots, for the platforms that are measuring wind parameters;
  - sea level trends (from PSMLS products) with in situ monthly and annual resolution.
- EMODnet Physics upgraded and renovated the portal, and further developed the existing user interfaces and machine-to-machine interfacing-functionalities.
- EMODnet Physics managed more than 180,000 download requests (and each request was always for more than one time-series).
- EMODnet Physics has been identified as the dissemination portal for an increasing number of key international projects and initiatives such as AtlantOS, JERICO-NEXT, FixO3, GOOS as well as an easy to use shopping window for CMEMS products and give more visibility to the CMEMS INSTAC.
- EMODnet Physics and CMEMS further consolidated their cooperation by signing a Memorandum of Understanding to enhance their collaboration for the supply of coherent and complementary sustained services, avoiding duplication of efforts and facilitating access to CMEMS and EMODnet services by a wider community who needs in situ products.
- EMODnet Physics actively worked on dissemination by participating to conferences, as well as promoting more focused workshops, in collaboration with EuroGOOS and ROOSs, to present progress and be involved in more organisations and users.

3. Description of the work done

Provide a description of the work done from the beginning of the project (max 20 page, plus Figures and Tables as needed – additional support materials can be added in Annex).

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**.**

EMODnet Physics provides a combined array of services and functionalities (a facility for viewing and downloading, dashboard reporting and machine-to-machine communication services) to obtain free of charge data, meta-data and data products on the physical conditions of European sea basins and oceans. Moreover, the system provides full interoperability with third-party software through WMS services, Web Services and Web catalogues in order to exchange data and products according to the most recent standards. EMODnet Physics is built on, and is working in coordination and cooperation with, EuroGOOS-ROOSs, CMEMS and the SeaDataNet network of NODCs. By means of joint activities with its three pillars and with the most relevant Organizations and associations within the sector, EMODnet is undergoing significant improvements and expansion.

EuroGOOS (http://www.eurogoos.org) is a pan-European ocean observing network operating within the context of the Global Ocean Observing System of the Intergovernmental Oceanographic Commission of UNESCO (IOC GOOS). EuroGOOS now has 40 members in 19 European countries. Among its priorities are the improvement of the observing system for operational oceanography in Europe, its contribution to global systems and the further development of GOOS, in particular by taking the lead in advancing Coastal GOOS. Activities of EuroGOOS associates and Regional Members are organised at regional level. The EuroGOOS **Regional Ocean Observing Systems** (ROOSs) are the core of the EuroGOOS association and acts as the operational arm of EuroGOOS and of projects. The ROOSs are responsible for the collection of data to fulfil the aims of the regional service needs.

Copernicus Marine Service (CMEMS) since May 2015 the CMEMS took the legacy of the MyOcean projects and it is operationally offering a wide range of oceanographic products: observation products (in situ and satellite) and numerical modelling products. These various products, gathered in a unique catalogue, cover the global ocean and the six European basins: Arctic, Baltic, North West Shelves and South West Shelves, Mediterranean Sea and Black Sea. These products inform on physical and biogeochemical states of the oceans. They cover long temporal periods starting from the 1990s or near real-time for observation products and few days forecast for modelling products. Within the Copernicus Marine Service, the In Situ thematic centre products for the global ocean and the six European seas. In situ data in a given region are collected, quality controlled and distributed into a product that can be near real time (assessed using automated procedures) for forecasting activities or reprocessed (assessed by scientific teams) for re-analysis and research activities. The REP products are developed in collaboration with SeaDataNet.

SeaDataNet (http://www.seadatanet.org) is developing and operating a Pan-European infrastructure for managing, indexing and providing access to ocean and marine environmental data sets and data products (e.g. physical, chemical, geological, and biological properties) and for safeguarding the long term archival and stewardship of these data sets. Data are derived from many different sensors installed on research vessels, satellites and *in-situ* platforms that are part of various ocean and marine observing systems and research programs. Data resources are quality controlled and managed at distributed data centres that are interconnected by the SeaDataNet infrastructure and accessible for users through an integrated portal. The data centres are mostly National Oceanographic Data Centres (NODCs) which are part of major marine research institutes that are developing and operating national marine data networks, and international organizations such as IOC/IODE and ICES.

As stated in the contract, during the past three years, the EMODnet Physics worked on:

(1) *assembling existing data from public and private organisations relating to the state of sea basins; processing them into interoperable formats, which include agreed standards, common baselines or reference conditions; assessments of their accuracy and precision;*
(2) *improving, operating and maintaining the EMODnet Physics portal, allowing public access and viewing of data, metadata and data products;*
(3) *collaborating with other EMODnet projects (e.g. Chemistry, Physical Habitats, Human activities, Biology, Geology, Bathymetry) for specific actions, as required by the tender;*
(4) *monitoring and reporting on the effectiveness of the system in meeting the needs of users in terms of ease and speed of use, quality of information and fitness for purpose of the data and products delivered;*

(5) *analysing what further steps need to be taken to improve the accuracy, precision, coverage and ease of use of the data,*
(6) *keeping the portal operational and ready for transfer to the Commission or to a party designated by the Commission.*

EMODnet Physics provides a single point of access to near real time data (the system is updated 3 times a day), delayed data and reprocessed data. Near real time data for the last 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 reorganised into the “monthly” dataset file). Each platform can provide one or more parameters. Operational platforms provide data time series as soon as data are ready – e.g. a fixed platform delivers data daily (at the latest), an ARGO 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 latest 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 INS TAC and SeaDataNet NODCs).

In 2013, EMODnet Physics was providing access to 429 fixed platforms and 3 ferrybox lines, it is now providing access to more than 12,000 platforms[13] giving more than 30,000 time series[14] as follows

Table 3 – Platforms on EMODnet Physics (01/06/2016)

	drifting buoy (DB)	Ferrybox and ship (FB)	glider (GL)	fixed platform and mooring time series (MO)	profiling float (PF)	Argo Float (AR)	Radar (RD)	TOTAL
platforms with data and full described metadata	411	21	20	1143	481	4628	13	6717
Platforms with data and incomplete metadata	3652	13	0	1427	163	144	0	5399

To these, a further 144 fixed stations should be added, providing Common Data Index (CDIs) only.

[13] http://www.emodnet-physics.eu/Map/dashboard/Section3.aspx
[14] http://www.emodnet-physics.eu/Map/dashboard/Section2SeaRegion.aspx

Table 4 is listing the EMODnet Physics parameter groups, each group may include more than one physical parameter (e.g. winds include wind speed and wind direction) and where available the time-series at different water depth (e.g. temperature and salinity). Fulfilling the tender requirements, the portal is providing the following types of measurements: 1) wave height and period; 2) temperature of the water column; 3) wind speed and direction; 4) salinity of the water column; 5) horizontal velocity of water column; 6) water clarity (light attenuation); 7) changes in sea-level.

Table 4 – Parameters time series (01/06/2016)

	Temp.	Salinity	Currents	Light Attenuation	Sea Level	Atmospheric	Others	Chemical	Wave	Winds	Total
Arctic, Barents, Greenland, Norwegian Sea	883	82	5	9	153	293	644	637	9	15	**2730**
Atlantic, Bay of Biscay, Celtic Sea	2478	1193	156	24	425	900	1561	238	208	292	**7475**
Baltic Sea	97	38	10	8	248	15	20	25	19	12	**492**
Black Sea	35	24	3	2	21	9	24	15	2	5	**140**
Global Oceans	5879	3514	32	12	789	1516	4596	458	201	508	**17505**
Mediterranean Sea	289	164	62	9	169	87	177	88	56	64	**1165**
North Sea	93	44	13	13	258	56	75	34	112	53	**751**
TOTAL	**9754**	**5059**	**281**	**77**	**2063**	**2876**	**7097**	**1495**	**607**	**949**	**30258**

The portal is well matching the required geographical coverage, including also data from Icelandic Sea and Barents Sea and it incorporated data from supplementary physical monitoring systems: ARGO (all the ARGO are available), gliders[15], and emerging measurement systems (i.e. HF radar).

On top of these data, EMODnet Physics portal provides 24/7 coverage of 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.

Currently, the portal provides users with following key services and functions:

1. **Landing page**, www.emodnet-physics.eu/portal, which presents the European Marine Observation and Data network background and introduces the EMODnet Physics scope and goals. The landing page also provides community news and meetings reports, as well as direct links to EMODnet Physics operational services and to other EMODnet Central and hence the other lots.

[15] the number of gliders data available in Physics is very little and already synch with what is available in CMEMS, some more data are available via GTS but are not going under the same QC/QF procedures applied to other platforms

Figure 16. EMODnet Physics landing page. The landing page provides the user with a menu to access further details on the ur-EMODnet and EMODnet Physics background, documents on references and standards, contributors etc. The body of the page is providing the user with sections to access the data discover and pre-view, the machine-to-machine services, the catalogues, etc. The landing page is also listing the number of available platforms and some interesting news.

2. **Dynamic map facility for viewing and downloading,** www.emodnet-physics.eu/map, which 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 also 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). Sea level trends and ice coverage products are also accessible via the map interface.

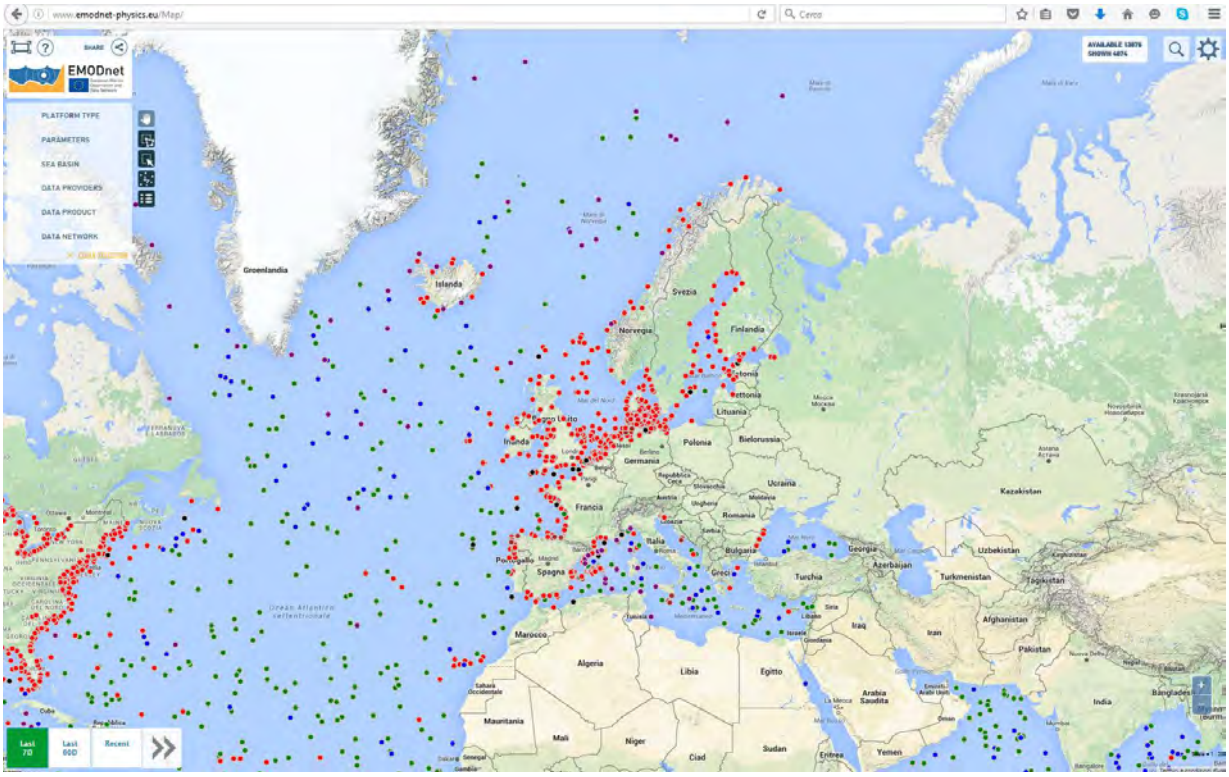


Figure 17. EMODnet Physics map. The user can refine the selection by applying filters per parameter, sea basin, and provider. The page also provides the user with sea level trend, ice, and ferrybox/ship products.

3. **Dashboard**, www.emodnet-physics.eu/map/dashboard, which is a reporting service where users can view and export various statistics about the data portal content and usage. The EMODnet Physics dashboard represents a valuable tool to discover data availability and monitor performance of the infrastructure behind the portal. The tool also provides KPIs (key performance indicators) presenting how much data and how many platforms are made available on a daily base, and extracts statistics on page access and data downloads etc.

4. **Interoperability services,** the 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 OCG 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.

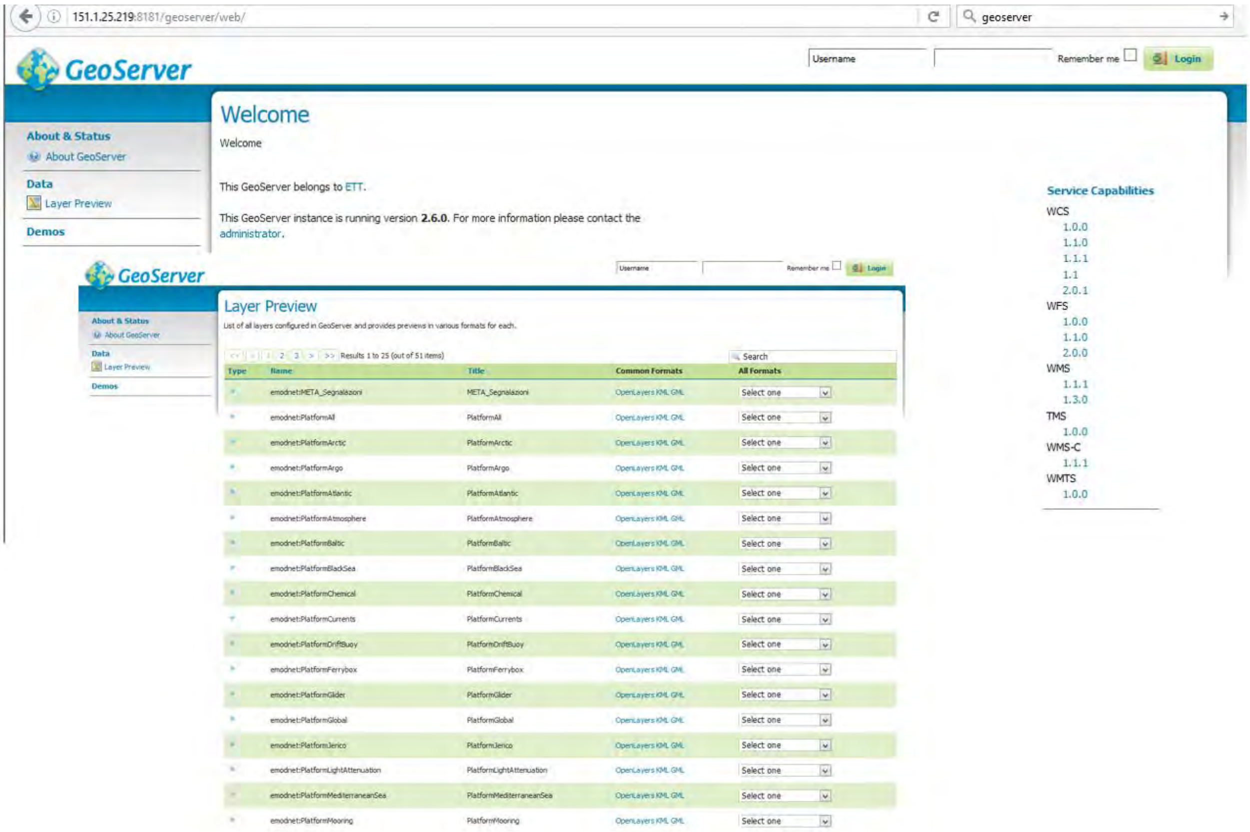


Figure 18. EMODnet Physics - GeoServer page

In the period from 01/07/2013 to 01/06/2016, EMODnet Physics managed about 28,200 manual data download requests[16], more than 154,200 data download web service requests and 3,110 CDI requests[17].

[16] http://www.emodnet-physics.eu/map/dashboard/ReservedAreaSection4.aspx
[17] http://www.emodnet-physics.eu/map/dashboard/Section22.aspx

- **EMODnet Physics infrastructure**

From a more technical point of view the EMODnet Physics is built upon two main data streams, namely archived data from monitoring stations and other in-situ physical observations, provided through SeaDataNet, and the stream of near real time (NRT) data from operational monitoring stations. To these, lately, EMODnet physics added the data access and preview for coastal not European areas (e.g. NOAA platforms for the US, IAPB platforms for the Arctic area, IMOS for the Australia[18])

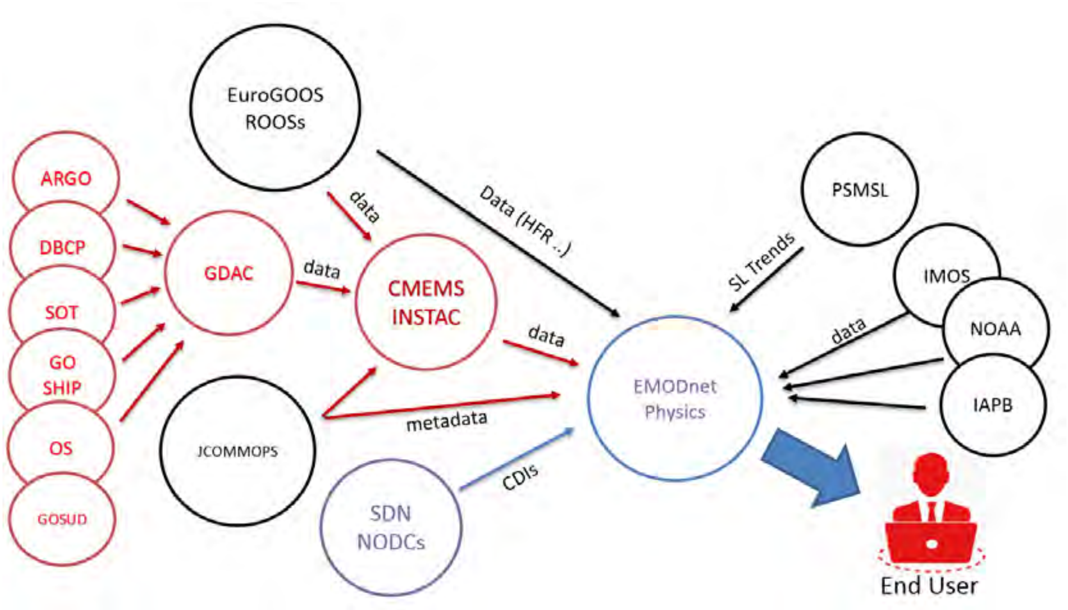


Figure 19. EMODnet Physics data stream. ROOS: Regional Oceanographic Operational System; NODC: National Oceanographic Data Centre; CMEMS: Copernicus Marine Environment Monitoring Service; SDN: SeaDataNet; JCOMMPOS[19]: JCOMM in situ Observing Platform Support Centre; GDAC: Global Data Assembly Centre; PSMSL: Permanent Service Mean Sea Level; DBCP: Data Buoy Coop. Panel; SOT: Ship Obs. Team; OS: OceanSITES; IMOS NOAA IAPB

The NRT datasets are managed in a cooperation between the EuroGOOS ROOSs (Regional Operational Oceanography Systems) and the INSTAC (In Situ Thematic Assembly Centre) of the Copernicus Marine Environment Monitoring Service (CMEMS).

EuroGOOS - ROOSs are the regional bodies responsible for the collection of data to fulfil the aims of the regional service needs and EuroGOOS coordinates five regional operational systems in Europe: in the

[18] EMODnet Physics is working on avoiding the presentation of duplicates.

[19] JCOMMOPS only provides metadata to both CMEMS and EMODnet. Data are provided by data networks.

Arctic (Arctic ROOS), the Baltic (BOOS), the North-West Shelf (NOOS), the Ireland-Biscay-Iberian area (IBI-ROOS) and the Mediterranean (MONGOOS).

For each EuroGOOS Region there is a Regional Data Assembly Centre (RDAC) closely cooperating with the INS TAC and connecting organisations operating monitoring stations. The INS TAC architecture is decentralised. However, quality of the products delivered to users must be equivalent wherever the data are processed. The four key functions implemented by the global and regional components of the CMEMS In Situ TAC are:

- Data Acquisition: Gathering data, available on international networks or though collaboration with regional and national partners.
- Data Quality control: applying automatic quality controls agreed at the In Situ TAC level. The procedures are defined by parameter, elaborated in coherence with international agreements, in particular with SeaDataNet NODCs, and documented in common Catalogues (e.g. Sextant[20]).
- Product Validation/Assessment: Assessing the consistency of the data over a period of time and an area to detect data not coherent with their neighbours but which could not be detected by automatic QC.
- Product Distribution: making the data available within the CMEMS INSTAC to ROOSs and EMODnet Physics (internal distribution) and external users (external distribution).

Figure 20 shows INSTAC core functions.

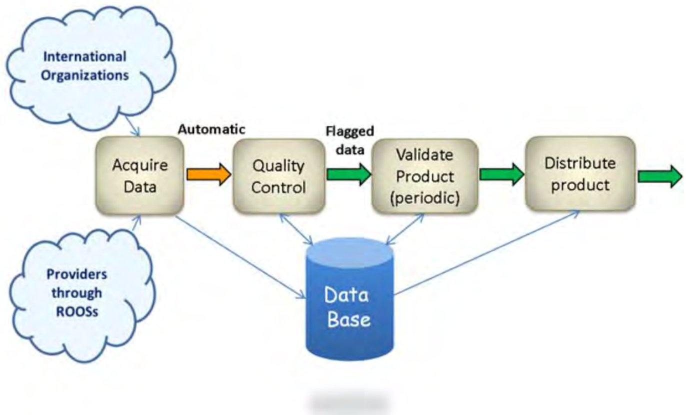


Figure 20. INSTAC core functions.

[20] http://sextant.ifremer.fr/en/web/emodnet_physics/catalogue

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 single data access point to bundle available data into an integrated dataset for validation and distribution (where validation follows 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 new data on its regional FTP portal. The data file format is an implementation of NetCDF OceanSITES format.

The EMODnet Physics portal routinely (three times a day) collects new data files from all RDACs and makes these available for discovery, pre-viewing, downloading (NetCDF and ASCII csv), and machine-to-machine interoperability (WMS, WFS and web services). The EMODnet Physics portal does not apply any further quality control: the quality control is under the responsibility of RDACs.

Figure 21 shows dataflow interconnections. EMODnet Physics portal monitors the data flow, metadata consistency, system performance assessment, etc. by means of an online dashboard and several indicators. The figure also shows the source for the ice product: starting from the Copernicus CMEMS - SEAICE_GLO_SEAICE_L4_NRT_OBSERVATIONS_011_001 product, EMODnet Physcis created a product in which the user can check the ice coverage from January 2013 in combination with the position of in situ platforms. The product is updated daily.

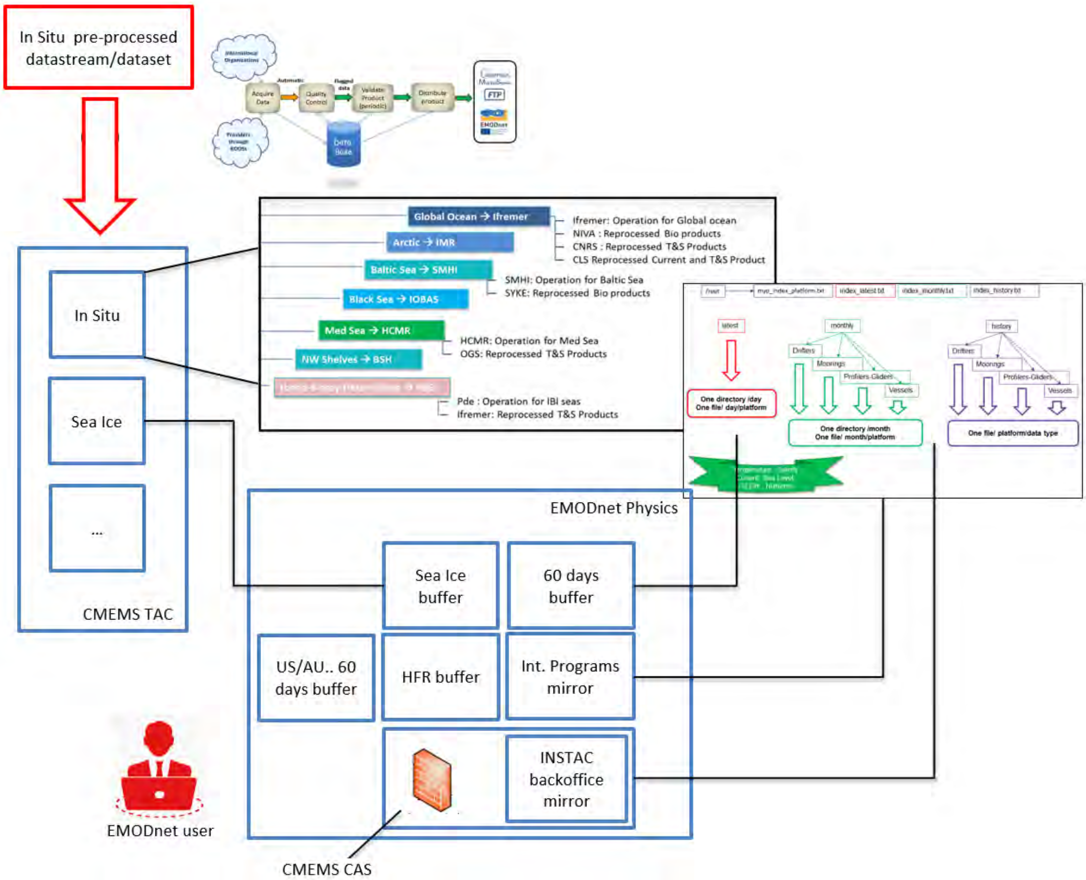


Figure 21. EMODnet Physics NRT dataflow and management

Figure 21 also shows the data flow for the long-term time series and historical reprocessed data (INSTAC and SeaDataNet joint products) – i.e. the best quality copy of an observation for that platform.

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 (Figure 20). A further validation and quality control takes place when the data are passed on to data centres for long-term storage and stewardship, in particular the NODCs execute the following core functions[21]:

- Data Quality control, more specifically detection of missing mandatory information; detection of errors made during the transfer or reformatting; detecting duplicates; detection of remaining outliers (spikes, out of scale data, vertical instabilities etc.);

[21] http://www.seadatanet.org/Standards-Software/Data-Quality-Control

- Data Validation/Assessment: assessment and labelling of individual data values by QC Flags
- Data Distribution

Download of datasets hosted by NODCs is arranged by means of the SeaDataNet CDI Data Access and Discovery service.

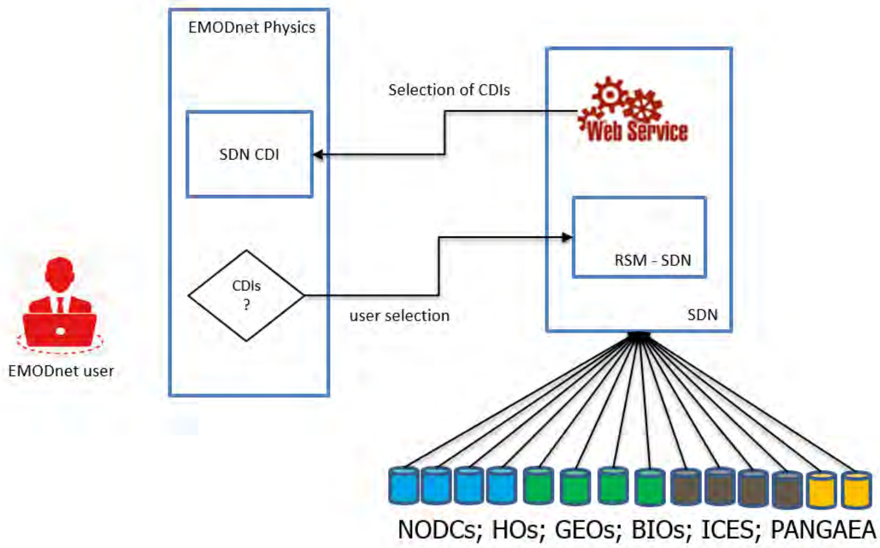


Figure 22. EMODnet and SeaDataNet interoperability scheme

- **EMODnet Physics Metadata**

Metadata give a detailed insight of the availability and geographical extent of marine data and description of individual data sets and measurements with key fields (what, where, when, how, who etc.). Metadata are fundamental information to come together with data in order to provide the user with the information and links to data producer. Metadata for data produced within the EuroGOOS ROOSs and SeaDataNet NODCs are fully described.

During the contract time, EMODnet Physics was able to interact more and more with providers who are working under international data network umbrellas and the number of platforms connect to the portal largely increased. Some of these networks are transmitting only a limited number of metadata (Table 3) while the full metadata is hosted and managed by international organizations. The most important is JCOMMOPS (Joint Technical Commission of Oceanography and Marine Meteorology in situ Observing Platform Support Centre).

JCOMMOPS maintains information on relevant data requirements for observations in support of GOOS, GCOS and the World Weather Watch of WMO as defined by the appropriate international scientific panels, and JCOMM Expert Teams and Groups, and routinely provides information on the functional status of the observing system. It also encourages platform operators to share data and distribute it in real-time and gives technical assistance with satellite data acquisition, automatic data processing and Global Telecommunication System (GTS) distribution of the data.

JCOMMOPS is the focal point keeping track of the open ocean platforms, and so it hosts and manages the international registry for ARGOs, gliders, research ships, DBCP (data buoy cooperation panel), GLOSS (global sea level stations) etc.

EMODnet Physics and JCOMMOPS are now collaborating and sharing information in order to support each other, better track metadata and information.

Common QA/QC protocols as well as best practices have been collected and made available on the page http://www.emodnet-physics.eu/portal/bibliography.

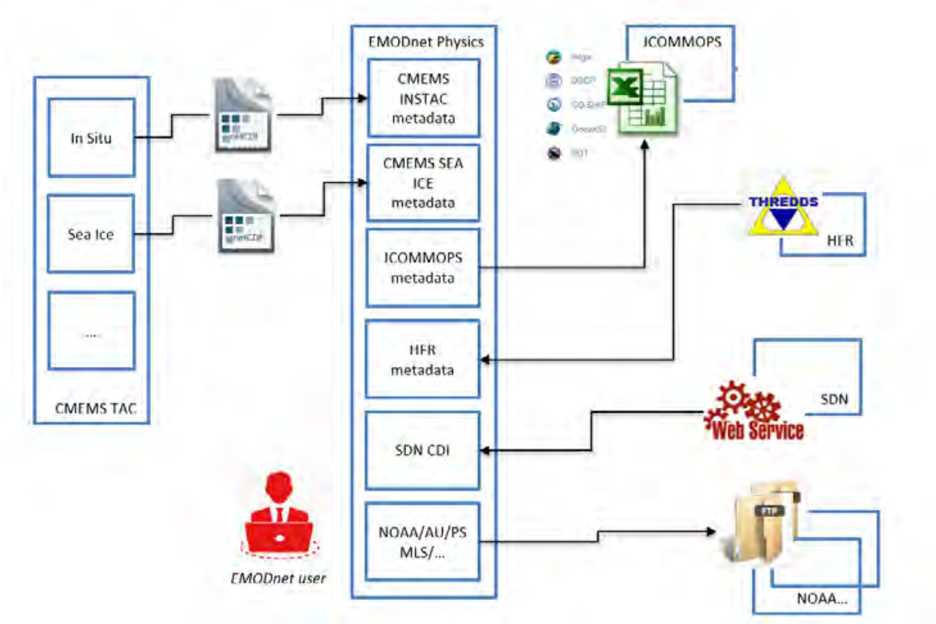


Figure 23. EMODnet Physics metadata flow

Figure 23 shows how EMODnet Physics is receiving and managing metadata from various sources. In detail: metadata of the European platforms are coming either from the INSTAC or SeaDataNet CDIs; metadata of the European network of HFR are directly managed by EMODnet Physics (until CMEMS INSTAC includes HFRs); metadata of open ocean and international data networks are managed by JCOMMOPS (and also available at the GDAC); and metadata of non-European coastal platforms are directly harvested from the data files (when available).

- **data access and products**

Table 5[22] shows the EMODnet Physics data availability. Data and product access and download is managed by the Dynamic map page (a detailed user guide is available on the web site).

Table 5 – available time series (01/06/2016)

parameter group	Water Temperature	Water Salinity, Conductivity, Density	Currents	Light Attenuation, Absorption, Fluorescence, Back Scattering	Sea Level	Atmospheric Parameters	Other Parameters	Chemical Parameters	Wave	Winds
Number of platforms providing operational data for latest 60days	6389	4087	106	46	512	1877	4893	642	462	858
Number of platforms providing operational data	9491	5004	145	60	589	2769	6924	1467	495	862
Number of platforms providing historical datasets	7106	4001	124	46	333	2031	4733	622	195	275
Number of platforms providing historical validated data (CDIs)	440	133	365	35	397	41	206	18	172	38

[22] http://www.emodnet-physics.eu/map/dashboard/Section16.aspx

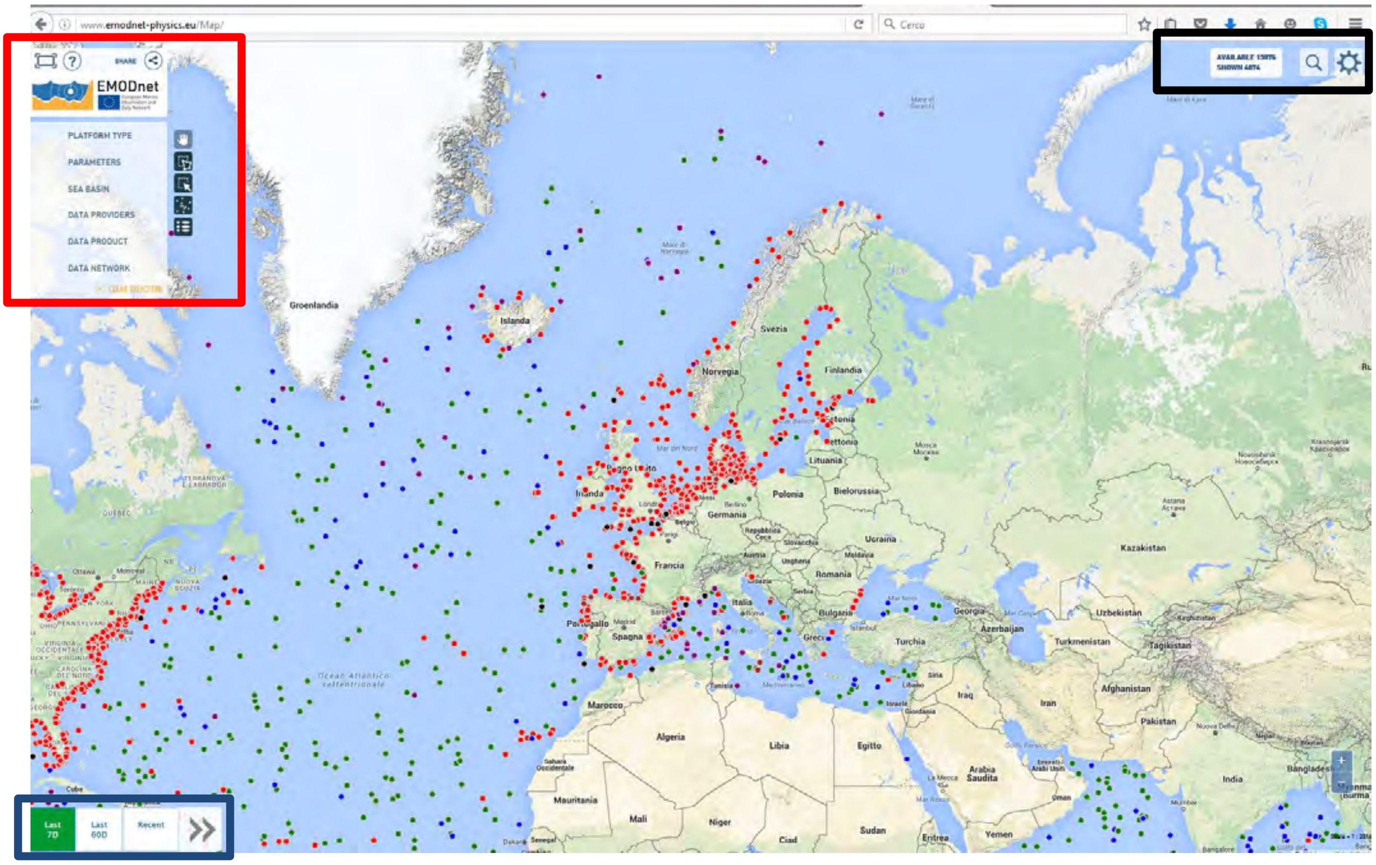


Figure 24. EMODnet map page

Briefly, the map has three control-filter areas (red, blue and black) and each platform (circle) is interactive (Figure 24). The red area provides the user with filters (parameters, platform type, sea basin, etc.) to subset the selection and create a list of the selected platforms. It also provides links to Sea level trends, Ice and Ferrybox products. The blue box provides the user with a filter to define the time window of interest. The black box provides the user with search tools (by name, by latitude and longitude) and some external layers (e.g. bathymetry).

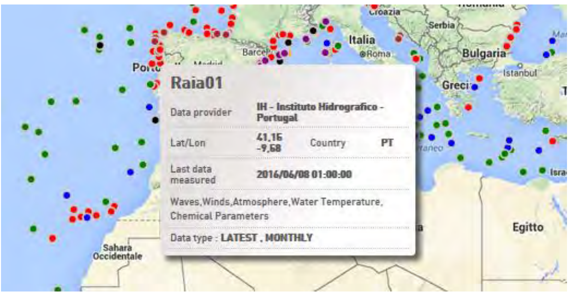


Figure 25. Platform metadata

If the user points to a platform, a window pops up and shows the platform metadata (Figure 25). If the user clicks on the platform, EMODnet Physics opens the platform page that was specifically designed according the typology of the platform to better match the interest of users of the data networks (ARGO, HFR, etc) and providers (Figure 26, Figure 27, Figure 28). These pages provide the user with metadata (left), plots, download features, platform products – e.g. monthly averages (Figure 29) – or wind plots (Figure 30), more info and links, as well as statistics on the use of the data from that platform.

Figure 26. Fixed Station page. The user can pass from the parameter group plots to the other parameter group plots by clicking the parameter symbol (red box).

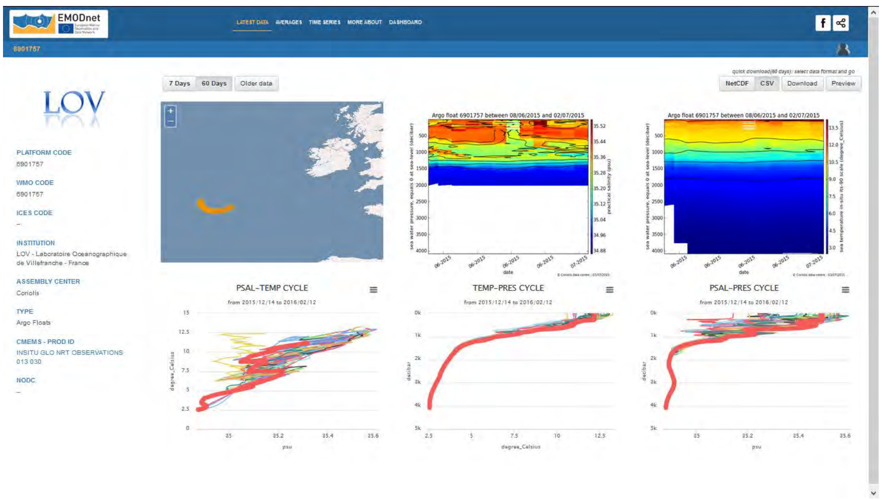


Figure 27. ARGO platform page

Figure 28. HF Radar platform page

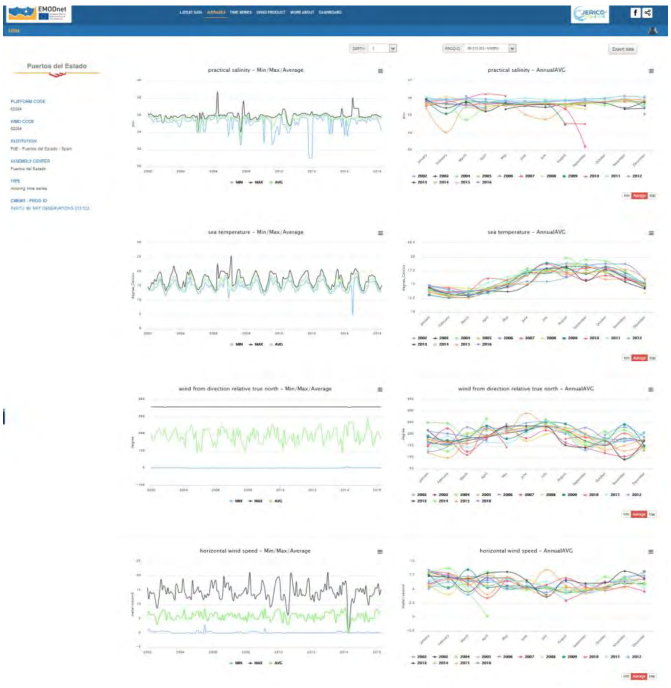


Figure 29. Example of the monthly data summary from the EMODnet Physics (platform 62084) - http://www.emodnet-physics.eu/map/platinfo/pimeanmaxmin.aspx?platformid=7340. Once the monthly file is available, the system also makes a data summary available (i.e. average, maximum and minimum) for the available parameters

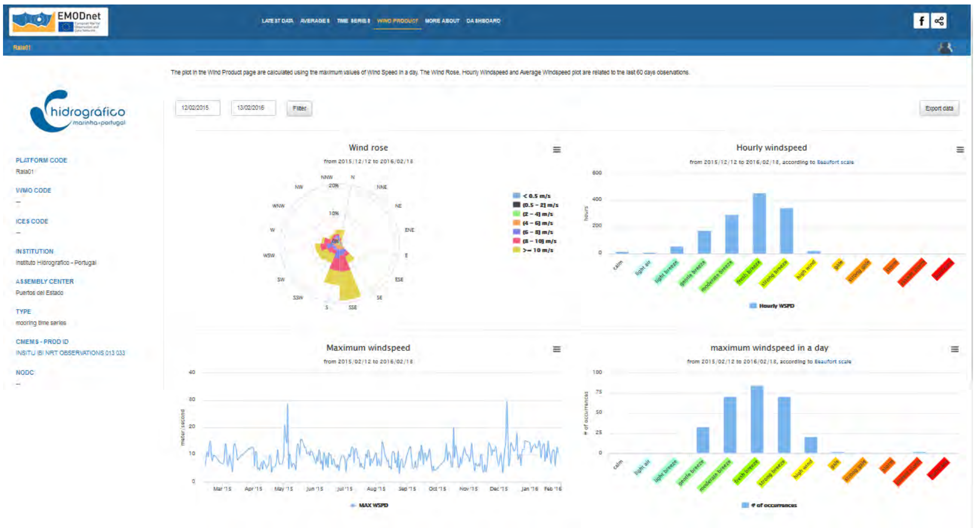


Figure 30. Wind plots

EMODnet Physics manages two types of product: platform products and other products. While the platform products are accessible via the platform page (e.g. averages or wind plots), the other products are presented on specific pages.

The “ferrybox” product shows the selected parameter values along the ferrybox route (Figure 31). If the user clicks the route, the system opens the ferrybox page (Figure 32).

The ice product is based on the CMEMS - SEAICE_GLO_SEAICE_L4_NRT_ OBSERVATIONS_011_001[23] and the in situ platform in the Arctic area. The user can discover the ice parameter (sea ice concentration, sea ice edge, sea ice type) time series for the past 3 years, as well as open and access the displayed in situ platforms page (Figure 33).

[23] The OSI SAF delivers three global sea ice products in operational mode: sea ice concentration, sea ice edge, sea ice type (OSI-401 OSI-402 and OSI-403). The products are delivered daily at 10 km resolution in a polar stereographic projection covering the Northern Hemisphere and the Southern Hemisphere. It is the Sea Ice operational nominal product for the Global Ocean. In addition, a sea ice drift product is delivered at 60 km resolution in a polar stereographic projection covering the Northern and Southern Hemispheres. The sea ice motion vectors have a time-span of 2 days.

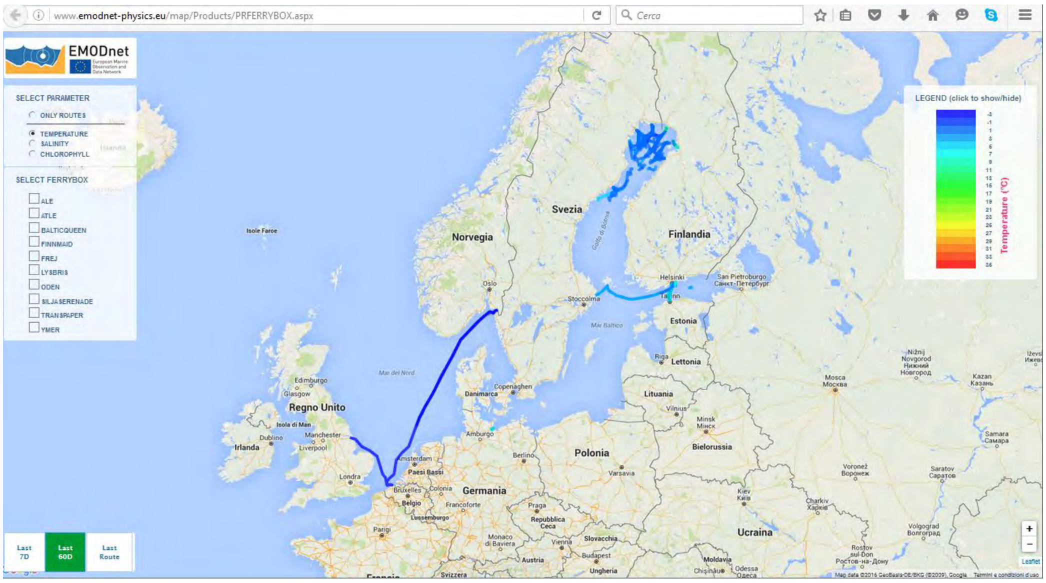


Figure 31. Ferrybox – parameter vs route plot

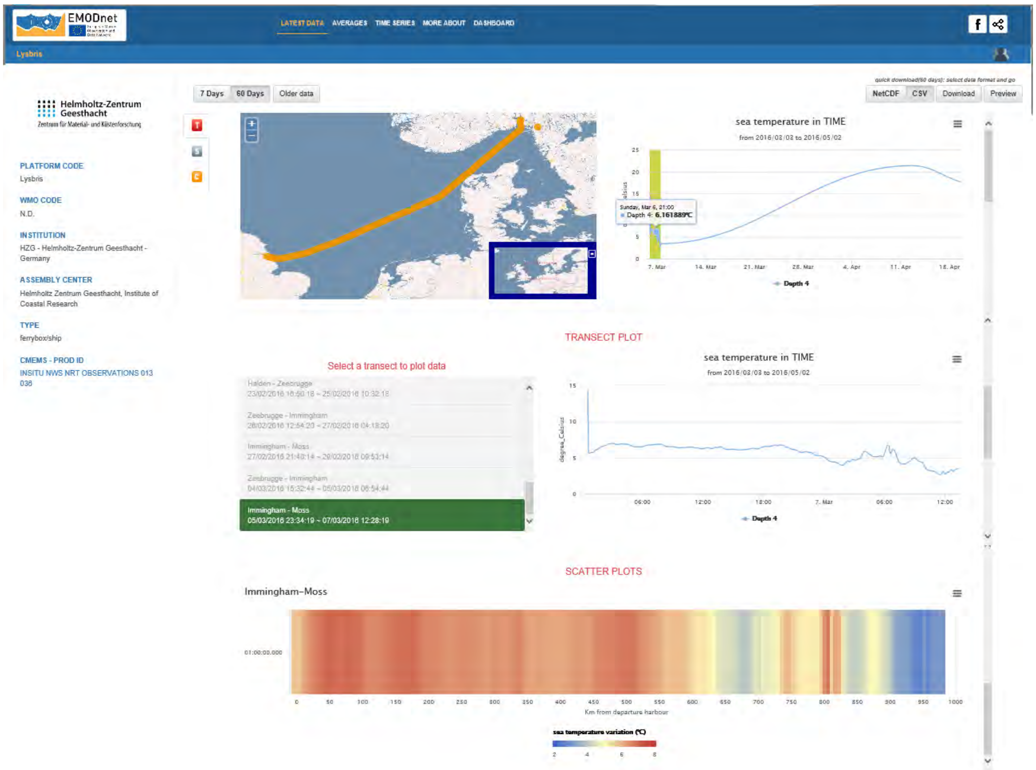


Figure 32. Ferrybox page

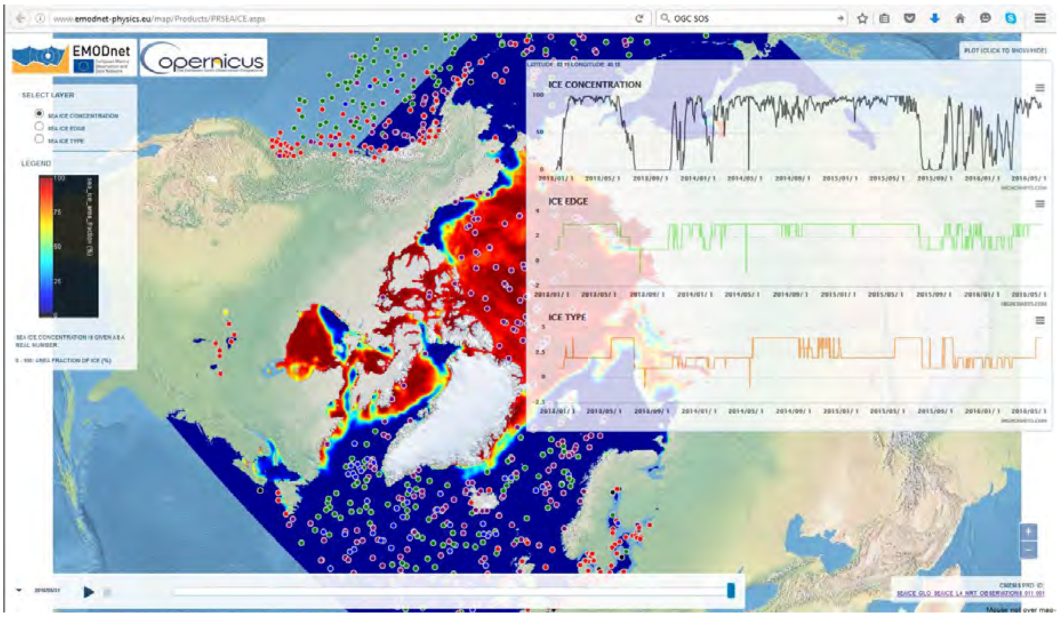


Figure 33. EMODnet Physics Ice product page. If the user selects a geospatial point the system shows the timeseries for the three parameters of the ice product (concentration, edge, and type)

The sea level trends page (Figure 34) is based on the Permanent Service on Mean Sea Level (PSMSL)[24]. The mean sea level (MSL) trends measured by tide gauges are local relative MSL trends as opposed to the global sea level trend. These trends are not corrected for land movement. Tide gauge stations measure Local Sea Level, which refers to the height of the water as measured along the coast relative to a specific point on land. If the user clicks on one of the platforms, the system opens the platform page and shows both the monthly and annual sea level trends (Figure 35).

EMODnet Physics delivered an analysis of the Sea Level Indicators that is available on the portal[25].

[24] http://www.psmsl.org/products/trends/

[25] http://www.emodnet-physics.eu/portal/documents-and-services

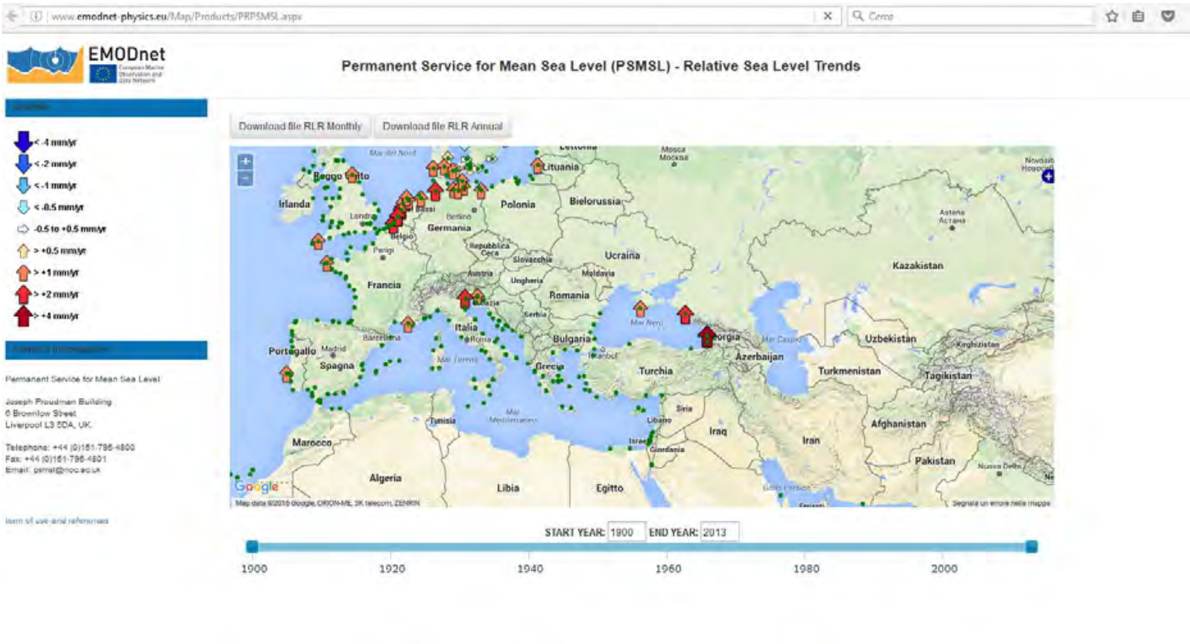


Figure 34. EMODnet Sea Level trends product page

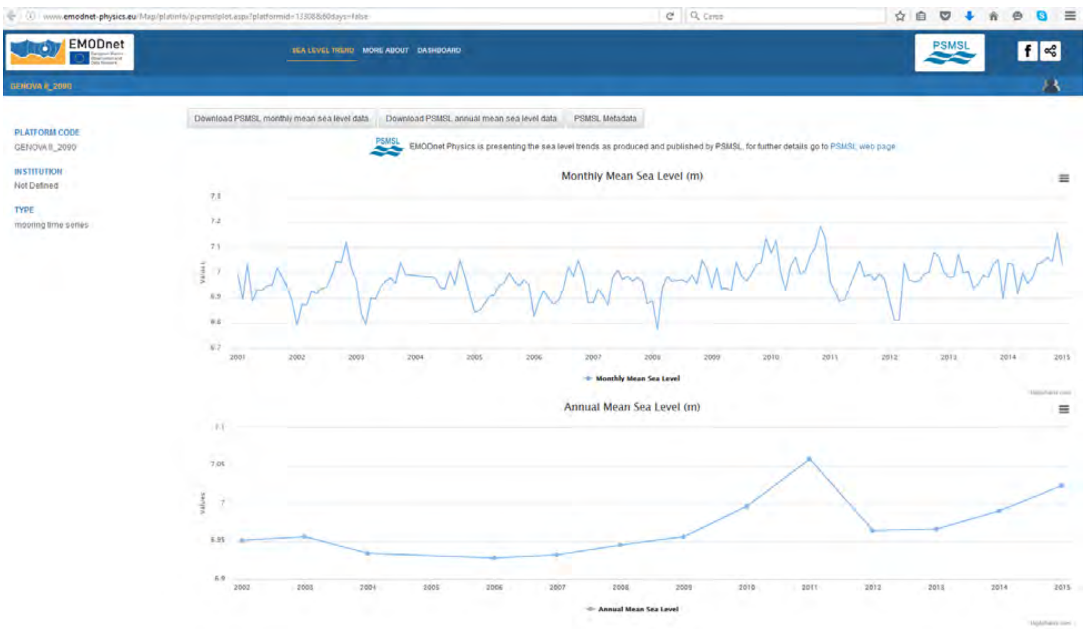


Figure 35. EMODnet Sea Level trends platform page

4. Challenges encountered during the project

Provide an overview of the main challenges encountered during the project and the measures taken to address them (max 2 pages, preferably in table format). Conclude with a summary of remaining challenges that require attention in the next phase.

1. Increase the availability and access to validated historical datasets

Validated historical datasets are made available via the EMODnet Physics back-office infrastructures:

- the CMEMS INSTAC is building historical products on a global and regional scale by combining four main sources of observations:
  - Historical data from JCOMM global networks,
  - SeaDataNet historical aggregated products from NODCs. At the moment this is done for Temperature & Salinity periodic synchronisation with US-NODC
  - direct update from EuroGOOS ROOS data providers, especially operational monitoring institutes that are not connected to the SeaDataNet network of NODCs

  Duplications between various data sources are managed at INSTAC level, and integration of data gathered directly from data originator are favoured except when data are distributed through Global Data Repositories such as ARGO, OceanSites or GOSUD, as the Network data system has been organised to provide the best version of the observation through these portals.

2. the access to validated archived data sets is arranged by means of the SeaDataNet CDI Data Access and Discovery service.

EMODnet Physics is making discoverable platforms with the CMEMS INSTAC historical products (as defined above) and 11,757 Common Data Index (CDI) from 879 fixed platforms (which are directly connected to the SDN Request Status Manager for data download from NODCs).

The number of CDI is still very limited and EMODnet Physics has to keep working in coordination and collaboration with both EuroGOOS ROOSs and SDN NODCs in order to improve the dataflow method and facilitate NODCs to harvest data from the operational flow, validate, create CDI and make validated datasets available in the system. As planned, two champions (IFREMER and SMHI) were identified for proofing the concept that has to be implemented during the next phase.

2. Harmonise data access when/if user identification is requested.

Although EMODnet Physics is supporting an open and unrestricted data access, some data older than 60 days may require user identification.

Data access is managed in coordination and cooperation with the CMEMS INSTAC, that developed and maintains operational tools to gather and carry out quality control in a homogeneous manner on oceanographic operational data. For the datasets that are older than 60 days EMODnet Physics is requesting the CMEMS user identification. EMODnet Physics interoperates with the CMEMS CAS service and is able to accept or reject the user, while providing the CMEMS with statistics on user selections.

EMODnet Physics also makes available 11,757 SeaDataNet Common Data Index (CDI) from 879 fixed platforms. Each CDI is fully describing a specific dataset with high quality control and validation procedures and it can be retrieved via the SeaDataNet – Request Status Manager (RSM) system. The access to the SDN RSM is managed by the MarineID CAS service.

A comparison between the two Service Licence Agreements is shown in annex 6.

Facilitating access to data has been carried out with the following countries and institutes in collaboration with EuroGOOS to encourage data integration within the CMEMS INSTAC and/or SDN NODCs:

- Turkish data – most of the marine data collected in Turkey belongs to the army and hence have restricted access. This restricted access also applies to marine institutes within Turkey. There is, however, an increased interest of sharing data from marine institutes not affected by the army's data restrictions. In coordination and collaboration with EuroGOOS, EMODnet Physics is following up with these institutes.
- IZOR (Croatia) which was only able to release data from HF Radar, while data from fixed stations along the Croatian coast are still restricted and inaccessible because of the specific programme that is funding the network.
- Cyprus fixed buoys: data are often visible (institute web site) but not accessible due to internal data policies.
- Poland: only the Sopot fixed platform is delivering data thanks to a specific action (supported by EMODnet Physics) to create the interoperability infrastructure and services between the IOPAN and Baltic INS TAC. Some Polish data are made available to, and restricted to, the BOOS community.
- UK/CEFAS, where data often are visible but not accessible due to internal data policies.
- Norway, institutes hosting (mainly) archived data are re-organising themselves at national level before making these marine data accessible to all users.

- Northern African countries. Restrictions due to national issues/internal data policies. Data sharing concept not as advanced as in Northern Europe with a couple of exceptions, e.g. Morocco.

4. Loss of platforms and data.

The most relevant case is the Italian Tide Gauge Network that was linked to EMODnet Physics in June 2013 and between December 2014 and early 2015 ceased to deliver data because the responsible institute (ISPRA) was not able to keep up maintenance.

The same is happening in other Member States e.g. in Greece the POSEIDON system is now providing data from only 3 out of the 10 fixed network platforms.

5. European Directory of the Ocean-observing System (EDIOS)

EDIOS is a searchable metadatabase for information on observing systems operating repeatedly, regularly and routinely in European waters, and it contains metadata on European observing systems such as platforms, repeated ship-borne measurements, buoys, remote imagery, etc.

The planned review and updating of the EDIOS was postponed in order to work on the management of a continuous data flow from the near-real-time (for operational purpose) to data qualification and historical preservation (for further uses). Unfortunately because the station codes and names (platforms ID) are not harmonised (or sometimes not even provided), the process is not straightforward. Two actions that were adopted and under development are:

- recommendation for and development of a unique PLATFORM ID in collaboration with the DATAMEQ[26] (if the platform WMO code is available that is the unique ID, otherwise it is the ROOS code);
- support for the update of the SeaDataNet C17 platform code directory, which aims to be an overarching catalogue of platform codes in use (combining code lists from ICES, WMO and others), harmonising and facilitating improved discovery.

[26] http://www.eurogoos.org/content/documents.asp?menu=0050000_000015_000000

5. Analysis of performance and lessons learned

Analyse and describe (i) the performance; and (ii) the lessons learned during the project (min 5 - max 15 pages). The performance can be described against the general objectives established in the call for tenders MARE/2012/10 (point 2.2) and against the items listed specifically for each thematic lot (point 2.4), but do not have to be limited to those aspects. Lessons learned should cover items listed in point 2.5.14 of the tender specifications.

- *The performance of the chosen portal technology in terms of speed of response, user-friendliness.*

Enabling data discovery and the download of currently more than 12,000 platforms providing both near real time and historical datasets (Figure 36), with more than 180,000 downloads during the past three years, and with more than 140,000 page views during the past two years (Figure 37), EMODnet Physics is developing according to the evolving needs of its users. These results confirm the appropriateness of the chosen portal technology in terms of both speed of response, and user-friendliness as well as they confirm the importance and need of continuous work on portal technology, graphical user interface, and machine-to-machine services updates.

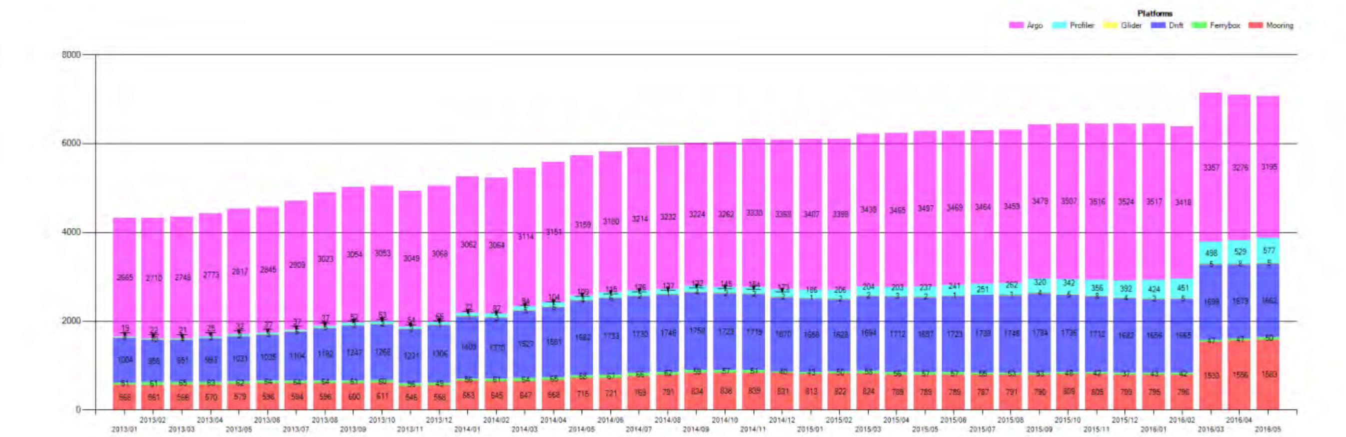


Figure 36. Connected platforms (monthly file datasets) since Jan 2013[27].

[27] http://www.emodnet-physics.eu/map/dashboard/Section19.aspx

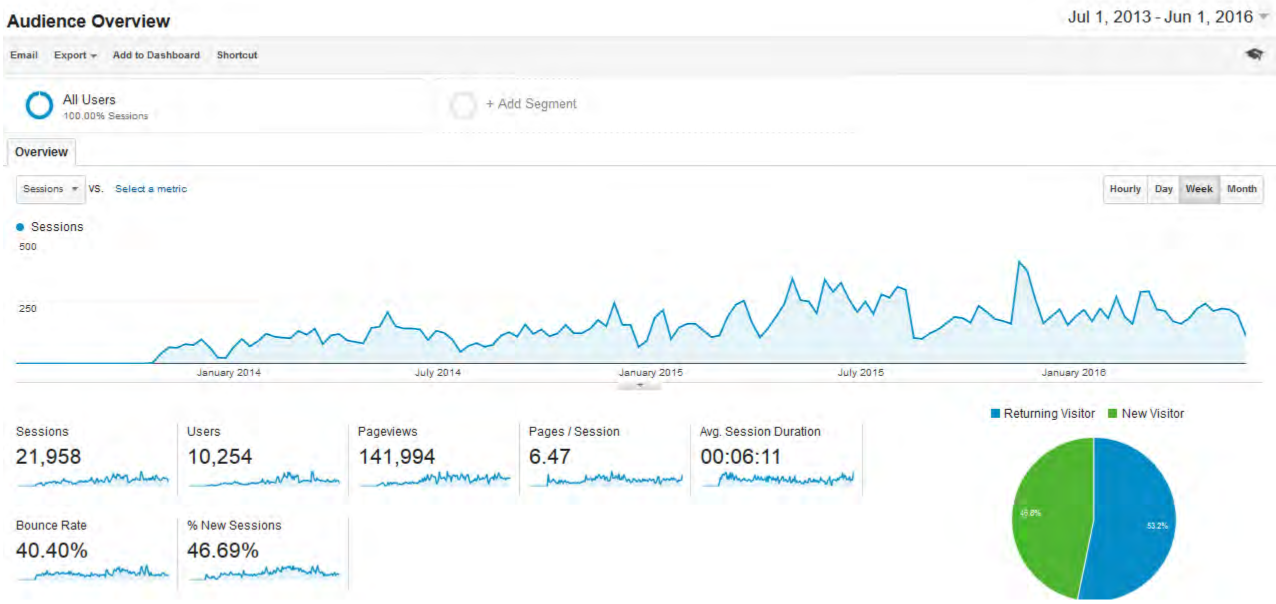


Figure 37. Google analytics of EMODnet Physics map page. The tracing was activated mid November 2014.

EMODnet Physics received 20 notifications in 3 years. They can be grouped as follow: users identified errors in metadata (60%); users had a technical problem to download data or use one of the interoperability services (30%); and one user notified an error in data coming from one platform.

The 85% of the notifications were resolved in one day, 10% in one week, 5% took more as they needed to involve the regional level (i.e. ROOS and CMEMS INSTAC DAC) to be fixed.

- *The challenges to rendering data interoperable including different measurement techniques, different baselines, different standards, different nomenclature etc. The contractor should indicate what steps that might be taken by data holders or the portal operator to improve interoperability*

While networks have built on strategic scientific and technical requirements, with design and implementation plans, others are voluntary communities that promote standards and best practices.

At the European level, cooperation and coordination between EMODnet Physics, EuroGOOS-ROOSs, CMEMS and the SeaDataNet network of NODCs is reaching important results on the harmonisation of data formats, standards and qualification procedures of some networks (e.g. the European fixed stations and mooring buoys).

At the global level, data management procedures have been defined at programme level, and often agreed at international level, by JCOMM (Joint Technical Commission for Oceanography and Marine Meteorology).

Data acquired by autonomous networks already have their own data system to curate and preserve them, generally in the context of international programmes (e.g. Argo, Ocean-Sites), which have defined the (still evolving) good practices with respect to data collection, quality control and distribution.

The most challenging activity for EMODnet Physics is to cooperate with these networks, in order to have better metadata exchange and establish a more sustained dataflow from the identified national or international data repositories as soon as they are operational. This will facilitate data availability for users; GO-SHIP, for example, is working on establishment European data centre for ADCP data and EMODnet is not yet connected to these data. When a dataset exists in multiple repositories, it is important for EMODnet Physics to provide users with the proper information (e.g. the same data is present here and there, some data are coming from a repository, other data from a different repository – which could be the case of SOOP data –, EMODnet is not connected yet to these data, etc.)

The willingness of data providers and data networks to work on interoperability and free and open data exchange is fundamental. EMODnet Physics, as well as EuroGOOS, CMEMS, SeaDataNet and other international organizations and initiatives, have to work and cooperate in order to update the dataflow. One example is glider data. EMODnet Physics is connected to a limited amount of glider data (about 20 gliders, 7 of which are operational and are transmitting data) and is currently only presenting glider data transmitted to the INSTAC, while much more real-time data is delivered as text messages (unstructured and unqualified data format) via the Global Telecommunication System, GTS. It is worth mentioning that the glider community has recently defined standards and data management[28] to fit the needs of the glider community.

A basic level of interoperability is to update the systems with new interoperability services and techniques e.g. OGC (Open Geospatial Consortium) SWE (Sensor Web Enablement), ISO, NetCDF and IODE standards, as well as provide data (be connected) to the networks in common standards:

- Fixed stations: NetCDF format, SeaDataNet vocabulary, CF convention variable
- Argo: NetCDF format, SeaDataNet vocabulary, CF convention variable
- Surface drifter: Standards and data management established by JCOMM/DBCP
- Deep ocean observatories: FixO3 data policy (based on OceanSITES policy), NetCDF format and ASCII;

[28] http://www.coriolis.eu.org/Observing-the-ocean/Observing-systemnetworks/EGO-gliders/EGO-Glider-data-management/A-NetCDFimplementation-for-glider-observations

- Glider: Standards and data management of the EGO COST Action ES0904 and FP7 GROOM

On top of these common standards, EMODnet Physics can develop and provide a further level of interoperability tools such as WMS, WFS, web services etc. as it is already doing[29], in order to make these data accessible, discoverable and usable by a wider community.

Common QA/QC protocols as well as best practices have been collected and made available through the page http://www.emodnet-physics.eu/portal/bibliography.

- *The challenges to producing contiguous data*

EMODnet Physics is developed on in situ data that are processed by providers and INSTAC, and observation products are made available to users who can assimilate data to run a model or use observations to validate/update models periodically. In situ observations may be used to validate satellite observations, and physical in situ observations can be correlated with other phenomena / data, etc.

EMODnet Physics is presenting continuous data for the platforms that are delivering continuous data, for instance HF Radar are delivering in situ continuous data (Figure 28), ferryboxes are recording and delivering continuous in situ data - EMODnet Physics is presenting the data in scatter plots (parameter along the route) (Figure 38) and in time-series plots (parameter vs time/distance) (Figure 32).

[29] http://www.emodnet-physics.eu/map/Service/WSEmodnet2.aspx

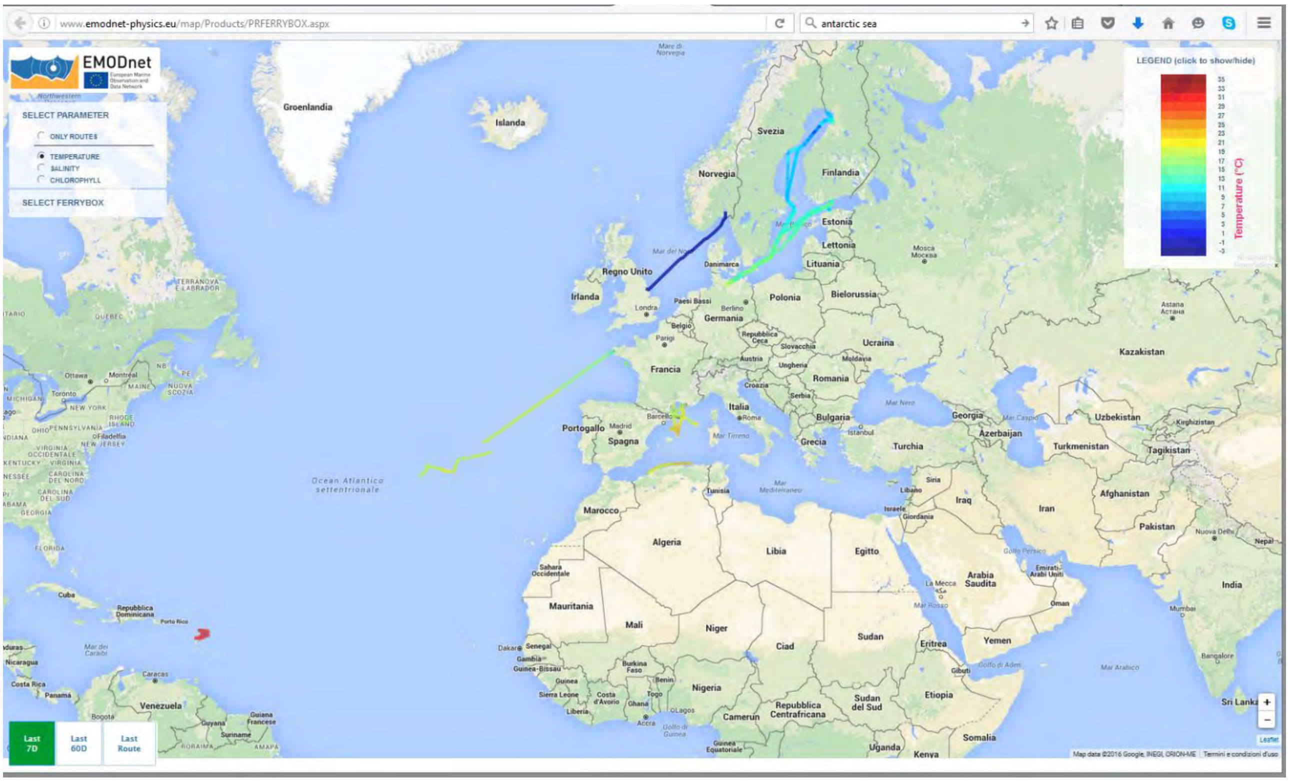


Figure 38. EMODnet Physics ferryboxes and ships contiguous data product.

More generally, EMODnet Physics is developed on in situ data and makes observation products available to users that can use them to create continuous gridded data. Therefore, over recent years, activity has been focused on making more in situ data available and creating in situ products (e.g. monthly averages, monthly peaks, wind plots, etc.) as well as on developing up to date machine-to-machine tools to enable users to assimilate the in situ data and create their own situations.

Although making one-dimensional interpolations available can create problems related to the increase of errors (see the “Annex 2. Producing contiguous data” for a more exhaustive description), they can provide results that can be quite easily and clearly interpreted. It is very different for 2D, 3D or even 4D interpolations. The scientific community is very active on this topic with various methods and different interpretations could be applied to the same dataset. The final products must be agreed by a practical community and is out of scope for EMODnet Physics.

- *The fitness for purpose of the data for measuring ecosystem health of the maritime basin*

The cost-effectiveness, reliability and utility of the existing monitoring and data integrator infrastructures (e.g. EMODnet Physics) is under assessment by the DG MARE EMODnet Sea Basin Checkpoints. The Checkpoints are assessing the quality of the current observation monitoring data at the level of the regional sea-basins and by testing the data against specific end-user challenges, they are determining whether the available data and products are meeting the needs of industry and public authorities.

For instance, the EMODnet Mediterranean Sea Check Point (MSCP) assessed the performance of EMODnet Physics in terms ISO 19115 quality elements that are including ‘availability indicators’.

Table 6 shows the assessment of EMODnet Physics done by EMODnet MSCP for 14 characteristics used for their challenges:

Table 6 - EMODnet MSCP performance assessment of EMODnet Physics

EMODnet Portal	# data sets	Data Policy	delivery time	format	cost	Access
Physics	14	Unrestricted	< 15 min	various	no charge	on-line downloading + advanced

For the availability indicators, EMODnet Physics portal was assessed as ‘green’, i.e. satisfying all user requirements.

The assessment can be concluded with the analysis of appropriateness of the data for specific use cases (what is called fitness for purposes / uses).

In this context, without entering into a debate on the definitions of ecosystems and ecosystem health, it is pragmatically accepted that Ecosystem health is a determination of changes or trends with respect to some reference conditions. Considering the EMODnet Physics contract, two examples (sea level changes and energy of the sea) were studied to assess the ‘usability’ of EMODnet Physics data and features. For sea level data, important work has been done to assure relevancy, reliability, adequacy, comparability and compatibility of data. The study (see Annex 3) indicates that EMODnet Physics can provide data to develop different products that can support the ‘blue economy’ or environmental management. Due to the objectives of the existing monitoring systems, this cannot be assured to other data, therefore EMODnet Physics refers to the EMODnet Sea Basin Checkpoints for a more exhaustive and complete study of the fitness for purpose.

- *what might be done to overcome any shortcoming for measuring ecosystem health*

The oceanographic community is asking for and already working on some key actions:

- Improving the extent, completeness and ease of access to marine data required by industries and agencies supplying products to industry (e.g. environmental and productivity information for sea-culture and fishing, pollution and operational weather forecasting for offshore energy and mining) and citizens directly (e.g. weather forecasts, water quality predictions, marine food safety). The improvement in quality and access to data will reduce costs and delays in existing industries and promote the development of emerging markets and practices (e.g. seabed mining, offshore aquaculture).
- Implementing more cost-effective multi-use platforms with improved capability and durability, measuring synchronously more interlinked variables (physics, biogeochemistry and biology), improving accurate and timely data delivery, and by systematically filling observational gaps for specific under-sampled areas.
- observing communities within existing networks observing EOVs including international expertise in the design and development disseminate best practices, harmonising data processing and quality control procedures.
- Closing the gap between continental shelf and deep-ocean observing networks and closing the gap between near real time observation delivery and its high-level qualification and long-term preservation.
- Promoting free-sharing of observing data at all levels (local, national, European and international)
- Defining a European policy for funding data acquisition that involves and considers both national and international programmes, agreements and conventions.

There are some specific actions to be done to improve accuracy and precision. It has been underlined that for some international initiatives (e.g. sea level, ARGO, OceanSites/FIXO3) the communities are making their data comparable and compatible. This is still a challenge for the coastal data collected at national or sub-national level. There is a need for dedicated action to compare data from different sources and very different areas. This ‘**data inter-comparison exercise**’ is especially important to assess the monitoring systems in the framework of the directives WFD and MSFD.

Some new products should be developed, combining in situ data, model outputs and satellite data. For example, the influence of rivers on ecosystems can be derived from a combination of in situ data and satellite ‘colours’ and ‘SST’.

- *The main barriers to the provision of data by data holders*

An impact assessment included in the EU communication “**MARINE KNOWLEDGE 2020 – marine data and observation for smart and sustainable growth**” estimates that the collection of marine data by public institutions in EU Member States costs more than €1 billion annually, with a further €0.4 billion for marine related satellite data. It also states that these data are largely collected with a specific purpose in mind – for instance to test a scientific hypothesis, to exploit marine resources, to ensure safe navigation, or to monitor compliance with regulations.

The slogan “capture once – use many times” is increasingly adopted to promote this concept. In order to make best use of these data for science and for society, a robust operational infrastructure based on widely agreed standards is required, covering data quality, easy access and long term stewardship as well as the technical and semantic aspects of interoperability.

It is worth mentioning that there is also an increasing requirement for the delivery of operational data in (near) real time for forecasting marine conditions and supporting operations at sea, as well as for protection of the seas and a recent public consultation concluded that users continue to find it hard to discover what data already exist.

This can be due to restrictions on access, use and re-use, or the pricing policy of some providers. Moreover, fragmented standards, formats and nomenclature, lack of information on precision and accuracy, and insufficient temporal or spatial resolution are further barriers.

Narrowing down to EMODnet Physics, in some cases convincing the data originators to disseminate their data through a European data infrastructure remains a challenge. Here are some of the main barriers noted regarding the provision of data by data holders, as well as some action already take to facilitate data sharing:

Table 7. Barriers and adopted actions

Barriers	Adopted actions
- Data providers are worried about losing the link to their users. Here EMODnet Physics and INSTAC can provide traceability of use and give feedback to data originators. - Data providers are worried about being criticised on the quality of their data if they provide non-polished data. - Some data originators have strict data policies and are unable to share. - Data are handled by military institutes and hence are not made available. - R&D data where data originator wants to publish before sharing. - In some institutes data are sold and hence they are not willing to share data that would compromise business. - Some organizations and scientists are concerned about "incorrect interpretation of [environmental] data."	- No extra costs for the data originator to share the data. EMODnet Physics/INSTAC to accept data in whatever format and do the transformation i.e. only need to be directed to the data source. Work from the data originator to enable release of data should be minimised. - To work on DOI for dataset to give full visibility to the operators. - To give time for scientists who collected these data to have the first opportunity to publish the results (e.g. a moratorium of two years). - It needs to be shown (part of EMODnet Physics activity) that in many cases it's the products based on the data that generate more funding than the data itself and hence releasing the data can attract new potential users and funding. - Present to data originators how they will benefit from sharing data o increased visibility o Data benefits the public good o Data boosts resilience o Data boosts the economy

Ocean observation is based on a growing number of in-situ observing infrastructures, mainly supported by national agencies for a specific information need. Often this is constituting a barrier as there is still a lack of coordination for sustained funding of ocean observation.

The issue of sustained funding of ocean observation in European member states is a hot topic: a number of recent studies (EuroGOOS) have demonstrated a striking reduction of number and activities of the European observing platforms. For instance, the new study by the EuroGOOS Tide Gauge Task Team has clearly demonstrated that about half of the European tide gauge systems are either lacking funding or have been stopped.

- *The priorities and effort required for improving the accuracy, precision and coverage of the data collated including a description of how an appropriate data quality assurance and control system can be established.*

- There is a gap between the automated collected time series, as acquired by network operators, and their validation and long-term archival and access provision by SeaDataNet data centres, which delays progress of EMODnet Physics targets and building of historical data products for re-analysis purposes;

- Connecting the near real-time observation data as included in the CMEMS INSTAC service (In situ Thematic Assembly Centre) and Regional Ocean Observation Systems (EuroGOOS ROOS's) with validated data as archived in SeaDataNet is complicated by using different platform codes. The work started in SeaDataNet II together with JCOMMOPS for a unique platform register needs to be continued;

- There is an increasing interest in the OGC Sensor Web Enablement (SWE) standards for streamlining the (near) real time data flows from platforms to data centres, to detail relevant metadata of these systems and data flows, and to facilitate easy access by means of Sensor Observation Services (SOS);

- the need to publish data in machine-readable formats.

6. Analysis of sustainability

Provide a set of recommendations describing what would be necessary for the overall EMODnet to remain as a sustained infrastructure. Items to be considered are indicated in point 2.5.15 of the call for tenders MARE/2012/10. The recommendations should take into account the outcome of the analysis of performance and lessons learned undertaken in the previous section of this report (Section 5).

EMODnet Physics does not operate in situ observing systems but collects observations in cooperation and coordination with EuroGOOS ROOSs, CMEMS INSTAC and SeaDataNet network of National Oceanographic Data Centres.

Operational oceanography in Europe was mainly initiated and sustained at national level before the 1990s. Since Framework Program IV, the European Commission (EC) has continuously supported research on integration and development of European operational oceanography monitoring and forecasting systems, some key programs were:

- Operational Forecasting Cluster projects (Cieslikiewicz et al., 2004[30]),
- MERSEA - Marine Environment and Security for the European Area (Johannessen et al., 2006[31])
- GMES - Global Monitoring for Environment and Security (Bahurel et al., 2010[32]), which is now transformed into the Copernicus Marine Environmental Monitoring Service (CMEMS, http://marine.copernicus.eu/) programme in the period 2015–2020.

In this framework, EuroGOOS and its ROOSs have played an active role in data exchange, sharing the best practice and knowledge, harmonising monitoring networks and forecasting systems, stimulating joint research activities. Development over the last 20 years has helped advance existing national services and establish new ones in many European countries.

---

[30] Cieslikeiewicz, W., Connolly, N., Ollier, G., and O'Sullivan, G. (Eds.): Proceedings of the EurOCEAN 2004, European Conference on Marine Science and Ocean Technology, Celebrating European Marine Science – Building the European Research Area – Communicating Marine Science, Galway, Ireland, 10-13 May 2004, 351–408, EC Publication, Italy, 2004

[31] Johannessen, J. A., Le Traon,P- Y., Robinson, I., Nittis, K., Bell, M. J., Pinardi, N., and Bahurel, P.: Marine Environment and Security for the European Area (MERSEA) – towards operational oceanography, American Meteorological Society, B. Am. Meteorol. Soc., 87, 1081–1090, doi:10.1175/BAMS-87-8-1081, 2006

[32] Bahurel, P., Adragna, F., 5 Bell, M. J., Jacq, F., Johannessen, J. A., Le Traon,P- Y., Pinardi, N., and She, N., J.: Ocean monitoring and forecasting core services, the European MyOcean example, in: Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society (Vol. 1), Venice, Italy, 21–25 September 2009, edited by: Hall, J., Harrison, D. E., and Stammer, D., ESA Publication WPP-306, doi:10.5270/OceanObs09.pp.02, 2010.

Thanks to these national- and EU-funded programs, we have seen major scientific achievements in the development of Earth Observation (EO) data management, short-term forecasting systems (including data assimilation) and reconstruction of long-term historical databases through reanalysis and reprocessing.

EuroGOOS ROOSs, CMEMS INSTAC and SeaDataNet is the wide EMODnet Physics network that is developing, adopting and adapting the best available standards and procedures for metadata and data flow (details are described in Section 3). This data flow includes the data owners/providers, the regional and inter-regional integration infrastructures, standardization and quality control, and open access and free access for the last 60 days of near real time data. Data from international programmes (e.g. ARGO) are free and open without any time window limitation. EMODnet Physics approach is successfully attracting more providers and users. Lately, it started cooperating more closely with main global networks from JCOMM (e.g. Argo, DBCP), providing more and better described data.

Table 8 shows the relevance and fulfilment of EMODnet Physics objectives and developments against relevance, efficiency, effectiveness, and impact indicators.

Table 8

Appropriateness	It is measuring how input data sets are fitting for the use. EMODnet Physics has only partially assessed the data appropriateness. In this report it is demonstrated that the data can be used for some products. A better assessment is underway in the Regional Checkpoints.
Availability	It measures the degree to which datasets are ready for use and obtainable appropriateness is measuring how input data sets are fitting for the challenges. Many actions have been coordinated within EMODnet Physics to make data easy accessible, free and open in an interoperable environment. Furthermore, the resources provided by DG MARE were converted, through a coordination of existing organizations, in outputs (data access) in timely and cost-effective manner. The result has been a consolidated partnership and synergetic exchange of resources, responsabilities were equally distributed and coordination very effective, data is provided in a timely manner.
Effectiveness	It is the extent to which data fulfils the intended use.
Efficiency	EMODnet Physics efficiency was evaluated and proofed by EMODnet Mediterranean Check Point in terms of ISO quality elements
Impact	EMODnet has been successful in constructing a strong collaboration among different communities operational and scientific. Practically a long term technical environment has been developed with institutions, programs and projects.

Usability	This means the extent to which data sets or data set series can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. Usability depends on applications and may vary on the base of data accuracy (a low accuracy could be requested for certain applications, while for others a quite high accuracy is required).
Relevance	Assess the importance of the portal regarding national, European and International initiatives. EMODnet Physics had the capacity to involve environmental agencies and groups working at national and regional level (e.g. the regional Conventions), as well as institutions from US and Australia.

These four elements have positive effects on sustainability (maintenance) of this infrastructure, with the model of governance established in terms of collaboration, coordination and cooperation between EMODnet Physics, CMEMS, SeaDataNet network of NODCs, and the EuroGOOS ROOSs.

In this framework, sustainable EU funding is essential in order to maintain data management, data discovery, data visualisation and data download of thematic data, as well as the capability of the thematic lot assemblies to unlock and make more (open and free) data available. It is also important to improve the infrastructure behind the portal (including quality control and standardisation) to guarantee quality and coverage of the products delivered by EMODnet, Copernicus and other relevant EU programmes, infrastructures and agencies.

The Regional level approach (i.e. EuroGOOS ROOSs – adopted, adapted and further developed by the CMEMS INSTAC) is likely to represent the best model to implement this policy.
It is important that long-term funding replaces financial support through research programmes for operational activities, while research programmes have to focus more on further technology and standards development.
A regional approach would also help in implementing more cost-effective multi-use platforms with improved capability and durability, measuring synchronously more interlinked variables (especially biogeochemistry and biology), improving accurate and timely data delivery, and by systematically filling observational gaps for specific under-sampled areas.
Member States are also playing a crucial role and national monitoring programmes are producing important and valuable data.

The entire EMODnet programme is based on the DG MARE institutional role, and only on this basis is the stakeholders' engagement likely to continue. This means that an evaluation of costs has to be done in terms of maintenance of data collection systems, networking and underlying infrastructures, including the EMODnet Physics Portal.

The EMODnet Physics outputs are a source of timely and up-to-date information about environment and security for the benefit of individual citizens and decision-makers not only in Europe but on a global scale. Sustainability is what citizens, decision makers and scientists want to have in the long term. It is based then on social, environmental and economic issues that must be analysed in a holistic way.

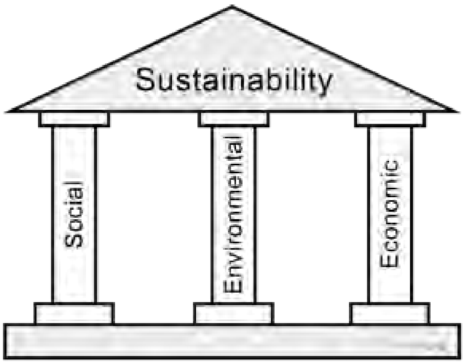


Figure 39 - The sustainability temple (from http://www.thwink.org/)

Various cost categories must be considered and assessed in order to see if an observing system is 'sustainable':

- Set-up costs (including infrastructure costs): these are the initial costs incurred when collecting, storing and publishing required data. These include investments for infrastructure. Here it is assumed that the set-up costs were covered in the past, and only infrastructure costs are considered in terms of 'labour' and 'other'.
- Operating costs (including maintenance costs): the operating costs are those costs incurred in order to carry out all the necessary activities to collect, store and publish required data.
- Data access costs. Data access costs can be two different cost types (included in consumables):
    - Licence costs for an external (commercial) database / data source that is purchased for use by the operator of EMODnet services (production or validation, etc.);
    - Costs that are specifically incurred to make data / information fit for purposes (e.g. make data available on the base of the indicators indicated in Mediterranean CheckPoint – an example is format).
- Co-ordination costs. These are costs incurred to coordinate the core service operator and the in-situ data providers. The co-ordination costs also include the estimation of personnel costs in terms of effort and frequency required for coordinating the various data updates, coordination between various providers, etc. These costs have been included in 'others'.

An estimate of costs associated to some observing systems at the global, regional and coastal level has been done by using an EEA GISC document and evaluation, previously done in the framework of the Mediterranean Operational Oceanography Network. The estimate is very partial and is giving only an idea of what is the order of magnitude of an observing system and what could be the EC contribution under some assumptions (to be verified practically). The exercise is in the table below.

			Capital	Capital depreciation	Consumables	Labour	Other	Annual cost	Comment
Component	Assumption	Number	k€	k€/year	k€/year	k€/year	k€/year	k€/year	
Global									
ARGO	Maintain 800 floats/year. 250 floats to be purchased yearly, 100 of them with new instrumentation. Operation costs for the 800 floats per year including Telecommunications, Personnel (FTE) for management/coordination, Personnel (FTE) for technical/ logistic support, Misc), Equipment and consumables, Dedicated ship time and Personnel costs for data management. The setup cost of the ARGO system is assumed to have been covered. Unit cost is 17k€. Other costs are for transmission and coordination.	€ 250,00	€ 4.250,00			€ 2.000,00	€ 1.125,00	€ 7.625,00	
Drifters	Estimated number for Europe as by E-SURFMAR. Unit cost 1,5K€. Other includes transmission and coordination	€ 100,00	€ 1.700,00	€ 340,00		€ 150,00	€ 50,00	€ 2.340,00	
Deep sea moorings /EuroSITES	Other costs are ship time (at 10KEuro/day for 8 days per year per site)	€ 12,00	€ 3.552,00	€ 710,40	€ 168,00	€ 648,00	€ 960,00	€ 6.050,40	
XBT Ships of Opportunity	At global level, costs are covered by NOAA. And approximate number of profiles is derived from	€ 25.000,00	€ 3.000,00			€ 200,00	€ 112,50	€ 28.312,50	The cost of the global observing system is assumed on US funding.

	SOOP reports. Cost of XBT is estimated 120€ each, all included.								
Continuous Plankton Recorder	Based on previous estimates by EEA GISC project EU seas and North Atlantic). SAHFOS cost base. An annual value has been estimated and defines as 'consumable'. Coordination costs are estimated at 75K€.				€ 2.600,00		€ 75,00	€ 2.675,00	
Regional									
Ferrybox TSG		€ 15,00	€ 1.350,00	€ 270,00	€ 75,00	€ 60,00		€ 1.770,00	
XBT Ships of Opportunity	In European regional seas (NwAtlantic, Mediterranean and Black Sea - 7 tracks)	€ 210,00	€ 3.570,00			€ 840,00	€ 945,00	€ 5.565,00	
Gliders		€ 30,00	€ 3.600,00	€ 720,00		€ 120,00	€ 30,00	€ 4.500,00	Could be shared with national funding
Coastal									
HF radar	On GISC and MOON estimates	€ 340,00	€ 51.000,00	€ 10.200,00	€ 340,00	€ 8.500,00		€ 1.530,00	Should be shared with national funding
Coastal Buoys	Supposed 55 for Med and North Sea, 65 for IBI, 30 for Black Sea, Baltic and Norwegian. Other costs are ship time	€ 265,00	€ 26.500,00	€ 5.300,00	€ 662,50	€ 1.590,00	€ 2.120,00	€ 36.437,50	Should be shared with national funding
Tide gauges	Some 348 tide buoys around Europe. Capital costs and operation costs per year based on IBI-ROOS average estimates and MOON	€ 348,00	€ 6.960,00	€ 1.392,00	€ 870,00	€ 2.088,00		€ 11.658,00	Should be maintained by national funding
	Total cost							€ 108.463,40	

	Cost for Europe (the global XBT has been eliminated)							€ 80.150,90	
	To be shared between EC and MS							€ 42.467,50	
	Tide gauges are supposed to be maintained entirely by MS							€ 11.658,00	

The coordination of the different initiatives should be considered, in order to make complementary the different proposed observing systems and cover all scales, from coastal to global. An additional 'coordination cost' should be added, in order to exchange data with US, Australia and other countries. This coordination should be constructed within existing international organisations (IOC, WMO).

The above estimation does not consider an additional observing element, defined as important by the Check Points: the energy and material that flow from rivers into the sea. This additional element would require the use of different platforms (in situ and satellite), progressing towards a major collaboration between EMODnet Physics and CMEMS (in particular with SST and COLOR TACs). The inclusion of this element means that the lack of coordination problem, for all the observing system, needs to be solved urgently. It is necessary to achieve efficiency and effectiveness by reducing observation costs.

7. User Feedback

Provide a summary of the feedback received from users (formal and informal) on your portal, your activities or those of other EMODnet projects/activities (min 1 page).

Also provide any suggestions you have received for EMODnet case studies and/or future products/activities/events (min 1 page).

In general, feedback is very positive, particularly regarding ease to access to metadata and data, plot parameters, and download data. The EMODnet Physics approach, making information on data and data provider accessible and visible, is highly appreciated. Interoperability services, e.g. WMS and WFS, are much appreciated by diverse communities and widely used by European agencies (e.g. EMSA, JRC).

Providers are interested in having easy tools that inform on the use and visibility of their data, and they like having the possibility of using EMODnet Physics as an easy and fast tool to check their data (and data consistency).

Some providers are interested in information such as who is using data, how often data is downloaded, which is the most downloaded platform etc. and the recent release of the platform dashboard is already answering most of these requests.

Some examples from data networks communities:

- ***Drifter community***

"The drifter data time series look very good there and the facility to download also looks nice". Some metadata are missing and they encouraged EMODnet Physics to work more in cooperation and collaboration with JCOMMOPS. They also like/suggested to have some further easy API such as python scripts.

- ***GO SHIP***

The ARGO platform page is also suitable for GO SHIP, mainly because it has the interior ocean projection (i.e. sections). GO SHIP is encouraging NRT submission of CTD data to Coriolis. GO-SHIP encourages EMODnet Physics to work on tools to build sections of variables measured by CTD in NRT too (S, T, O, Chl-a). GO-SHIP delivers a significant number of chemical (and some biological) variables as well as physical parameters, although these are delivered in delayed mode, they encourage EMODnet Physics to plan the development of an option to quickly build sections of BGC variables as well as facilitate links to the chemistry and biology portal.
They also highlighted that hardly anyone is interested in downloading data from one single point during a GO-SHIP cruise, but rather all the data from a whole cruise/transect. This could ideally be linked to

other repeat transects of that line, or other transects in a certain region, so that all data can be exported in one file for the user.

- ***SOCAT***

The portal and the map user interface, together with its features including NRT data access, subsetting of parameters and how to get access to older data, was much appreciated. One warning was on how to coordinate the NRT carbon dioxide data and physical oceanographic data: often these data follow two different data streams and the activity on the identification of unique id (in cooperation and coordination with JCOMMOPS and ICES) is a fundamental prerequisite for achieving the goal.

- ***Other users***

Since the first HF Radar data were made available (March 2015), there has been an increased interest of this technology and potential. High Frequency Radar (HFR) is a unique technology that offers the means to map ocean surface currents and, for some installations, wave fields (along with other secondary variables) over wide areas (reaching distances from the coast of over 100km) with high spatial and temporal resolution and with relative ease in terms of technical effort, manpower and costs. HF Radar represents a very effective solution to work on surface ocean circulation that is highly influenced by winds, tides, buoyancy forces and, in the coastal areas, by complicated topography, which coexist (and interact) on different time-and-spatial-scales with the circulation.

For the past three years, EMODnet Physics has focused on testing the concept and organising the European HF Radar community and data. The next phase should focus on connecting additional radars and organising access to historical datasets by exploiting infrastructures and catalogues, compatible with this big data format (i.e. THREDDS).

Users expressed a big interest in data collected by tagged sea mammals. Tagged seals provide interesting and complementary data, NRT CTD profile data and the tracks i.e. movement of the mammals, in less accessible regions - e.g. the Arctic - Figure 40 and Figure 41. Unlike many platform types, data from marine mammals i.e. seals, enables access to data from under the ice cover.

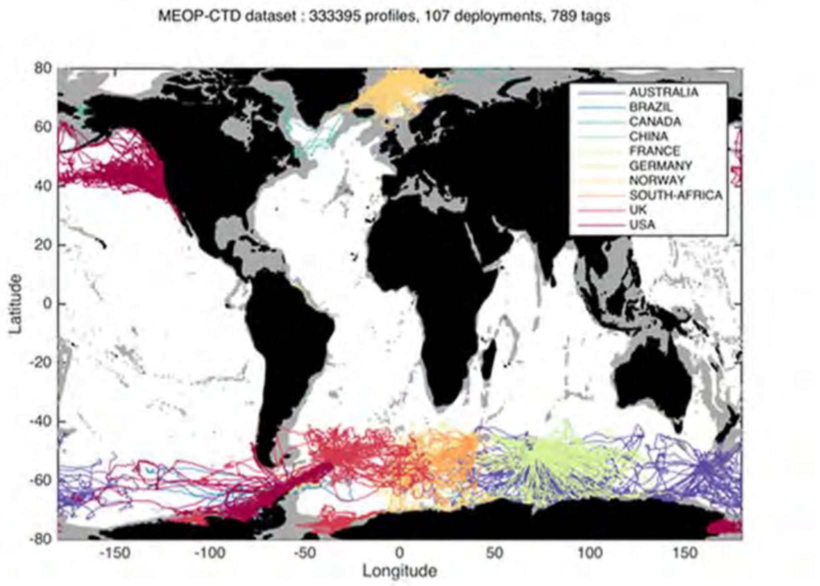


Figure 40. World map showing the distribution of CTD profiles (i.e. vertical profiles of temperature and salinity) collected since 2004 currently available in the MEOP-CTD database , 333394 profiles, 107 deployments and 789 tags

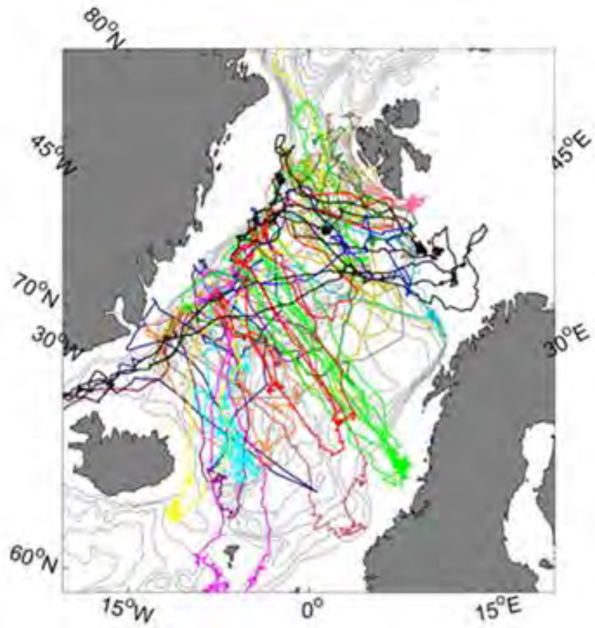


Figure 41. Tracks of hooded seals in the Nordic Seas from mid-July 2008 to end of November 2008 collecting 61112 CTD profiles

Further, there is an increased interest in underwater noise as it is particularly relevant for MSDF - Descriptor 11[33]:

- Indicator 11.1.1. Impulsive Noise - The aim of indicator 11.1.1 is to provide information describing temporal and spatial distribution of activities generating impulsive noise, allowing a MS (member state) to assess possible cumulative impacts of displacement on marines species at the population level (a common strategy for all MSs is not agreed yet). This data is also relevant to evaluate impact of tourism (e.g. ships) in/close to marine protected areas.
- Indicator 11.2.1. Ambient Noise - The aim of the indicator 11.2.1 is to determine annual trends within 1/3 octave bands 63 and 125 Hz (centre frequency).

There is an increasing interest in near real time biogeochemical information where EMODnet Physics (and backbone in situ infrastructure) has been suggested as the landing/hosting place for this data. EMODnet Physics is already receiving BioARGO data. Much archived BGC data are available via ICES and future work will be carried out in close cooperation with both ICES and HELCOM to avoid duplication of efforts. There is an interest in proving if the developed data management flow can be applied to the new biosensors for fixed stations too.

As already reported, users are also asking for a better connection between NODC and ROOSs for a continuous data flow from Real time/near real time to its validation, while ensuring easy accessibility to request data.

Wave data and wave products are one of the most required data sets. EMODnet Physics is now giving access to approximately 270 platforms providing wave data. Data are time series in discrete points. Users are interested in both in situ products (similar to what the portal is providing for wind data) and high-resolution wave data products (provided as outputs from models that are assimilating in situ data. To meet these user requirements there will be further discussions, and the activity will be planned, in cooperation with CMEMS.

The wind data products are much appreciated and it was suggested to disseminate and promote these products more. The possibility of accessing a page showing these products from many platforms (one after the other) will make an even greater impact. One example of an EMODnet Physics wind product is the wind rose. Wind roses summarise the occurrence of winds at a location, showing their strength, direction and frequency. Sailors use wind rose information to get average winds for each month of the year to help to create optimal sailing routes between ports. Wind power farms do extensive wind rose

[33] http://ec.europa.eu/environment/marine/pdf/MSFD_reportTSG_Noise.pdf

type studies prior to erecting their wind turbines. Thus, the wind rose is a simple information display technique that has a multitude of uses.
An additional wind product that could be of interest for the Blue Economy is the so called 'wind power for offshore wind farming'. Products could be in terms of intensity, variability in time and in direction. These will be only preliminary indications on 'wind suitability' to be finalised with additional environmental information.

The community also shows an interest in, and is asking for, more EuroGOOS/EMODnet physics data workshops to present and discuss the EMODnet program, EMODnet Physics and collaborators i.e. CMEMS, ROOSs and SeaDataNet, to help to sort national and regional data issues and understand the system as a whole, and though this raise awareness and increase the amount of data available.

EMODnet Physics has been identified as the dissemination portal for an increasing number of key international projects and initiatives such as AtlantOS, JERICO-NEXT, FixO3, GOOS as well as an easy to use shopping window for CMEMS products, giving more visibility to the CMEMS INSTAC. This is a game change and proves that the portal fulfils many user requirements. Further, this approach enables projects to avoid duplication of efforts from a portal/data display point-of-view and reduces the confusion among users and data providers by providing one single portal where projects and initiatives can display their data with sufficient and clear credit to the project, initiative and data provider.

Finally, yet importantly, the International Oceanographic Commission urged greater engagement of EMODnet and GMES in the global GOOS (Global Ocean Observing System) and GEOSS (Global Earth Observation System of Systems) efforts, saying that

> *"interoperability [with a global system] will bring benefits to Europe through the provision of non-European data that may impact on forecasts or the health of European seas."*

In this context EMODnet Physics is already indicated as the operational platform and exemplar on which GOOS has to build on (GOOS and JCOMM: intersections with IODE activities, A. Fisher presentation to IODE Officers 21/1/2016 (the presentation is available on request[34]).

[34] contacts@emodnet-physics.eu

8. Allocation of project resources

Please provide information about the effort (percentage of project resources) spent during the whole project on the following groups of activities: (i) collecting, harmonising and giving access to data; (ii) creating data products; (iii) developing and maintaining IT; (iv) management and reporting; and (v) answering questions and other communication activities.

Details about the effort spent during the reporting period are not available, as they were not always specifically tracked. In general, 70% of the budget was allocated to the improvement of data infrastructure in order to connect, access and make data (and products) available across countries (including dissemination - coordination actions in those areas). A further 15% was specifically allocated to web portal development (landing page, map page and interoperability services and products). The rest was allocated to project management and coordination.

Table 9

categories	planned resources (percentage of total)	Used resources (percentage of total)
Making data and metadata interoperable and available	67%	65%
Preparing data products	6%	7%
Preparing web-pages, viewing or search facilities	13%	13%
Project management	11%	11%
Interaction with users	4%	4%
Other	0%	1%
total	100%	100%

9. Outreach and communication activities

Please list up all the relevant communication activities or products you have developed/executed during this period (preferable in a table) and highlight the 5 most important ones. This can include presentations, lectures, trainings, demonstrations and development of communication materials such as brochures, videos etc. This can also include scientific papers and/or popular articles you know have been published using/referring to the work developed in EMODnet.

Table 10 reports the outreach and communication activities. The most relevant are indicated in bold and are the events that had crucial impact on integrating more and new data from crucial (undercovered) areas or data networks.

Table 10 – communication activities

Date	Event and Location	Means
9-10 September 2013	**EuroGOOS DATAMEQ meeting, Brussels, Belgium**	**Oral presentation**
17-20 September 2013	MARES2020, Varna, Bulgaria	Oral presentation
22-24 September 2013	IMDIS2013, Lucca, Italy	Oral presentation + YouTube channel
25-26 September 2013	SeaDataNet annual Meeting, Lucca, Italy	
8-10 October 2013	FUTOORE, Hamburg, Germany	Oral presentation
14 October 2013	Meeting with TEN-T - MONNALISA project, Genova, Italy	Oral presentation
28-31 October 2013	GMES-PURE workshop, Brussels, Belgium	
19 November 2013	presentation to the JERICO WP2 meeting, Brussels, Belgium	Oral presentation
3-4 December 2013	**EMODnet workshop - Adriatic Sea Region, Split, Croatia**	**Oral presentation**
30 January 2014	Meeting with officers from Regione Liguria - Direzione centrale Affari legali, giuridici e legislativi - Settore Sistemi informativi e telematici regionali, Genoa, Italy	Oral presentation
11 February 2014	Baltic Port Species Workshop in Hamburg, Hamburg, Germany	
14 February 2014	Presentation @ World Maritime University, Malmo, Sweden	Oral presentation
26 -27 February 2014	presentation to the JERICO Steering committee, Brussels, Belgium	
26-27 March 2014	MyOcean Annual Meeting, Athens, Greece	
2-5 April 2014	In situ TAC annual meeting, Trollfjord vessel between Bergen to Bodo, Norway	Oral presentation
28-30 April 2014	EGU annual meeting, Vienna, Austria	Oral presentation + EMODnet Physics splinter session + 2nd HFR coordination group meeting
4 May 2014	BOOS newsletter	Article

5-7 May 2014	Presentation to JERICO general assembly, Oslo, Norway	Oral presentation
19 May 2014	FIXO3 project, Rome, Italy	Oral presentation
20 May 2014	Day of the Sea – DLTM, La Spezia, Italy	Oral presentation
26-29 May 2014	6th IEEE/OES Baltic Symposium 2014, Tallinn, Estonia	Oral presentation (IEEE paper)
27 May 2014	Safer Transport in the Mediterranean Sea, Lecce, Italy	Oral presentation + YouTube channel
4 June 2014	Presentation to EMSO project, Rome, Italy	Oral Presentation
10 June 2014	**EMODnet Workshop Iceland, Reykjavik, Iceland**	**Oral presentation**
16–18 June 2014	JERICO Summer School, Delft, Netherlands	Oral presentation
23-26 June 2014	Presentation at the ODP - ETDMP-IV, Oostende, Belgium	Oral presentation
31 July – 1 August 2014	**European HF Radar meeting group @ ATZI, S. Sebastian, Spain**	**Oral presentation**
8-9 September 2014	Annual Ferrybox Meeting, Tallin, Estonia	
12 September 2014	EMODnet presentation @SMHI, Sweden	Oral presentation
24 September 2014	SeaDataNet Annual Meeting, Split, Croatia	Oral presentation
6 October 2014	EMODnet pre-event EUROCEAN, Rome, Italy	Oral presentation
27 October 2014	EuroGOOS - EMODnet HFR side event @ EuroGOOS conference	Oral presentation
29 October 2014	**EMODnet Physics @ EuroGOOS conference**	**Oral presentation**
5-7 November 2014	EMODnet Physics presentation @ EMODnet MED CheckPoint annual meeting, Bologna, Italy	Oral presentation
16-18 November 2014	2nd International Ocean Research Conference (IORC) "One planet, one ocean, Barcelona, Spain[35]	Oral Presentation
22 November 2014	EMODnet session @ PLOCAN Glider School, Las Palmas, Spain[36]	Oral presentation
26-27 November 2014	EMODnet Physics presentation @ MonGOOS annual meeting, Lecce, Italy	Oral presentation
16-20 March 2015	IODE-XXII, Bruges, Belgium	Oral presentation
12-13 April 2015	EGU, Vienna, Austria	Session O2.4
16 April 2015	EGU, Vienna, Austria	Oral presentation
16 April 2015	FixO3 Workshop "an introduction and practical use of European marine data infrastructures	Oral presentation
18-20 May 2015	Ocean 2015, Genoa, Italy	Oral presentation
28-29 May 2015	European Marine Days, Athens, Greece	
10-12 June 2015	Sea Level Workshop, Mallorca, Spain	Oral presentation
15-16 June 2015	9th GEO European Projects WS, Copenhagen, Denmark	Oral presentation
9-12 June 2015	**Presentation at the AtlantOS kick off meeting, Brussels, Belgium**	**Oral presentation**
9-10 September 2015	Introduction to the EMODnet @ EMODnet Baltic Sea Check Point, Copenhagen, Denmark	Oral presentation
22-24 September 2015	GOOS Regional Alliances Forum VII, Heraklion, Greece	Oral presentation
25 September 2015	European HF Radar Task Team, Heraklion, Greece	
7-8 October 2015	Tide Gauge Task Team meeting, Madrid, Spain	

[35] www.iocunesco-oneplanetoneocean.fnob.org.
[36] http://acamimusan.es/gliderschool/

15 October 2015	Italian DHI Conference, Turin, Italy	Oral presentation
20 October2015	EMODnet Jamboree, Oostende, Belgium	Oral presentation
21-22 October 2015	EuroGOOS DataMEQ and EMODnet Physics meeting, Oostende, Belgium	
25 November 2015	Italian EMODnet Day, Rome, Italy	Oral presentation
3-4 December 2015	Presentation @ WP7 AtlantOS meeting, Paris, France	Oral presentation
2 February 2016	meeting with IFREMER, Brest, France	Oral presentation
3 February 2016	**EMODnet Physics – AtlantOS – JericoNEXT tech meeting, Brest, France**	**Oral presentation**
18 February 2016	**EMODnet Physics and COSYNA, HZG, Hamburg, Germany**	**Oral presentation**
19 February 2016	EMODnet Data Workshop in Germany, Hamburg, Germany	Oral presentation
22-26 February 2016	AGU, New Orleans, USA	Poster presentation
1 – 3 March 2016	**Black Sea Observing System meeting, GeoEcoMar, Bucharest, Romania**	
9-11 March 2016	meeting with EuroGOOS HFR Task Team, S. Sebastian, Spain	
14-16 March 2016	workshop on OGC – SWE standard, Oceanology International, London, UK	Oral presentation
6-9 April 2016	7th Ferrybox Annual meeting, Heraklion, Greece	Oral presentation
17-22 April 2016	EGU, Vienna, Austria	Oral presentation
19-20 May 2016	meeting with CMEMS INSTAC, Hamburg, Germany	
31 May – 2 June 2016	GEPW16, GEO European Projects Workshop, Berlin, Germany	Oral presentation

Progress on EMODnet Physics activities were also presented at each EuroGOOS regional meeting

Table 11 – meeting with EuroGOOS ROOSs

when	what	where
9/11/2013 - 21/11/2013	EuroGOOS Annual Meeting 2013	EuroGOOS AISBL
02/10/2013 - 04/10/2013	MONGOOS meeting	Puertos del Estado, Madrid
15/09/2014 - 17/09/2014	NOOS Annual Meeting	Deltares, The Netherlands
21/05/2014 - 23/05/2014	EuroGOOS Annual Meeting 2014	EuroGOOS AISBL, Brussels, Belgium
07/05/2014 - 09/05/2014	BOOS/HIROMB Annual Meetings	Hotel Elefant, Riga, Latvia
05/05/2015 - 07/05/2015	BOOS Annual Meeting and scientific Workshop	Elite Grand Hotel Norrköping
15/04/2015 - 16/04/2015	IBI ROOS Annual Meeting	Galway, Ireland
17/12/2014 - 18/12/2014	Arctic ROOS Annual Meeting	NIVA, Oslo, Norway
26/11/2014 - 28/11/2014	3rd MonGOOS meeting	Palazzo Turrisi, Lecce, Italy
04/11/2015 - 06/11/2015	MONGOOS annual meeting	Hotel Tryp Palma Bellver
27/10/2015 - 29/10/2015	NOOS annual meeting	
30/11/2015 - 01/12/2015	Arctic ROOS annual meeting	Marine Research Institute
05/04/2016 - 06/04/2016	IBI-ROOS General Assembly	Centro Oceanográfico de Canarias
25/05/2016 - 27/05/2016	EuroGOOS General Assembly 2016	EuroGOOS AISBL, Brussels, Belgium
17/05/2016 - 19/05/2016	BOOS General Assembly, Modelling Meeting and Scientific Workshop	Institute of Oceanology Polish Academy of Sciences

EMODnet Physics started being cited and indicated in a number of official documents and reports (from both private and public organizations), some key examples are:

Table 12

2015	DHI Italia	Citation of EMODnet Physics into DHI new MWM product
2015	FP7 Perseus	PERSEUS Data Management Handbook V1.1
2016	CMEMS	CMEMS INS PUM 013 – product user manual
	FP7 Ocean of Tomorrow projects, H2020 AtlantOS, H2020 JericoNEXT	Project reports

EMODnet Physics is also present in scientific papers. Most are proceedings (e.g. IMDIS, EGU, MARE2020, etc.) but it is worth mentioning the book chapter: Calewaert et al., The European Marine Data and Observation Network (EMODnet): Your Gateway to European Marine and Coastal Data. Quantitative Monitoring of the Underwater Environment. Volume 6 of the series Ocean Engineering & Oceanography (Springer) pp 31-46, 2016.

10. Evolution of Progress Indicators

Using the indicator as a header, list the metrics collated and the time interval. This section should show the progress achieved throughout the project: please, provide time series when possible.

Indicator 1. Volume of data made available through the portal

EMODnet Physics is providing access to both near real time and historical datasets from as recorded by different platform types. Some platforms are delivering data continuously (e.g. fixed stations, radars, ferryboxes), other platforms are delivering data as soon as they can (e.g. ARGO, glider) covering a defined time period, i.e. the mission. Some platforms are not working any longer and so only old data may be available. A platform generally measures one or more parameters and Table 5 summarises the available datasets by parameters.

Data are organised in files according the data age and more specifically the system is making available:

1. Daily files for the past 60 days. It is a sliding window on the latest 60 days of observations for real-time applications, data go towards automatic quality check/flag procedures and no authentication is required to download these data

2. Monthly files. By the end of the first week the month, for each platform, data for the previous month are organised into a single file. The file contains the best copy of the recent dataset according automatic quality check/flag procedures[37]. Some of these datasets download requires user authentication.

3. Long Term time series data files. Annually the monthly files are reprocessed (together with validated data from NODCs) into a single file creating a single best copy history file for each platform. Some of these datasets download requires user authentication.

4. Validated historical datasets. Organized in CDI - dataset files hosted by NODCs (validated data[38], requires user registration).

Table 13 shows the number of connected platforms and their typology. Annex 5 reports the full list and details of the connected platforms.

---

[37] http://www.emodnet-physics.eu/map/ARH/QualityCheck/recommendations_for_rtqc_procedures_v1_2.pdf
[38] Validated according the SeaDatanet Quality Check procedure - http://www.seadatanet.org/content/download/18414/119624/file/SeaDataNet_QC_procedures_V2_%28May_2010%29.pdf

Table 13 – connected platforms (14/06/2016)

	last 60 days	platforms
drifting buoy (DB)	1750	4163
Ferrybox and ship (FB)	48	195
glider (GL)	7	21
fixed platform and mooring time series (MO)	1621	3941
profiling float (PF)	602	693
Argo Float (AR)	3321	4751
Radar (RD)	16	16
Total	**7365**	**13780**

Indicator 2. Organisations supplying each type of data based on (formal) sharing agreements and broken down into country and organisation type (e.g. government, industry, science).

Table 14 – Organizations supplying data based on formal agreements.

Belgium	MDK - Maritieme Dienstverlening en Kust - Belgium
Belgium	VMM - Flemish government agency - Belgium
Bulgaria	IOBAS - Institude of Oceanology - Bulgarian Academy of Science - Bulgaria
Croatia	IZOR - Institute of Oceanography and Fisheries - Croatia
Cyprus	UNY CYPRUS - Cyprus Oceanography Center - Cyprus
Denmark	DCA - Danish Coastal Authority, Ministry of Transport and Energy - Denmark
Denmark	DMI - Danmarks Meteorologiske Institut - Denmark
Estonia	MSI - Marine Systems Institute - Estonia
Finland	FMI - Finnish Meteorological Institute - Finland
Finland	SYKE - Finnish Environment Institute - Finland
France	CEREMA - Centre Etudes et Expertise sur les Risques Environnement Mobilite et Amenagement - France
France	COM CNRS - Center of Oceanology of Marseille - La Seyne Sur Mer - France
France	ENSTA - Ecole Nationale Superieure des Techniques Avancees - France
France	EPOC - Environnements Et Paleoenvironements Oceaniques
France	IFREMER - Institut Francais de Recherche pour l'Exploitation de la Mer - France
France	INSU - Institut National des Sciences de l'Univers - France
France	IRD - L'Institut de recherche pour le developpement - France
France	IUEM - Institut Universitaire Europeen de la Mer - France
France	LOCEAN - Laboratoire d'Oceanographie et du Climat - France
France	LOV - Laboratoire Oceanographique de Villefranche - France
France	Meteo France - France
France	MIO - Mediterranean Institute of Oceanography - France
France	SBR - Station Biologique de Roscoff - France
France	SHOM - Service Hydrografique et Oceanographique de la marine - France
Germany	AWI - The Alfred Wegener Institute - Germany
Germany	BSH - Bundesamt fur Seeschifffahrt und Hydrographie - Germany
Germany	HPA - Hamburg Port Authority - Germany
Germany	HZG - Helmholtz-Zentrum Geesthacht - Germany
Germany	IFM - Institute of Oceanography, University of Hamburg - Germany
Germany	KIELMS - University of Kiel Institute for Marine - Germany
Germany	WSAL - Waterways and Shipping Authority Lubeck - Germany
Germany	WSAW - Waterways and Shipping Authority Wilhelmshaven (WSA-WIL) - Germany
Germany	WSOB - Waterways and Shipping Office Bremerhaven - Germany

Germany	WSOC - Waterways and Shipping Office Cuxhaven - Germany
Germany	WSOE - Waterways and Shipping Board Emden - Germany
Germany	WSOS - Waterways and Shipping Office Stralsund
Germany	WSOT - Waterways and Shipping Office Toenning - Germany
Greece	HCMR - Hellenic Centre for Marine Research, Institute of Oceanography - Greece
Ireland	MI - Marine Institute - Ireland
Ireland	UCG - University College of Galway - Ireland
Italy	ISMAR CNR ISMAR - CNR Istitute of Marine Science - Italy
Italy	ISPRA - Istituto Superiore per la Protezione e la Ricerca Ambientale - Italy
Italy	ISSIA CNR ISSIA - CNR Institute of Intelligent Systems for Automation - Italy
Italy	OGS - Istituto Nazionale di Oceanografia e di Geofisica Sperimentale - Divisione di Oceanografia - Italy
Italy	UPA - CALYPSO - Dip. di Ingegneria Civile, Ambientale, Aerospaziale, dei Materiali, University of Palermo
Latvia	LEGMA - Latvian Environment, Geology and Meteorology Agency - Latvia
Malta	UOM - CALYPSO - Dept. of Geosciences, University of Malta - Malta
Netherlands	Deltares - Netherlands
Netherlands	KNMI - Koninklijk Nederlands Meteorolologisch Instituut - Netherlands
Netherlands	RIKZ- Rijkswaterstaat Waterdienst - Netherlands
Norway	CMR - Christian Michelsen Research - Norway
Norway	IMR - Institute of Marine Research - Norway
Norway	MetNo - Norwegian Meteorological Institute - Norway
Norway	NHS - Norwegian Hydrographic Service - Norway
Norway	NIVA - Norsk Institutt for Vannforskning - Norway
Poland	IOPAS - Institute of Oceanology of the Polish Academy of Sciences - Poland
Portugal	IH - Instituto Hidrografico - Portugal
Portugal	UAC - Universidade dos Acores - Portugal
Romania	INFP - National institute for Earth Physics - Romania
Romania	NIMRD - National Institute for Marine Research and Development - Romania
Romania	NIRD - GeoEcoMar - Institutul National de Cercetare-Dezvoltare pentru Geologie si Geoecologie - Romania
Russian Federation	NWAHEM - North-West Regional Administration for Hydrometeorology and Environmental Monitoring - Russia
Slovenia	ARSO - Slovenian Environment Agency - Slovenia
Slovenia	NIB - National Institute of Biology - Slovenia
Spain	CEAB - Centre d'Estudis Avancats de Blanes - Spain
Spain	Euskalmet- Basque Goverment - Spain
Spain	IEO - Spanish Oceanographic Institute - Spain
Spain	PdE - Puertos del Estado - Spain

Spain	PLOCAN - Oceanic Platform of the Canary Islands - Spain
Spain	SOCIB - Balearic Islands Coastal Observing and Forecasting System
Spain	UPC - Universitat Politecnica de Catalunya - Spain
Spain	XG - Xunta Galicia - Spain
Sweden	SMHI - Swedish Meteorological and Hydrological Institute - Sweden
Turkey	IMS METU - Middle East Technical University - Institute of Marine Sciences - Turkey
United Kingdom	CEFAS - Centre for Environment, Fisheries & Aquaculture Science - UK
United Kingdom	IOSBL - Institute of Oceanographic Sciences - Bidston Laboratory - United Kingdom
United Kingdom	Met Office- United Kingdom
United Kingdom	NOC - National Oceanography Centre Southampton - UK
United Kingdom	UKM - United Kingdom Recent Marine Data - UK

In general, EMODnet Physics is receiving data from all the EuroGOOS and ROOSs members (based on a formal data sharing agreement). EMODnet Physics is also receiving data from providers that have sharing agreements with organisations that are cooperating with EMODnet Physics on the data management infrastructures (i.e. CMEMS INSTAC and ROOS RDACs). For instance, through these agreements EMODnet Physics is receiving data from 24 oil platforms (North Sea).

Indicator 3. Organisations that have been approached to supply data with no result, including type of data sought and reason why it has not been supplied.

In general, data originators were collaborative and whenever possible they made data accessible and available in the data management infrastructures behind EMODnet Physics.
Sometimes it was not possible and e.g.:

- Turkish data – most of the marine data collected in Turkey belongs to the army and hence have a restricted access. This restricted access also applies to marine institutes within Turkey. There is, however, an increased interest of sharing data from marine institutes not affected by the army's data restrictions. In coordination and collaboration with EuroGOOS, EMODnet Physics is following up with these institutes.
- IZOR (Croatia) which was only able to release data from HF Radar while data from fixed stations along Croatian coast are still restricted and inaccessible because of the specific programme that is funding the network.
- Cyprus fixed buoys: data are often visible (institute web site) but not accessible due to internal data policies.
- Poland: only the Sopot fixed platform is delivering data thanks to a specific action (supported by EMODnet Physics) to create the interoperability infrastructure and services between the IOPAN and Baltic INS TAC. Some Polish data are made available to, and restricted to, the BOOS community.
- UK/CEFAS, where data are often visible but not accessible due to internal data policies.
- Norway: institutes hosting (mainly) archived data are re-organising themselves at national level before making these marine data accessible to all users.
- Northern African countries: Restrictions due to national issues/internal data policies. Data sharing concept not as advanced as in Northern Europe with a couple of exceptions, e.g. Morocco.

Summarising the possible issues that are limiting data sharing are:
- data originators/curators do not have enough manpower or technical expertise to make steps toward the infrastructure (e.g. formatting data, filling the metadata etc.)
- data originators/curators are not permitted to make their data accessible (data recorded under specific contracts, not UE originators/curators)
- "research" originators/curators tend to delay data accessibility until they complete their research activity and publish

Indicator 4. Volume of each type of data and of each data product downloaded from the portal

EMODnet Physics is tracking the IP address where the request comes from. Internal requests (ETT IPs) and known internet page-indexing/sniffing robots (e.g. Google) are filtered out. If data is requesting authentication (e.g. monthly files) EMODnet forwards the request to the CAS service (e.g. CMEMS CAS - Figure 21) and if the acknowledgment is positive the user can download data, if it is not the user is requested to fill up the registration form to receive a login and password.

Table 15 – volume of data downloaded from the portal (1/7/2013 – 1/6/2016)[39]

Country	Files in the latest 60 days sliding window	Monthly files	Long Term time series	WebService	Total
Belgium[40]	1066	365	15	82729	84175
Italy	2616	1023	896	40813	45348
Portugal	4189	763	277	7580	12809
United States	12	1	1	10219	10233
Germany	293	197	227	6714	7431
Netherlands	562	435	759	1482	3238
France	115	970	40	1690	2815
Greece	52	783	1621	16	2472
Ireland	9	1237	1015	9	2270
Denmark	2091	73	39	6	2209
United Kingdom	154	154	451	1312	2071
Senegal	649	649	649	0	1947
Switzerland	966	1	0	0	967
Russia	46	65	177	459	747
China	1	1	2	677	681
Spain	163	123	250	60	596
Indonesia	154	152	154	1	461
Norway	272	10	1	26	309
Turkey	259	16	24	5	304
Luxembourg	260	9	9	1	279
Poland	146	2	17	61	226
Canada	27	13	10	155	205
N.D.	44	8	14	21	87

[39] http://www.emodnet-physics.eu/map/dashboard/ReservedAreaSection13.aspx

[40] The figure is biased by the fact that EMODnet Secretariat and EMODnet Central Portal are located in Belgium

Croatia	27	14	27	4	72
Singapore	0	43	15	2	60
Sweden	34	12	2	8	56
Finland	26	12	12	3	53
Austria	1	0	0	52	53
Ukraine	1	0	0	45	46
Latvia	0	0	0	29	29
Australia	3	0	0	25	28
Estonia	16	5	5	0	26
India	2	9	0	13	24
Bulgaria	15	1	1	2	19
Slovenia	3	7	6	0	16
Romania	9	3	0	3	15
Morocco	12	0	0	1	13
Republic of Korea	1	0	0	11	12
Czech Republic	0	0	0	8	8
Hungary	0	0	0	8	8
Albania	7	0	0	0	7
Japan	0	0	0	7	7
Brazil	0	1	0	5	6
Egypt	0	3	1	1	5
Lebanon	3	1	0	1	5
Taiwan	0	0	0	5	5
Malta	3	0	0	0	3
Israel	2	0	0	1	3
Philippines	1	0	0	2	3
Pakistan	0	0	0	3	3
Vietnam	0	0	0	3	3
Iceland	1	0	0	1	2
Hong Kong	0	0	0	2	2
Thailand	0	0	0	2	2
Jersey	1	0	0	0	1
Peru	1	0	0	0	1
Republic of Lithuania	1	0	0	0	1
Saudi Arabia	0	1	0	0	1
South Africa	1	0	0	0	1
Belarus	0	0	0	1	1
Costa Rica	0	0	0	1	1
Iran	0	0	0	1	1

Kuwait	0	0	0	1	1
New Zealand	0	0	0	1	1
Serbia	0	0	0	1	1
Venezuela	0	0	0	1	1
Total	**14317**	**7162**	**6717**	**154290**	**182486**

Table 16 – volume of CDIs requested from the portal (1/7/2013 – 1/6/2016)[41]

Country	Platform	CDI tot
Belgium	12	912
Denmark	2	15
France	12	38
Germany	3	3
Greece	25	157
Ireland	9	151
Italy	14	56
Malta	1	1
Netherlands	6	1643
Russia	3	7
Spain	6	12
Turkey	1	1
United Kingdom	14	114

[41] http://www.emodnet-physics.eu/map/dashboard/Section22.aspx

Table 17 – Top 20 most manually downloaded platforms (1/7/2013 – 1/6/2014)[42]

platform	Number of requests
62304	223
62103	185
61001	147
ATHOS	145
61417	135
68422	126
64045	123
62107	117
62305	108
Europlatform	107
61280	107
DarsserS	106
61277	102
NsbII	102
Arkon	102
62163	101
61198	101
62304	99
Arkona	99

Table 18 – Top 20 most web service downloaded platforms (1/7/2013 – 1/6/2014)

platform	Number of requests
Milwaukee, WI	7618
Roscoff	7095
RoscoffTG	7091
62068	7089
FMLW	6852
Westhinder	3991
NieuwpoortTG	3544
Millport	3052
MillportTG	3012
62091	2814
ZeebruggeTG	2256
Lysbris	2129

[42] http://www.emodnet-physics.eu/map/dashboard/ReservedAreaSection6.aspx

Oostende	1972
OostendeTG	1918
USNDBC_mlww3	1474
62094	1431
41702	1034
62142	942
MeetboeiPBW1	922
62305	707

Indicator 5. Organisations that have downloaded each data type

The most active countries are Belgium (Central Portal), Italy (DLTM, DHI, D'Appolonia, CNR), USA, Portugal (EMSA), Germany, Netherlands and France (IFREMER). Table 19 shows the Country (rows) where a request came from versus the sea basin (columns) where the dataset - platform is belonging to.

Table 19 – datasets (both manual and ws) download (01/07/2013 – 01/06/2016)[43]

Country	Arctic, Barents, Greenland, Norwegian Sea	Atlantic, Bay of Biscay, Celtic Sea	Baltic Sea	Black Sea	Global	Med Sea	North Sea	Download all	Total
Albania	0	0	0	0	0	7	0	0	**7**
Australia	0	0	0	0	26	0	2	0	**28**
Austria	0	1	0	0	51	1	0	0	**53**
Belarus	0	0	0	0	1	0	0	0	**1**
Belgium	18	52060	232	15	379	203	31300	14	**84221**
Brazil	1	0	0	0	5	0	0	0	**6**
Bulgaria	0	0	0	9	10	0	0	2	**21**
Canada	3	48	2	0	147	5	0	0	**205**
China	0	16	0	0	665	0	0	0	**681**
Costa Rica	0	0	0	0	1	0	0	0	**1**
Croatia	0	1	1	0	6	65	0	2	**75**
Czech Republic	0	1	0	0	7	0	0	0	**8**
Denmark	50	473	322	4	30	208	1138	8	**2233**
Egypt	0	0	0	0	1	4	0	0	**5**
Estonia	0	0	24	0	3	0	0	3	**30**
Finland	0	0	50	0	3	0	0	0	**53**
France	26	829	3	1	1801	154	39	26	**2879**
Germany	33	181	251	1	6626	43	302	5	**7442**
Greece	4	728	207	46	556	782	308	44	**2675**
Hong Kong	0	0	0	0	2	0	0	0	**2**
Hungary	0	0	0	0	7	0	1	0	**8**
Iceland	0	1	0	0	1	0	0	0	**2**
India	0	0	7	0	14	3	0	1	**25**
Indonesia	0	0	0	0	461	0	0	456	**917**
Iran	0	0	0	0	1	0	0	0	**1**
Ireland	18	643	96	0	393	240	993	6	**2389**
Israel	0	0	0	0	1	2	0	0	**3**
Italy	921	7957	2243	190	4605	25449	3944	36	**45345**
Japan	0	0	0	0	7	0	0	0	**7**
Jersey	0	1	0	0	0	0	0	0	**1**
Kuwait	0	0	0	0	1	0	0	0	**1**
Latvia	0	12	0	0	17	0	0	0	**29**
Lebanon	0	0	0	0	1	4	0	0	**5**

[43] http://www.emodnet-physics.eu/map/dashboard/ReservedAreaSection5.aspx

Luxembourg	0	3	232	0	1	0	25	0	**261**
Malta	0	0	0	0	2	2	0	1	**5**
Morocco	0	12	0	0	1	0	0	0	**13**
N.D.	0	8	35	5	24	15	0	2	**89**
Netherlands	26	508	20	19	638	13	2058	4	**3286**
New Zealand	0	0	0	0	1	0	0	0	**1**
Norway	14	32	3	0	85	0	175	4	**313**
Pakistan	0	0	0	0	3	0	0	0	**3**
Peru	0	1	0	0	0	0	0	0	**1**
Philippines	0	1	0	0	2	0	0	0	**3**
Poland	0	1	142	0	65	0	18	4	**230**
Portugal	65	7357	620	0	1610	673	2475	123	**12923**
Republic of Korea	0	1	0	0	10	0	1	0	**12**
Republic of Lithuania	0	0	1	0	0	0	0	0	**1**
Romania	0	0	0	12	3	1	0	0	**16**
Russia	3	40	268	11	426	1	3	7	**759**
Saudi Arabia	0	0	0	0	1	0	0	0	**1**
Senegal	6	969	0	0	960	12	0	0	**1947**
Serbia	0	0	0	0	1	0	0	0	**1**
Singapore	3	15	1	0	23	0	18	0	**60**
Slovenia	0	0	0	0	0	18	0	0	**18**
South Africa	0	1	0	0	0	0	0	0	**1**
Spain	0	395	0	0	111	101	3	12	**622**
Sweden	1	2	25	0	12	4	12	4	**60**
Switzerland	10	302	226	4	27	142	256	0	**967**
Taiwan	0	0	0	0	5	0	0	0	**5**
Thailand	0	1	0	0	1	0	0	0	**2**
Turkey	0	1	0	250	5	49	0	1	**306**
Ukraine	0	0	0	0	46	0	0	1	**47**
United Kingdom	30	847	41	0	855	69	261	22	**2125**
United States	79	911	2	0	9205	37	0	1	**10235**
Venezuela	0	0	0	0	1	0	0	0	**1**
Vietnam	0	0	0	0	3	0	0	0	**3**
	1311	**74360**	**5054**	**567**	**29956**	**28307**	**43332**	**789**	**183676**

Indicator 6. Using user statistics to determine the main pages utilised and to identify preferred user navigations routes

EMODnet Physics is using Google analytics to track users' behaviour.

Table 20

Portal[44]	Visits	Visit duration (average)	Page views	New visitors	New visitors %
June 2013	325	03:51	740	190	58%
July 2013	284	02:01	466	185	65%
August 2013	242	02:26	486	143	59%
September 2013	280	01:29	458	192	69%
October 2013	385	02:21	783	270	70%
November 2013	355	02:26	688	260	73%
December 2013	311	02:42	658	211	68%
January 2014	272	01:57	505	166	61%
February 2014	377	04:00	1007	191	50%
March 2014	342	02:06	686	191	56%
April 2014 (1st-18th)*	210	02:35	465	115	55%
April 2014 (18th-30th)	124	06:38	627	64	51%
May 2014	579	05:33	2014	191	33%
June 2014	282	03:49	685	155	57%
July 2014	188	01:40	347	110	58%
August 2014	190	01:55	492	105	55%
September 2014	280	03:02	705	160	67%
October 2014	280	02:54	693	133	65%
November 2014	462	02:44	1237	252	55%
December 2014	315	02:16	671	176	56%
January 2015	294	02:47	664	159	54%
February 2015	293	02:19	536	168	57%
March 2015	263	02:07	479	146	55%

[44] http://www.emodnet-physics.eu/

April 2015	230	01:42	416	147	64%
May 2015	249	04:08	1103	147	51%
June 2015	281	02.38	615	156	55%
July 2015	249	02:47	558	122	67%
August 2015	191	01:28	443	98	73%
September 2015	191	01:27	325	114	60%
October 2015	280	02:18	661	161	58%
November 2015	194	01:37	494	92	47%
December 2015	255	02:10	495	124	49%
January 2016	238	02:59	667	110	46%
February 2016	262	02:14	520	119	45%
March 2016	294	01:15	546	150	74%
April 2016	271	00:59	205	164	60%
May 2016	514	02:45	1412	352	68%
June 2016	363	03:29	1107	204	68%
July 2016	237	01:10	485	202	69%

Table 21

Map Page[45]	Visits	Visit duration (average)	Page views	New visitors	new visitors %
November 2013	247	09:41	1210	42	17%
December 2013	263	11:37	1520	55	21%
January 2014	345	10:20	1671	38	11%
February 2014	426	08:38	2031	130	31%
March 2014	502	06:29	2005	176	35%
April 2014	440	06:27	1452	162	36%
May 2014	582	05:32	2040	193	33%
June 2014	534	05:37	2102	188	39%
July 2014	432	08:31	2724	128	30%
August 2014	334	07:20	2514	102	33%
September 2014	554	06:36	3869	158	31%
October 2014	442	07:42	4533	136	31%
November 2014	590	07:08	5726	209	35%
December 2014	669	05:57	5118	316	47%
January 2015	684	07:29	6458	306	45%
February 2015	559	05:32	5160	232	41%
March 2015	893	05:38	7486	524	59%
April 2015	713	05:44	6583	444	62%
May 2015	1112	03.51	6338	796	71%
June 2015 (*)	1261	03:15	6706	921	72%
July 2015	1075	05:50	6799	729	67%
August 2015	861	04:47	4630	582	67%
September 2015	698	04:36	4049	367	53%
October 2015	833	06:06	5372	351	42%
November 2015	1212	02:48	5230	808	67%
December 2015	846	05:35	5381	481	56%
January 2016	839	05:53	5320	408	49%
February 2016	842	07:12	5922	273	33%
March 2016	1092	09:24	7880	318	29%
April 2016	840	07:10	5152	309	35%

[45] http://www.emodnet-physics.eu/map

May 2016	918	07:25	6168	306	33%
June 2016	872	07:16	5879	331	38%
July 2016	718	05:41	3996	355	43%

Indicator 7. List of what the downloaded data has been used for (divided into categories e.g. Government planning, pollution assessment and (commercial) environmental assessment, etc.)

Most of the users are using data for model assimilation and forecast, validation and re-analysis (e.g. MeteoFrance, Deltares, DLTM, DHI (commercial), and RINA – D'Appolonia (commercial)) or local analysis. We recorded an increasing number of contributors that are using EMODnet Physics to check if their data/system are working and feeding the infrastructure (SMHI, IFREMER, BSH, HCMR, CNR, etc.).

EMSA is using EMODnet Physics services (WFS and Web Services) for operational purpose (e.g. S&R - Search and Rescue activities)

Considering the direct contacts and interactions with users on the data requests, "waves and winds" and "sea level" groups are likely to be the most interesting to them.

Indicator 8. List of web-services made available and user organisations connected through these web-services

EMODnet Physics is offering different web-services and machine-to-machine data distribution services. By means of a GeoServer based infrastructure, EMODnet Physics is offering OGC compliant catalogues and services (WMS, WFS, etc.). The following links redirect to the landing page of each of the available service and Annex 4 presents the available features and services in details.

- WEB SERVICE: www.emodnet-physics.eu/map/service/WSEmodnet2
- WMS: www.emodnet-physics.eu/map/service/GeoServerDefaultWMS
- WFS: www.emodnet-physics.eu/map/service/GeoServerDefaultWFS
- THREDDS: thredds.emodnet-physics.eu:8080/thredds/catalog.html
- SEXTANT: http://sextant.ifremer.fr/en/web/emodnet_physics/catalogue
- GEOSERVER: http://151.1.25.219:8181/geoserver/web/

Annex 1. Maritime Economic Activities

Table 22 presents the preliminary analysis on possible contributions to Maritime Economic Activities of EMODnet Physics.

Table 22 - List of Maritime Economic activities (MEA) (*Source: FWC MARE/2012/06-SC D1/2013/01: Support Activities for the development of maritime clusters in the Mediterranean and Black Sea areas. Annex III*) to which EMODnet Physics can provide data and products

Maritime Economic Activities		Short description	Data provided
0.2	Construction of water projects	This sector includes the construction of waterways, harbour and river works, pleasure ports (marinas), dams and dykes. Activities such as dredging of waterways are also included.	Currents, waves, Atmospheric conditions, sea level, tides
1.1	Deep-sea shipping	International (freight) transport by sea with large vessels that often sail fixed routes (containers, major bulks) or tramp shipping. Port services, e.g. operating terminals, handling cargoes, storage, VAL, port management.	Currents, waves, Atmospheric conditions, sea level tides, ice cover
1.2	Short-sea shipping	National and international freight transport within Europe and to/from neighbouring countries with medium sized ships. Port services, e.g. operating terminals, handling cargoes, storage, VAL, port management. The same segments are found as under deep-sea shipping.	Currents, waves, winds, sea level, tides, ice cover
1.3	Passenger ferry services	Transporting passengers on fixed sea routes, national and international. Mainly intra-European. Sometimes this is combined with RoRo transport.	Currents, waves, Atmospheric conditions, sea level, tides, ice cover
3.1	Offshore oil and gas	Extraction of liquid fossil fuels from offshore sources.	Currents, waves, Atmospheric conditions, sea temperature, ice cover
3.2	Offshore wind	Construction of wind parks in marine waters and exploitation of wind energy by generating electricity offshore.	Currents, waves, Atmospheric conditions
3.3	Ocean renewable energy	Offshore development and exploitation of a variety of renewable energy sources excluding wind, including wave	Currents, waves, Atmospheric conditions

		energy, tidal energy, Ocean Thermal Energy Conversion, Blue energy (osmosis) and biomass.	
4.1	Coastal tourism	Shore based sea related tourist and recreational activities.	Currents, waves, Atmospheric conditions, sea level, temperature, salinity, pH, Turbidity
4.2	Yachting and marinas	This activity is strongly interlinked with coastal tourism. It can be defined as coastal tourism including the use of yachts and other pleasure boats and excluding cruise.	Currents, waves, Atmospheric conditions
4.3	Cruise tourism	Tourism based on people travelling by cruise ship, having the ship itself as their home base of holidays and making visits to places called at during the trip.	Currents, waves, Atmospheric conditions, temperature
5.1	Coastal protection	Protection against flooding and erosion, preventing saltwater intrusion, protection of habitats.	Currents, waves, Atmospheric conditions
6.1	Surveillance	Equipment and services used for security purposes in the field of maritime transportation; surveillance of the EU coastal borders using a variety of services, technologies and dedicated equipment.	Currents, waves, Atmospheric conditions, sea level, temperature, salinity, ice cover
6.2	Environmental monitoring	Marine environmental monitoring is not a clear-cut function. It may cover water quality, temperature, pollution, fisheries etc.	Currents, waves, sea level, temperature, salinity, O2, Fluorescence, pH, Turbidity.

Table 23 shows the monitoring parameters that EMODnet Physics can provide to the Marine Strategy Framework Directive.

Table 23

Ref. No	PARAMETER	MSFD indicator
39	Acidification	1.6.3
43	Currents	1.6.3, 7.2.2
46	Ice cover	1.6.3
48	Mixing characteristics	1.6.3
50	Oxygen	1.6.3, 5.3.2
51	Residence time	1.6.3
52	Salinity	1.6.3
60	Temperature	1.6.3
61	Turbidity	1.6.3, 5.2.2
62	Underwater noise	11.1.1, 11.2.1
63	Upwelling	1.6.3
64	Wave exposure	1.6.3

Table 24 shows the monitoring parameters that EMODnet Physics can provide to the Water Framework Directive.

Table 24

Ref. num.	WFD PARAMETER	Relevant MSFD parameter of Annex III	Relevant MSFD indicator
22	Acidification	39	1.6.3
26	Oxygenation	50	5.3.2, 1.6.3
30	Conductivity		1.6.3
32	Direction of Dominant Currents	43	1.6.3
34	pH	39	1.6.3
35	Salinity	52	1.6.3
36	Temperature	60	1.6.3
37	Transparency	61	1.6.3, 5.2.2
38	Residence Time	51	1.6.3

Annex 2. Producing contiguous data

- **The challenges to producing contiguous data over a maritime basin from fragmented, inhomogeneous data and how to overcome these challenges**

1. *Introduction*

Many methodologies are used to interpolate in situ data in order to represent a physical state in a particular time period. Some of them are based on statistics, others on knowledge of phenomenological scales. There are also methodologies that take into consideration the dynamics of marine circulation.
Observations always have inaccuracies. In general terms, it is supposed that observations are the sum of many independent processes and have a normal, or nearly normal, Gaussian distribution. Statistic theory provides powerful methods of obtaining the most reliable information possible from a set of observations. The principles behind these methods can be derived from the principle of maximum likelihood, if the errors follow the Gaussian distribution.

In general, for a fixed set of data and the underlying statistical model, the method of maximum likelihood selects the set of values of the model parameters that maximizes the likelihood function. Intuitively, this maximizes the "agreement" of the selected model with the observed data, and for discrete random variables it indeed maximizes the probability of the observed data under the resulting distribution. Maximum-likelihood estimation gives a unified approach to estimation, which is well-defined in the case of normal distribution and many other problems.

In addition to the observational inaccuracies, in oceanography there is another problem related to the uneven temporal and spatial coverage of the observations.

Figure 42 shows a data coverage from different platforms in a period of 7 days, including most of the stations along coasts. Data in each place includes signals on different temporal and spatial scales.

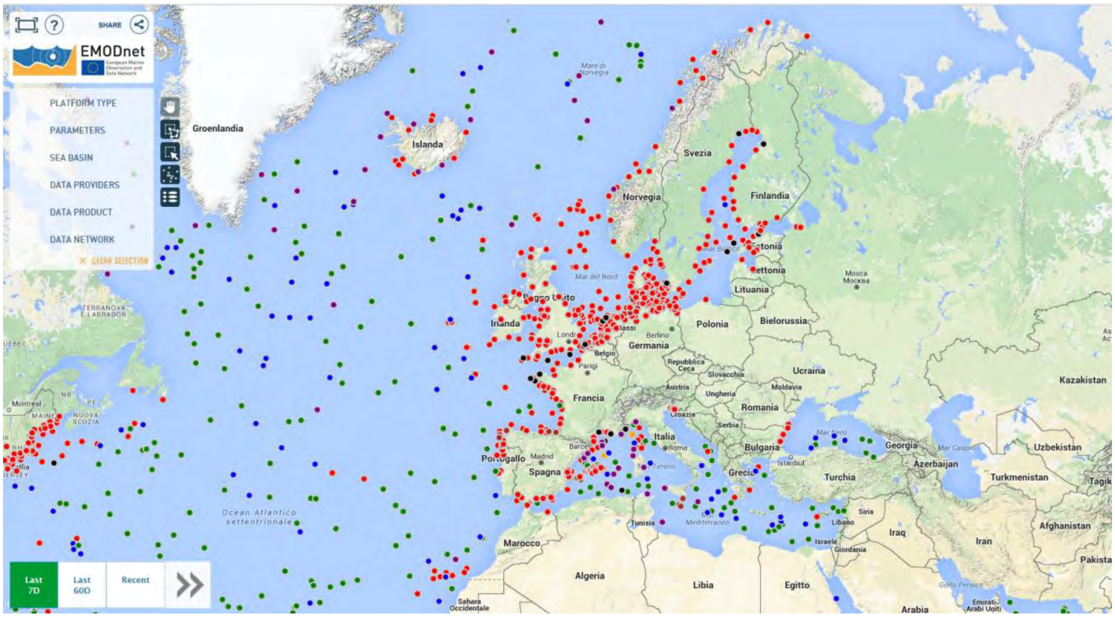


Figure 42 – EMODnet Physics last 7 days

Two inhomogeneous data distributions are considered in this short report: temporal and spatial.

2. One dimensional interpolation

The example considers a data point sequence i.e. time series. In oceanography, there are very frequently a number of data points, obtained by sampling, representing the values of a function for a limited number of values of the independent variable. It is often necessary to interpolate (i.e. estimate) the value of that function for an intermediate value of the independent variable. This may be achieved by curve fitting or regression analysis. In the mathematical field of numerical analysis, interpolation is a method of constructing new data points within the range of a discrete set of known data points.

The simplest interpolation method is to locate the nearest data value, and assign the same value.

- **Linear interpolation** is quick and easy, but it is not very precise. Another disadvantage is that the interpolant is not differentiable at the point x_k.
- **Polynomial interpolation** is a generalization of linear interpolation. Generally, if we have n data points, there is exactly one polynomial of degree at most n−1 going through all the data points. The interpolation error is proportional to the distance between the data points to the power n. Furthermore, the interpolant is a polynomial and thus infinitely differentiable. Therefore, we see that polynomial interpolation overcomes most of the problems of linear interpolation. However, polynomial interpolation also has some disadvantages. Calculating the interpolating polynomial is computationally expensive (see computational complexity) compared to linear interpolation. Furthermore, polynomial interpolation may exhibit oscillatory artefacts, especially at the end points

(see Runge's phenomenon). Polynomial interpolation can estimate local maxima and minima that are outside the range of the samples, unlike linear interpolation. However, these maxima and minima may exceed the theoretical range of the function—for example, a function that is always positive may have an interpolant with negative values, and whose inverse therefore contains false vertical asymptotes. More generally, the shape of the resulting curve, especially for very high or low values of the independent variable, may be contrary to common sense, i.e. to what is known about the experimental system which has generated the data points. These disadvantages can be reduced by using spline interpolation or restricting attention to Chebyshev polynomials.

- **Spline interpolation** uses low-degree polynomials in each of the intervals, and chooses the polynomial pieces such that they fit smoothly together. Like polynomial interpolation, spline interpolation incurs a smaller error than linear interpolation and the interpolant is smoother. However, the interpolant is easier to evaluate than the high-degree polynomials used in polynomial interpolation. It also does not suffer from Runge's phenomenon.
- **Gaussian process** is a powerful non-linear interpolation tool. Many popular interpolation tools are actually equivalent to particular Gaussian processes. Gaussian processes can be used not only for fitting an interpolant that passes exactly through the given data points but also for regression, i.e., for fitting a curve through noisy data. In the geostatistics community Gaussian process regression is also known as Kriging.

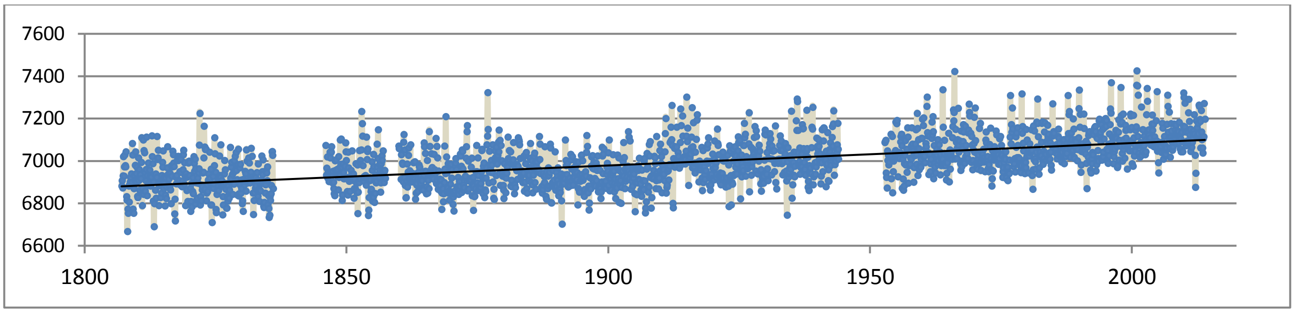


Figure 43 - The monthly sea level data in Brest. Data from PSMSL

This short section of interpolation methods is not exhaustive. An example of application of interpolation techniques is provided using the monthly sea level data in Brest from PSMSL. The entire time series is shown in Figure 43

There are long periods without data and it is impossible to make an interpolation except one that is related to a linear trend, calculated from the time series.

In the same time series, there are gaps for very short periods that can be filled with any of the methods described above. Figure 44 is a subset of the series shown in Figure 43. There are two gaps the first one filled by using a polynomial fit (the same can be done with the second gap).

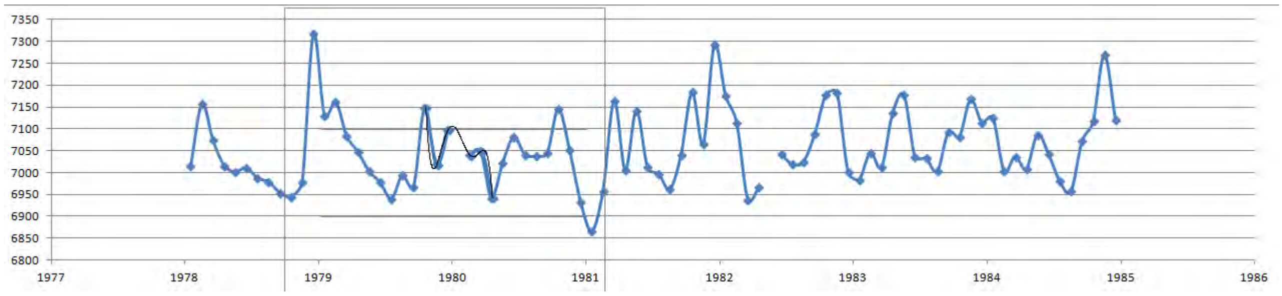


Figure 44 - Subset of the monthly sea level in Brest. The black line is the polynomial interpolation used to fill a short period gap.

3. *Spatial interpolation*

Ocean Data View (ODV - https://odv.awi.de/) is a proprietary, freely available, software package for the analysis and visualization of oceanographic and meteorological data sets. The software displays data values on a map.

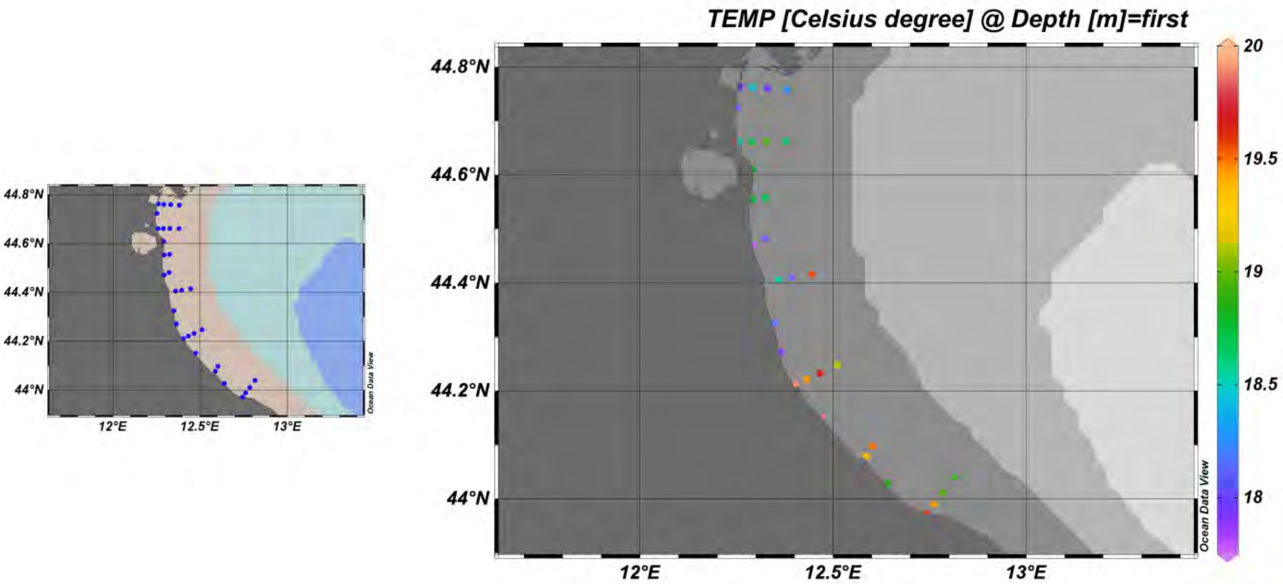


Figure 45 - Temperature data mapped with ODV

Ocean Data View also includes options that permit an objective analysis by means of

1) quick gridding for which an equidistant, rectangular grid is used
2) weighted-average gridding for which grid-spacing along the X and Y directions varies according to data density. High resolution (small grid-spacing) is provided in regions with high data density, whereas in areas of sparse sampling a coarser grid with reduced resolution is used

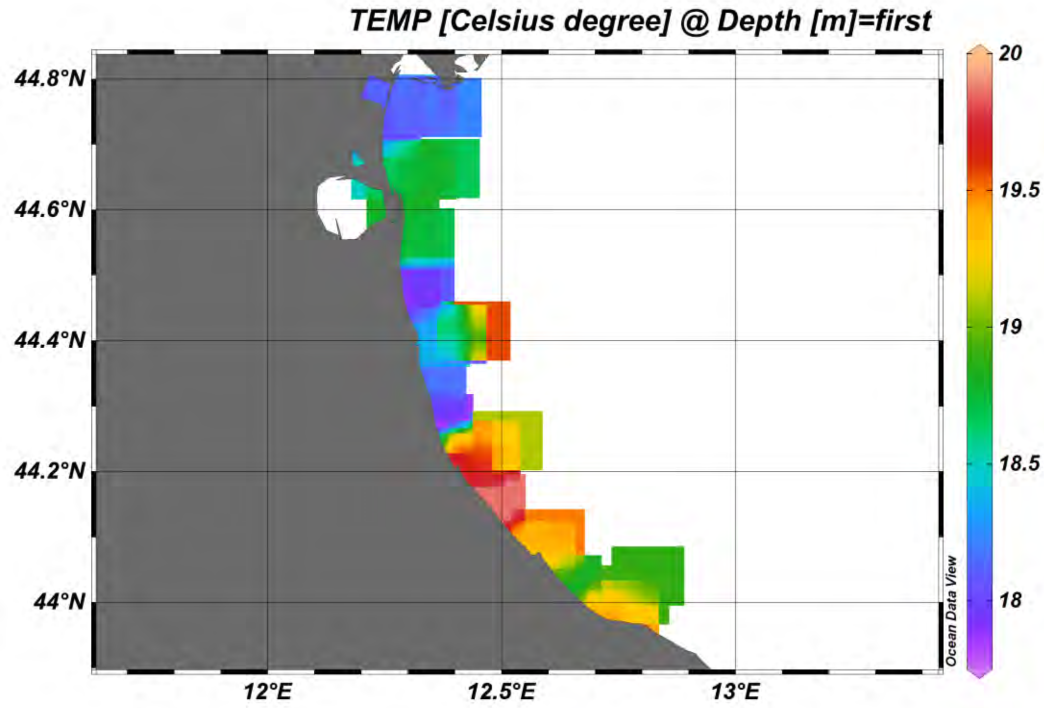


Figure 46 - The data shown in Figure 45 mapped with a quick gridding algorithm

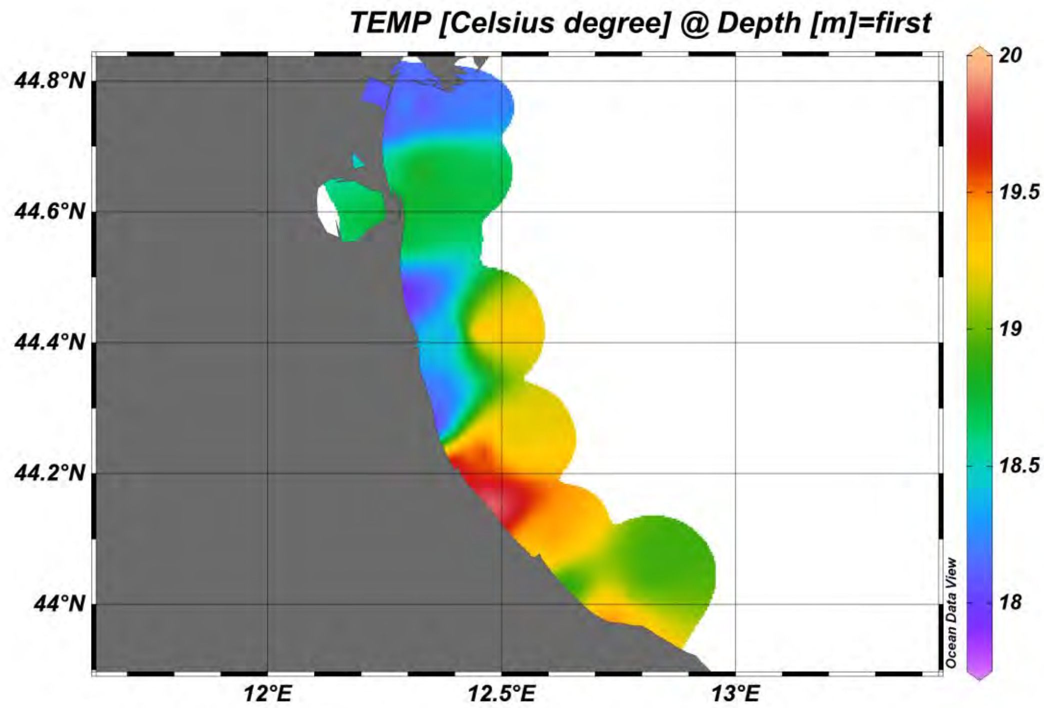


Figure 47 - The data shown in Figure 46 mapped with a weighted-average gridding algorithm

One popular interpolation method is **DIVA (Data-Interpolating Variational Analysis)** allows the spatial interpolation/gridding of data (analysis) in an optimal way, comparable to optimal interpolation (OI), taking into account uncertainties on observations. In comparison to standard OI, used in Data assimilation, DIVA, when applied to ocean data, takes into account coastlines, sub-basins and advection because of its variational formulation on the real domain.

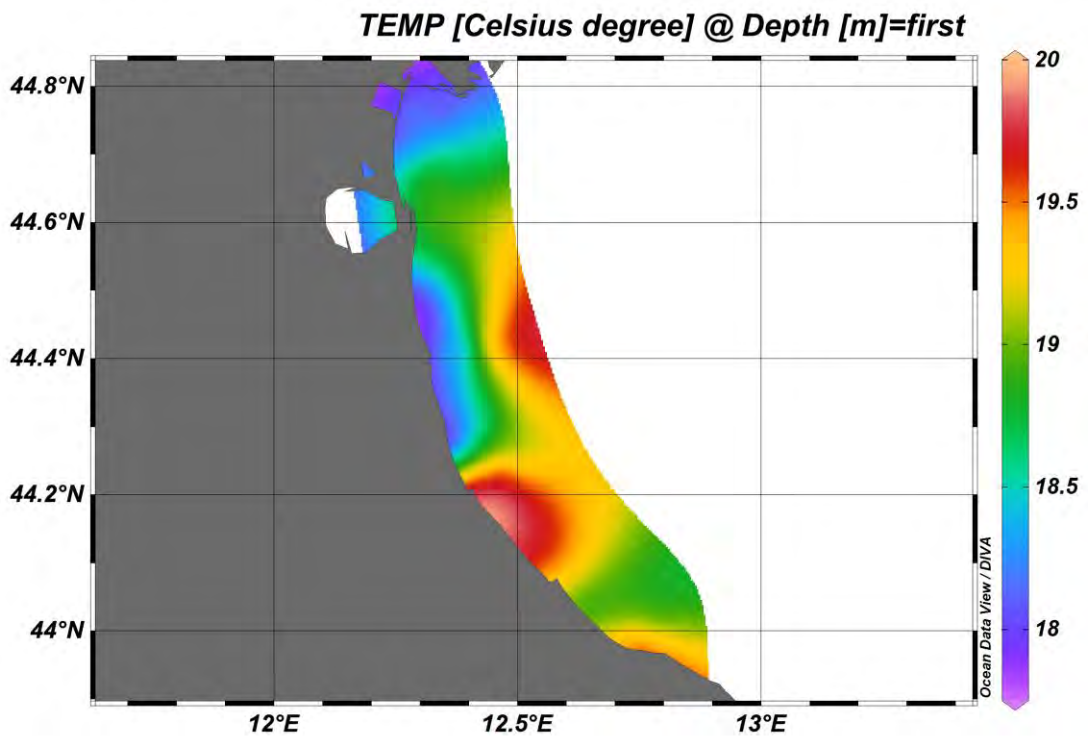


Figure 48 - The data shown in Figure 46 mapped with DIVA algorithm

Processing is highly optimised and relies on a finite element resolution. Tools to generate the finite element mesh are provided as well as tools to optimise analysis parameters. Quality control of data can be performed and error fields can be calculated. Also detrending of data is possible. Finally, 3D and 4D extensions are included with emphasis on direct computations of climatologies from ODV spreadsheet files.

The software, the first version of which has been available since 1996, can now be downloaded at the DIVA site (http://modb.oce.ulg.ac.be/mediawiki/index.php/DIVA) and is the reference tool for calculating climatologies within the SeaDataNet projects. It has also been included as the state-of-the art gridding method in Ocean Data View.

Data assimilation or, more-or-less synonymously, data analysis is the process by which observations of the actual system are incorporated into the model state of a numerical model of that system. Applications of data assimilation arise in many fields of geosciences, perhaps most importantly in weather forecasting and oceanography.

The analysis combines the information in the background with that of the current observations, essentially by taking a weighted mean of the two; using estimates of the uncertainty of each to determine their weighting factors. The data assimilation procedure is invariably multivariate and includes approximate relationships between the variables. The observations are of the actual system, rather than of the model's incomplete representation of that system, and so may have different relationships between the variables from those in the model. To reduce the impact of these problems incremental analyses are often carried out; the analysis procedure determines increments which, when added to the background, yield the analysis. As the increments are generally small compared to the background values, this leaves the analysis less affected by 'balance' errors in the analysed increments. Even so some filtering, known as initialisation, may be required to avoid problems, such as the excitement of unphysical waves like activity or even numerical instability, when running the numerical model from the analysed initial state.

4. *Synthetic oversampling*

The ocean is dramatically under-sampled and this is the main problem that pressured the development of interpolation techniques, some of which have been described in the previous chapter. A way to add ‘stations’ in a particular area can be obtained using a Montecarlo method, that is derived from the Gaussian interpolation presented previously. An exercise was carried out using an initial dataset composed of 98 CTD casts of temperature / salinity vertical profiles, collected in February 19 - 22, 2007 over an area of about 90x100 km in the northern Adriatic sea by CNR-ISMAR from Bologna and the Emilia-Romagna regional environmental agency – Daphne (Figure 49A). The vertical resolution of profiles was reduced to 1 metre.

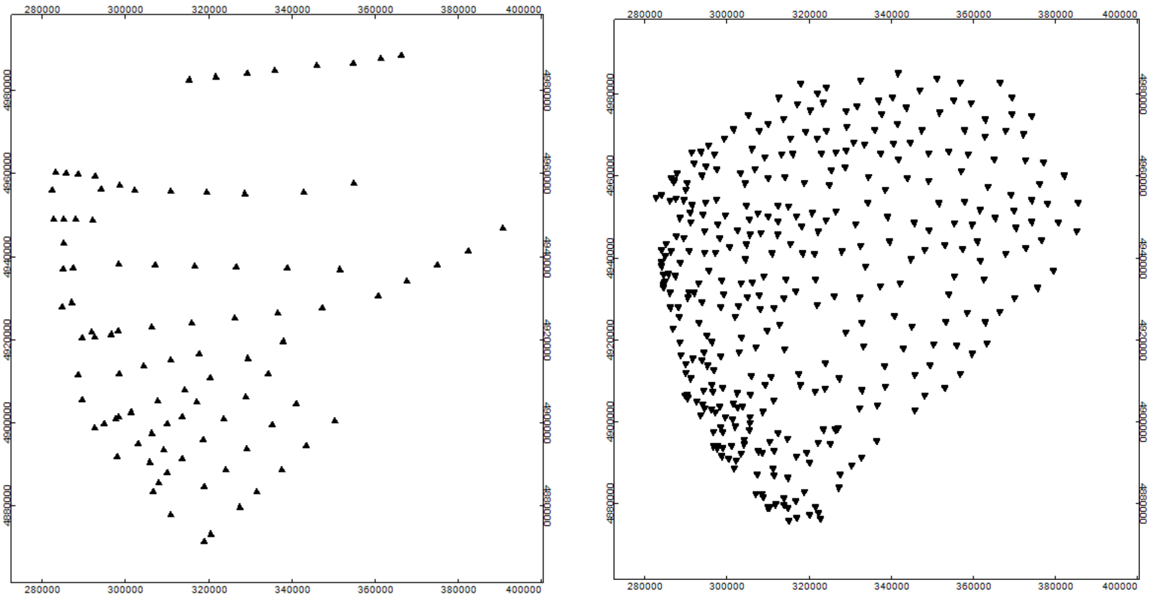


Figure 49 - The initial dataset (left A), the simulated dataset (right B)

The algorithm finds, within the area, a number of randomly simulated stations and for each of them computes seawater temperature and salinity vertical profiles.

5. Definition of randomly placed stations

In the open sea, the sampling strategy is based on the internal radius of deformation. In coastal and shelf areas, this concept cannot be applied and different criteria must be defined. The simulation locations, which are the points where T/S profiles will be calculated, are randomly defined with constraints based on the nearest neighbour distance and the local sea depth. The algorithm uses a recursive logical structure to find a suitable location that assures both randomness and homogeneity inside to pre-defined depth ranges which correspond to adjacent polygons on the sea surface.

In detail, the iterative procedure is the following:

- The original bathymetric data are interpolated to have a new bathymetric chart with a resolution of 50 m;
- The area is divided in strips defined by the bathymetries of 0-7, 7-15, 15-35 and greater than 35 metres;
- For each of these strips, the number of stations to be simulated and the minimum distance between stations are defined;
- The randomly generated positions that respect the above conditions are accepted as part of the 'synthetic' oversampling.

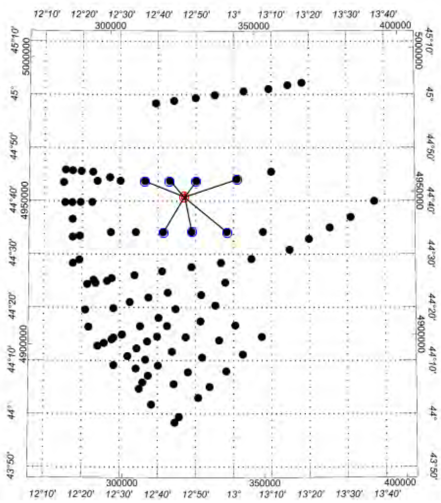


Figure 50 - A subset of neighbour points

This way, the goal of having a random sampling with a bathymetric controlled wavelength is achieved.

The new bathymetry with 50 m resolution, defined in the step 1 of the procedure, is reconstructed from the metadata contained in the initial dataset using bi-dimensional cubic interpolation. In total, 458 "synthetic" stations have been randomly placed in the area.

For each of the previously simulated locations the algorithm selects a number of neighbour stations among the sampled dataset. These stations are selected accordingly to a search radius empirically defined hereafter:

$$sR = -1{,}758z \quad 2 \quad + \quad 172{,}4z \quad + \quad 139{,}0$$

where sR is the search radius [m] and z [m] is the sea depth at the i-th simulated location.

Figure 50 shows the initial dataset (black filled dots) and a subset of neighbour points (black dots outlined with blue), selected by the algorithm during the simulation of temperature and salinity profile at a specific location (red dot).

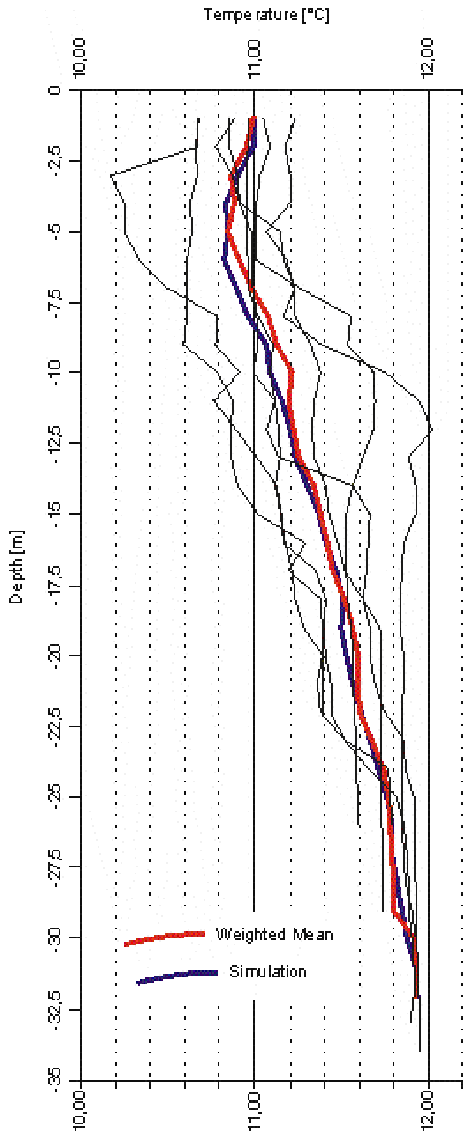


Figure 51 - An example of temperature profile simulation at a specific site. Thin black lines show neighbour's data

6. Simulation of temperature

For each simulated location, a certain number of neighbour observed profiles are selected and the temperature values at each depth are evaluated by a random value within the data envelop. Considering

$$T_m(z) = \{T_{m1}(z), T_{m2}(z), \ldots, T_{mn}(z),\}$$

where $T_m(z)$ is the set of the temperature values sampled at a specific depth *z* in all *n* neighbour stations and $\hat{T}_m(z)$ is the mean averaged temperature profile :

$$\hat{T}_m(z) = \frac{\sum_{i=1}^{N} T_{mi}(z) W_m(z)}{\sum_{i=1}^{N} W_m(z)}$$

where $W_m(z)$ is the weight of the "*ith*" neighbour station data defined as an inverse function of the distance between the station itself and the current simulation station.

The weighted variance $\sigma_{mw}(z)$ is defined in the same way.

Since the observed temperatures show a near normal distribution, a set, $T_s(z)$ of simulated temperature values is randomly generated with normal distribution so as to respect the following :

$$\hat{T}_m(z) - k\sigma_{mw}(z) \leq T_s(z) \leq \hat{T}_m(z) + k\sigma_{mw}(z)$$

where $0 \leq k \leq p$, *p* being a positive real number and *k* being a user defined value as a measure of overall variability allowed in the simulation procedure. High *k* values (≥ 3) give too noisy simulations.
In that case, a third degree polynomial spline is applied to smooth the simulated temperature profile.

7. Simulation of salinity

For the calculation of salinity a third degree polynomial spline is calculated from T/S diagrams (Figure 52) of all sampled data. Using this polynomial function, a corresponding salinity vertical profile is calculated from any temperature value. This method assures the stability of the density profiles in the water column.

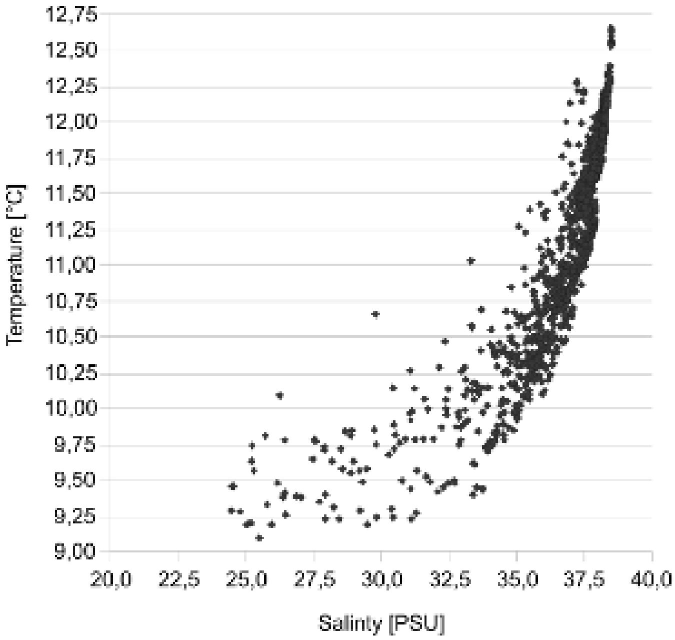


Figure 52 - Salinity vs. temperature plot of observed data

8. Temperature Maps

Map of temperature observed at the surface is shown in Figure 53, the temperature map at the surface, obtained from simulated over-sampling is shown in Figure 54. Maps have been obtained applying a minimum curvature algorithm. Grid size in figures is 1000m, contour interval is equal to 0.25°C.

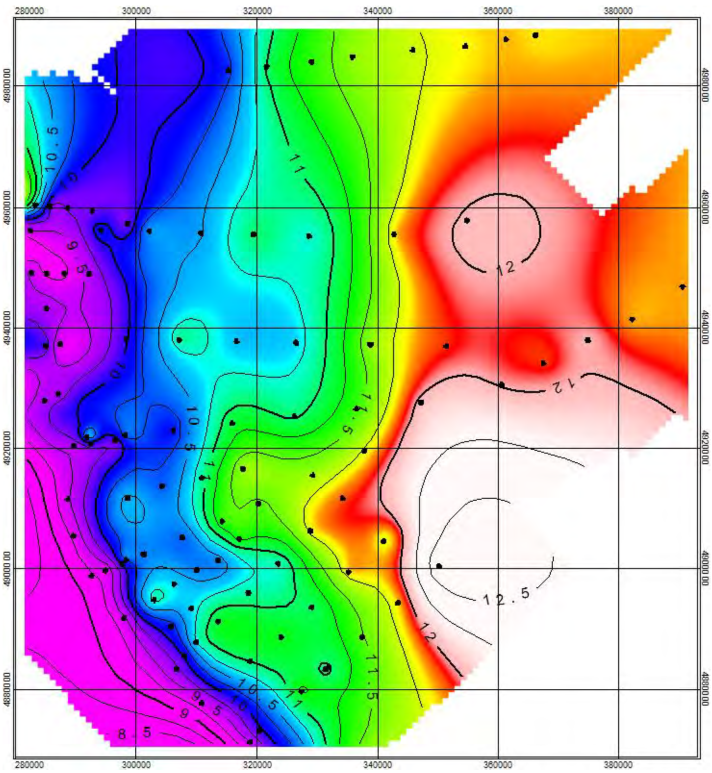


Figure 53 - Observed data, temperature at the sea surface, contour interval = 0.25 °C; black dots : observation points

The original data (Figure 53) shows a general north-south alignment of isotherms with few meanders. The coastal area is characterised by the presence or relatively cold water coming from rivers.

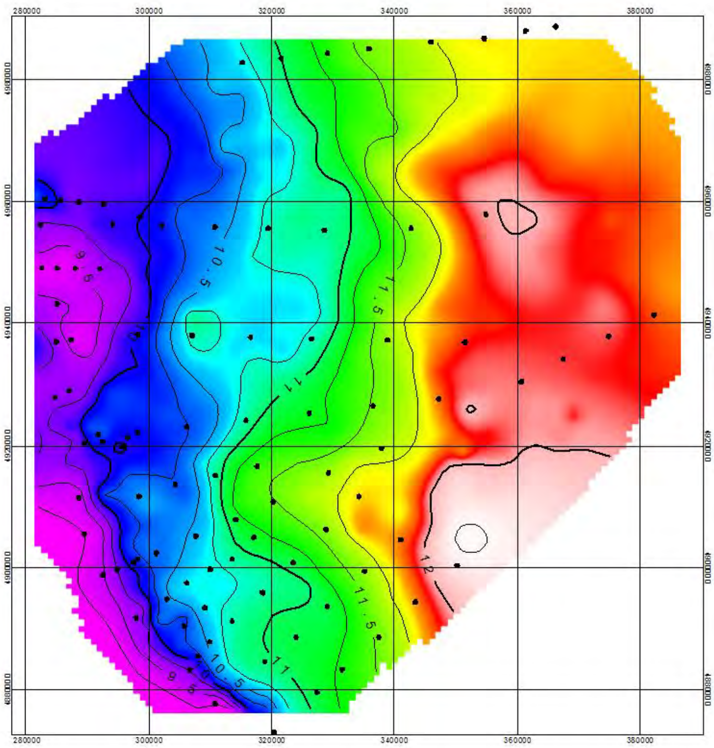


Figure 54 - Synthetic data, temperature at the sea surface, contour interval = 0.25 °C; black dots : observation points

The shelf water is warmer and is divided from the coastal water by significant thermal gradients. Figure 54 shows that three different water masses could be defined: coastal, shelf and transitional water, comprised between 10.75 and 11.75 °C. The general behaviour of original data is maintained in the "synthetic" map, but more complex features are created by the over-sampling. The three water masses are occupying the same areas and the thermal gradient dividing them is maintained. However, meanders are much more pronounced when compared to the smoother behaviour of the original data. In general, short wave-length components are added to the original data.

9. Salinity Maps

“Synthetic” salinity is calculated from T-S diagram as explained in par. 7. Figure 55 and Figure 56 shows observed and estimated data respectively. The salinity field shows the presence of three water masses. The separation of coastal waters from the transitional layer is characterised by a significant haline gradient. The shelf water is spatially homogeneous.

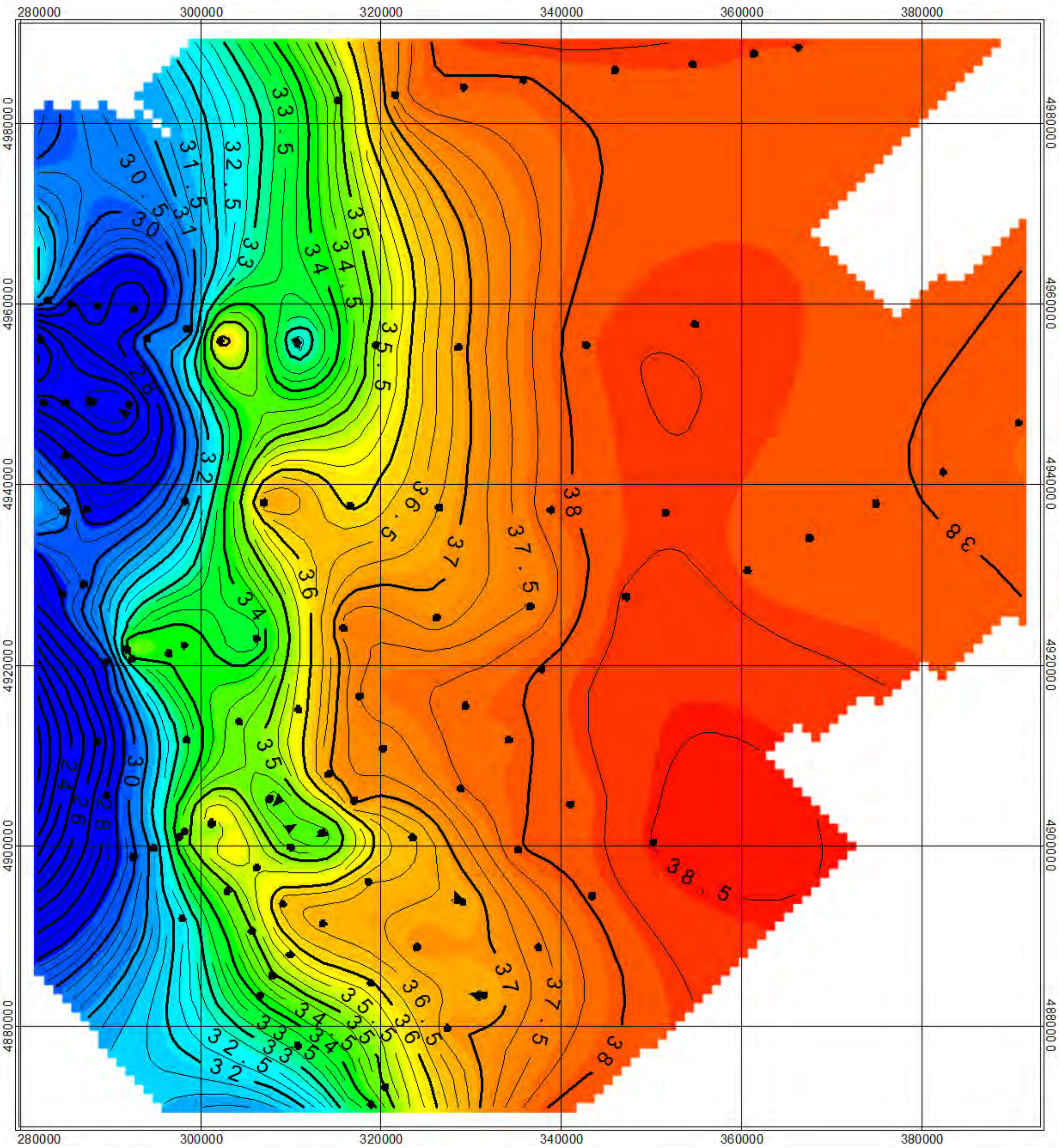


Figure 55 - Observed data, salinity at the sea surface, contour interval = 0.25 PSU; black dots : observation points

In general, the “synthetic” salinity present meanders at the limit of the coastal waters and a minor spatial homogeneity on the shelf area.

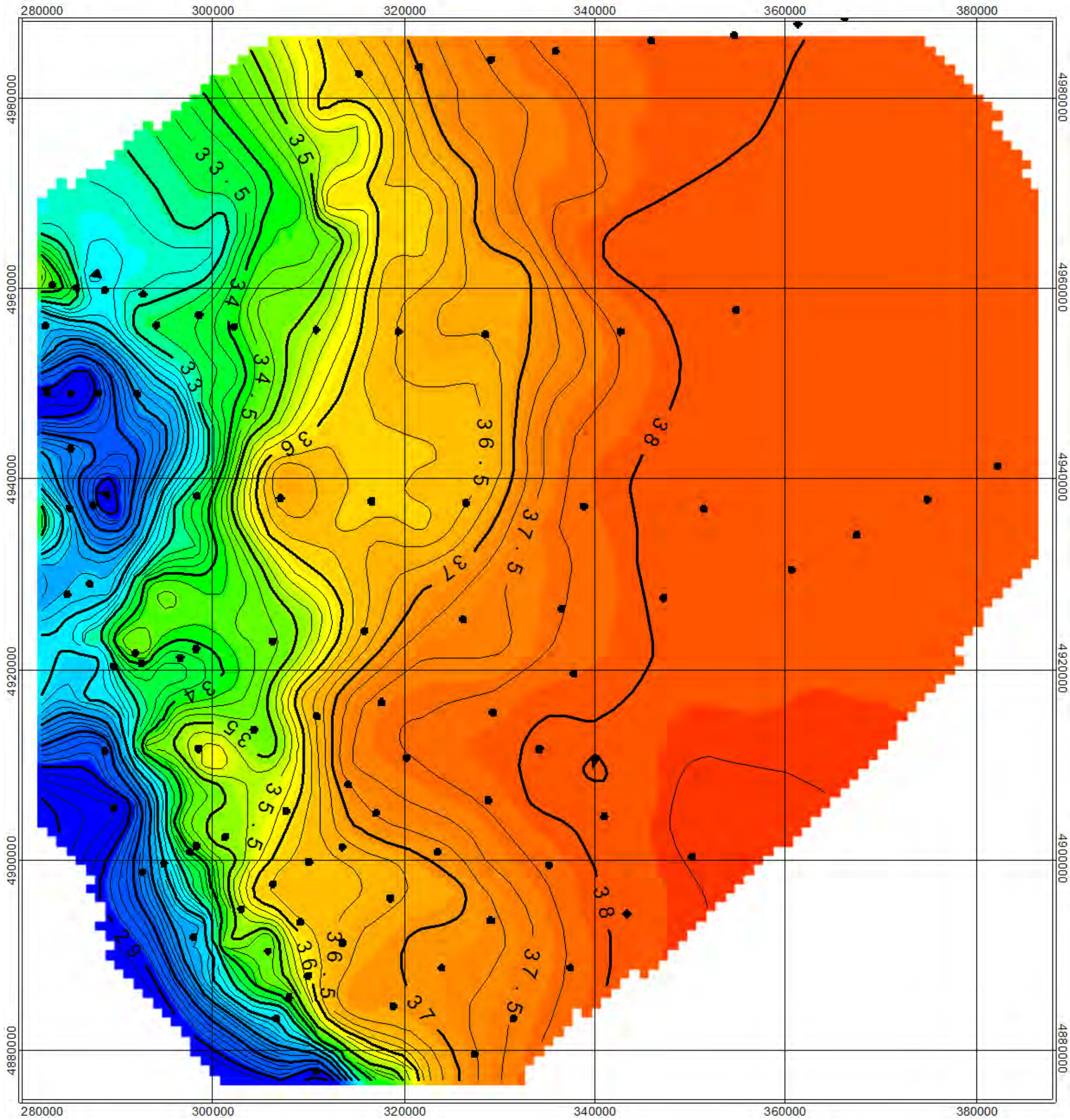


Figure 56 - Simulated data, salinity at the sea surface, contour interval = 0.25 °PSU; black dots : observation points

10. Conclusions

The one-dimensional interpolation, although presenting problems related to the addition of errors, can provide results that can be quite easily and clearly interpreted. Very different is the 2D, 3D or even 4D interpolation. Existing techniques can provide different maps. Data assimilation is a powerful tool, but needs quite a complex machinery. A Gaussian – Montecarlo method has been applied to a particular case, but also in this case the production of maps is quite complex.

The only conclusion is that the different methods should be applied and the interpretation of the products must be agreed by a community of practice.

11. References

- *Crochiere R.E., L.R. Rabiner. (1983). Multirate Digital Signal Processing. Englewood Cliffs, NJ: Prentice–Hall.*
- *Young H.D. (1962) Statistical Treatment of Experimental Data. McGraw-Hill*
- *Wahba G. (1990). Spline Models for Observational Data 59. SIAM. p. 162.*
- *Williams, C. K. I. (1998). "Prediction with Gaussian Processes: From Linear Regression to Linear Prediction and Beyond". Learning in Graphical Models. pp. 599–621. doi:10.1007/978-94-011-5014-9_23. ISBN 978-94-010-6104-9.*

Annex 3. Data for measuring ecosystem health

- **The fitness for purpose of the data for measuring ecosystem health of the maritime basin and what might be done to overcome any shortcomings**

Fitness for purpose means that data sets or data set series should be suitable for the intended purposes and is a principle of quality assurance, that is the 'set of planned and systematic actions necessary to provide appropriate confidence that a product or service will satisfy the requirements for quality[46].

Quality Assessment includes management of the quality of materials, assemblies, products and components, services related to production, and management, production and inspection processes.

On the base of ISO19115-1:2014(E) and ISO19157:2013(E) data producers are creating data sets or data set series to satisfy the purposes for their intended uses. In marine science, data producers and users are (in most of the cases) the same group of communities. However, to understand better their needs it is necessary suppose that they are different communities with different requirements. Data set or data set series could be used with intentions different from the one for which they were originally created.
The difference between data producers and data users was considered in the first Data Adequacy Report of EMODnet Mediterranean Checkpoint, where the concept was elaborated in terms of 'Universe of Discourse'[47].

[46] http://library.oceanteacher.org/OTMediawiki/index.php/Marine_Data_Quality_Assurance

[47] http://www.emodnet-mediterranean.eu/wp-content/uploads/2015/06/D11.2-revised-V11.pdf

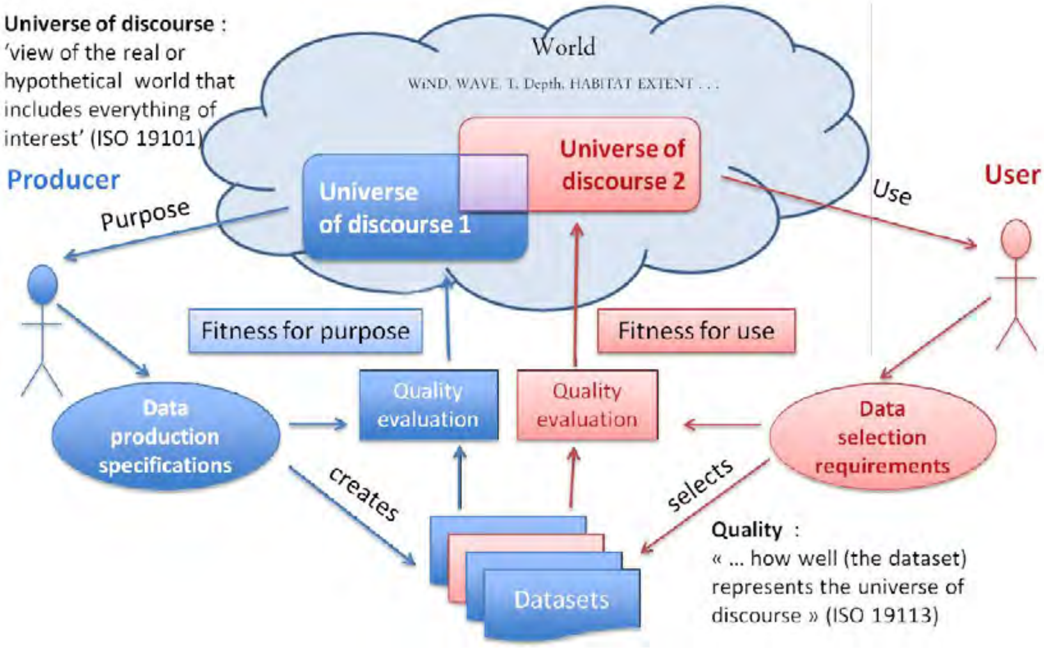


Figure 57. ***Universe of Discourse (from EMODnet Mediterranean Checkpoint [3])***

According to Arndt and Langbein[48], information quality means consistently meeting the information customer's expectations.

Information quality means the degree to which information has content, form, and time dimensions that give it value to specific end users (O'Brein[49]).

ISO standards for cataloguing the information includes:

- 8601 Representation of date and time
- 19108 Temporal characteristics of geographic information
- 19113 revised by 19157 standard for geographic information
- 19115 Geographical information metadata
- 19119 Taxonomy of services
- 19139 Geographical information metadata implementation specification

The product quality model defined in ISO/IEC 25010 comprises quality characteristics shown in figure below:

[48] Arndt, D. and N. Langbein (2002). Data Quality in the Context of Customer Segmentation. International Conference on Information Quality.

[49] O'Brien, J. A. (2003). Introduction to Information Systems (Twelfth Edition), Mc Graw-Hill/Irwin.

Product Quality - ISO/IEC 25010

Characteristics	Sub-Characteristics	Definition
Functional Suitability	Functional Completeness	degree to which the set of functions covers all the specified tasks and user objectives
	Functional Correctness	degree to which the functions provides the correct results with the needed degree of precision.
	Functional Appropriateness	degree to which the functions facilitate the accomplishment of specified tasks and objectives
Performance Efficiency	Time-behavior	degree to which the response and processing times and throughput rates of a product or system, when performing its functions, meet requirements.
	Resource Utilization	degree to which the amounts and types of resources used by a product or system, when performing its functions, meet requirements.
	Capacity	degree to which the maximum limits of the product or system, parameter meet requirements.
Compatibility	Co-existence	degree to which a product can perform its required functions efficiently while sharing a common environment and resources with other products, without detrimental impact on any other product
	Interoperability	degree to which two or more systems, products or components can exchange information and use the information that has been exchanged.
Usability	Appropriateness recognisability	degree to which users can recognize whether a product or system is appropriate for their needs.
	Learnability	degree to which a product or system enables the user to learn how to use it with effectiveness, efficiency in emergency situations.
	Operability	degree to which a product or system is easy to operate, control and appropriate to use.
	User error protection	degree to which a product or system protects users against making errors.
	User interface aesthetics	degree to which a user interface enables pleasing and satisfying interaction for the user
	Accessibility	degree to which a product or system can be used by people with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use.
Reliability	Maturity	degree to which a system, product or component meets needs for reliability under normal operation.
	Availability	degree to which a product or system is operational and accessible when required for use.
	Fault tolerance	degree to which a system, product or component operates as intended despite the presence of hardware or software faults.
	Recoverability	degree to which, in the event of an interruption or a failure, a product or system can recover the data directly affected and re-establish the desired state of the system.
Security	Confidentiality	degree to which the prototype ensures that data are accessible only to those authorized to have access
	Integrity	degree to which a system, product or component prevents unauthorized access to, or modification of, computer programs or data.
	Non-repudiation	degree to which actions or events can be proven to have taken place, so that the events or actions cannot be repudiated later.
	Accountability	degree to which the actions of an entity can be traced uniquely to the entity.
	Authenticity	degree to which the identity of a subject or resource can be proved to be the one claimed.
Maintainability	Modularity	degree to which a system or computer program is composed of discrete components such that a change to one component has minimal impact on other components.
	Reusability	degree to which an asset can be used in more than one system, or in building other assets.
	Analyzability	degree of effectiveness and efficiency with which it is possible to assess the impact on a product or system of an intended change to one or more of its parts, or to diagnose a product for deficiencies or causes of failures, or to identify parts to be modified.
	Modifiability	degree to which a product or system can be effectively and efficiently modified without introducing defects or degrading existing product quality.
	Testability	degree of effectiveness and efficiency with which test criteria can be established for a system, product or component and tests can be performed to determine whether those criteria have been met.
Portability	Adaptability	degree to which a product or system can effectively and efficiently be adapted for different or evolving hardware, software or other operational or usage environments.
	Installability	degree of effectiveness and efficiency in which a product or system can be successfully installed and/or uninstalled in a specified environment.
	Replaceability	degree to which a product can replace another specified software product for the same purpose in the same environment.

Quality in Use - ISO/IEC 25010

Characteristics	Sub-Characteristics	Definition
Effectiveness		accuracy and completeness with which users achieve specified goals
Efficiency		resources expended in relation to the accuracy and completeness with which users achieve goals
Context Coverage	Context Completeness	degree to which a product or system can be used with effectiveness, efficiency, freedom from risk and satisfaction in all the specified contexts of use
	Flexibility	degree to which a product or system can be used with effectiveness, efficiency, freedom from risk and satisfaction in contexts beyond those initially specified in the requirements

Figure 58. ISO/IEC 25010 quality models

- *Sea level changes*

A dedicated report has been produced by EMODnet Physics based on IPCC work and data provided by PSMSL[50]. Data in EMODnet Physics are 'available' and 'appropriate' but are quite short in time and can provide partial information on changes linked to climate variability or changes. The data existing in EMODnet Physics from Funchal station and Brest have been compared for the period 1985 – 2007 (Figure 59). A trend of 2.08 mm/year has been calculated.

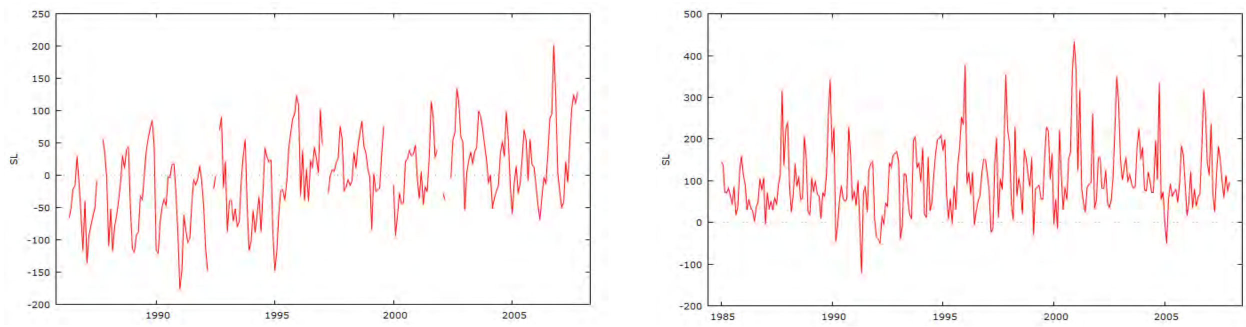


Figure 59 - Funchal (left) and Brest (right) sea level data calculated with respect to the revised local reference level and mean sea level for the period 1985 - 2007.

In this period, the sea level trend shown in PSMSL is in between 2 – 4 mm/year. In the IPCC report it is written: between 1993 and 2010, the rate was very likely higher at 3.2 [2.8 to 3.6] mm yr–1. This value is slightly larger than the very limited analysis done with EMODnet data, but there is an agreement on the existence of a positive trend.

For each basin, it is necessary to consider many measurement points to assess changes or trends. This means that for the assessment process the data must be:

- Relevant - covering the extent to which data are appropriate for objectives of the challenge, that is the use of sea level indicator to assess climate variability/change;
- Reliable - evaluating the inherent quality of data, reports or publications relating to preferably standardised methodology and the way that the experimental procedure and results are

---

[50] Holgate, S.J., Matthews, A., Woodworth, P.L., Rickards, L.J., Tamisiea, M.E., Bradshaw, E., Foden, P.R., Gordon, K.M., Jevrejeva, S., Pugh, J., 2013. New Data Systems and Products at the Permanent Service for Mean Sea Level. J. Coastal Res., 29, 3, 493-504.
IAPSO, 1968. Publications Scientifique No. 26. Association Internationale des Sciences Physiques des Océans, IUGG. (available from: http://www.psmsl.org/about_us/other_reports/iapso.php).
Oort A.H et al., 1989. "Available Potential Energy in the World Ocean". Journal of Geophysical Research, Vol.94, p. 3187-3200.

described to give evidence of the clarity and plausibility of the findings. Reliable data is also that for which internationally accepted protocols were followed in the data acquisition, replicates were done with comparable results, inter-calibration was done and reference materials used;

- Adequate - defining the usefulness of data for assessment purposes. When there is more than one set of data for each challenge, the greatest weight is attached to the most reliable and relevant. Data is adequate also when errors do not compromise the intended use;
- Comparable - means "to examine things to see how they are alike and how they are different, to judge one thing and measure it against another thing"[51]. Data comparability exists when data are of known quality and can thus be validly applied by external users, even when project objectives differ. Ideally, in order to maximize the potential for data comparability, data collection should be done with pre-determined minimum data elements, including background information;
- Compatible - is defined as ideas, principles, etc. 'that can exist together without problems and conflicts'[52], i.e. data that can be used together.

Agreement on standardised criteria for characterising and differentiating the quality of data (their reliability, relevance, and adequacy) may be useful for a broader understanding and acceptance worldwide. On the basis of quality evaluation procedures and considering the many processes affecting sea level variations, it can be said that <u>relevant</u> and <u>reliable</u> data exist. They are also <u>adequate</u> for assessment purposes, but <u>comparability</u> and <u>compatibility</u> need some additional effort to take into consideration all the relevant, reliable and adequate studies on sea level variations causes listed in the table. The most important errors could probably be related to the local effects, requiring precise knowledge of them in each different station.

The figures presented in the EMODnet Physics report have been summarised in an assessment report[53] of EEA as presented in Figure 60.

[51] A.S. Hornby (1995) Oxford Advanced Learner's Dictionary. Ed. J. Crowther. Oxford University Press, UK.
[52] A.S. Hornby (1995) *ibidem*
[53] http://www.eea.europa.eu/data-and-maps/indicators/sea-level-rise-2/assessment

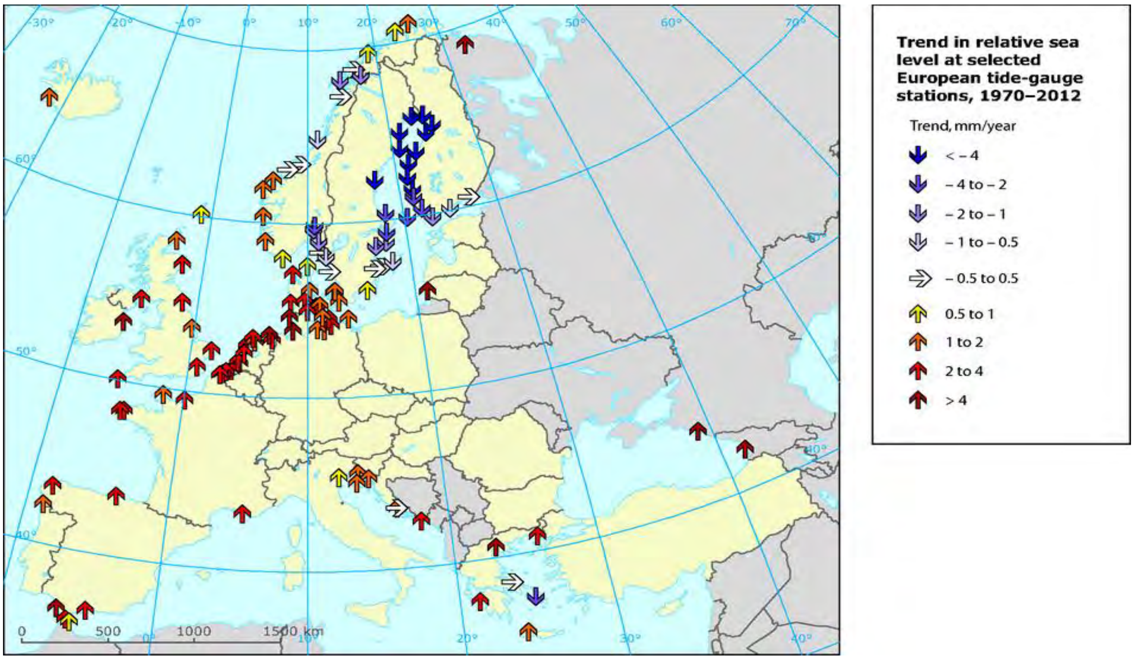


Figure 60 - Sea Level trends from in situ measurements during the period 1970 – 2012 (from EEA assessment report[13])

The EEA assessment report is also showing sea level trends derived from satellite observations.

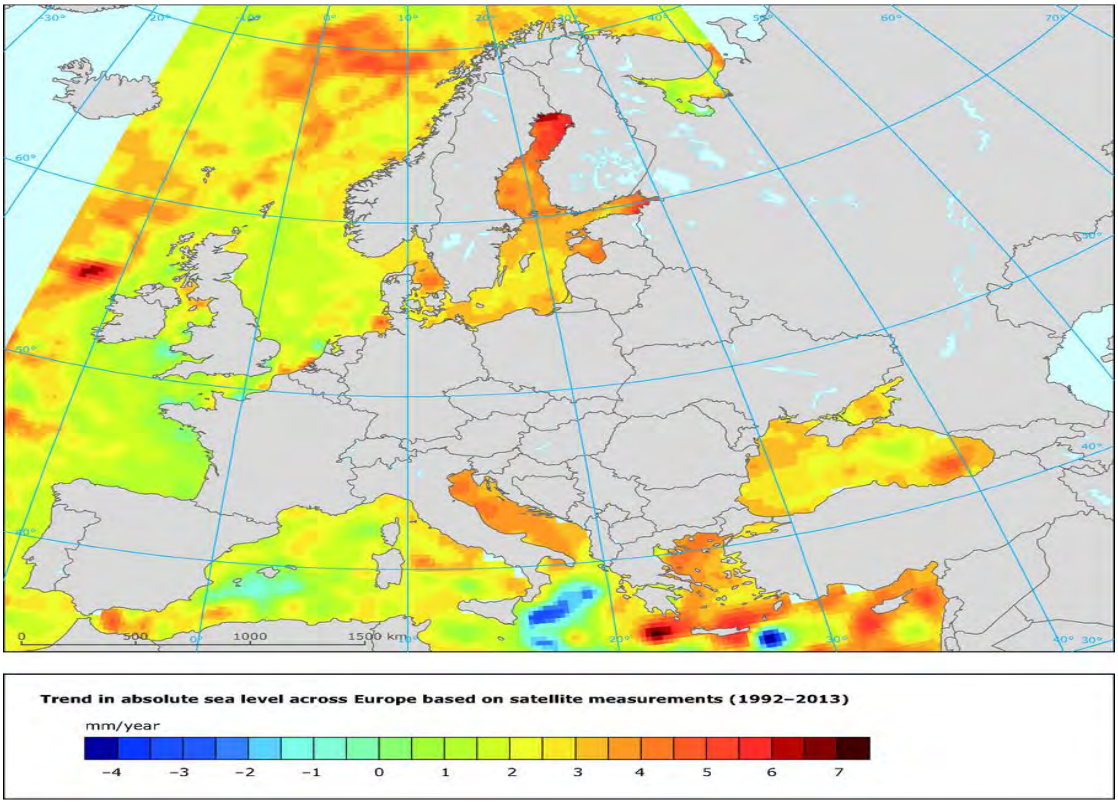


Figure 61 - Sea Level trends from satellite observations during the period 1992 – 2013 (from EEA assessment report[13])

Figure 61 shows trends in absolute sea level from 1992 to 2013 as observed by satellites. The trend in the Mediterranean is varying spatially from +6 mm/year to -4 mm/year. By visual inspection, there seems to be a significant contribution of water mass circulation variability and trends in sea levels (e.g. Alboran Sea gyre, Ionian reversals). The trend in the North Sea is typically around 2 mm/year. The trend in the Baltic Sea is between around 2 mm/year and 5 mm/year.

Trends from in situ measurements and satellite observations can differ because of the longer time period covered and because tide gauge measurements are influenced by vertical land movement whereas satellite measurements are not. In the EEA report it is written that "*the lands around the northern Baltic Sea are still rising since the last ice age due to the post-glacial rebound*".

- *Energy of the sea*

1. Kinetic energy

Kinetic energy is quite a simple product to provide to users. The main problem is related to the calculation of mass. Density of water can be calculated from depth, salinity and temperature measured locally, but for the volume it is important to know the area affected by the same physical characteristics.

Indications on kinetic energies can be provided for only a few locations in European Seas (Figure 62).

Figure 62 - Data points with observations of currents in EMODnet Physics during the 60 day before June 8, 2016.

The formula applied to demonstrate this product is:

$$E = \frac{1}{2}\rho V(u^2+v^2)$$

Where E is kinetic energy, ρ the water density, V the water volume and u, v, the horizontal components of the velocity. An example of kinetic energy product is given in Figure 63, with calculations done for the data collected in the Gulf of Trieste by the Slovenian Environment Agency.

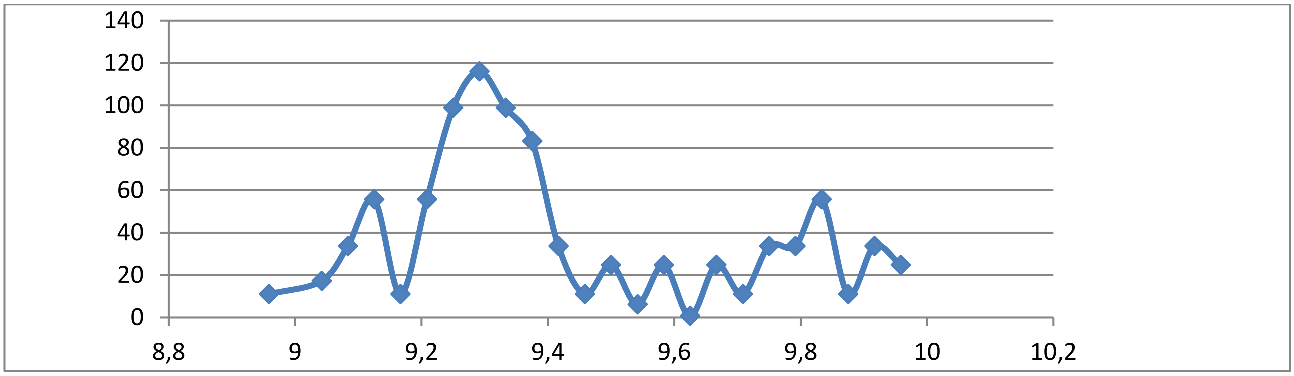


Figure 63 - Kinetic energy calculated for a water area of 100x100 metres and 10 meter deep. On the X axis are days (8 – 10 April 2016) and on Y axis Kinetic Energy in kJ

2. Wave Power

Wave power is the transport of energy by wind waves, and the capture of that energy to do useful work – for example, electricity generation, water desalination, or the pumping of water into reservoirs.

In deep water, where the water depth is larger than half the wavelength, the wave energy flux is[54]

$$\mathrm{P} = 0.49\ \mathrm{H}_{\mathrm{m0}}^{2}\mathrm{T}_{\mathrm{e}}$$

with P the wave energy flux per unit of wave-crest length, H_{m0} the significant wave height, T_e the wave energy period, ρ the water density and g the acceleration by gravity, or

$$P = 0.55\ \mathrm{H}_{\mathrm{m0}}^{2}\mathrm{T}_{02}$$

With T_{02} average zero crossing period in hypothesis that T_e / T_{02} = 1.12. When the significant wave height is given in metres, and the wave period in seconds, the result is the wave power in kilowatts (kW) per metre of wave front length.

The formula has been applied to data from a buoy near the Balearic Island (Figure 64).

[54] Cahill, B., Lewin, T., 2014. WAVE PERIOD RATIOS AND THE CALCULATION OF WAVE POWER Proceedings of the 2nd Marine Energy Technology Symposium, METS2014, April 15-18, 2014, Seattle, WA

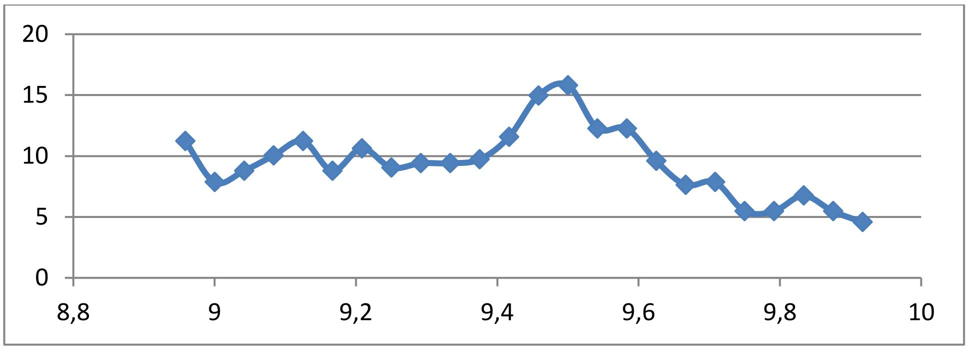


Figure 64 - Wave power example. On the X axis are days (8 – 10 April 2016) and on Y axis Wave Power inkW/m

3. Internal Energy

In the oceans, the Internal Energy is defined (Oort et al., 1989) by:

$$\text{eq: 1}\mathrm{IE_i} = \iiint \rho c_0 T dxdydz$$

where $\overline{\mathrm{HC}}_{\mathrm{rp}}$ r = 1025 kg/m^3 is the in situ density and c_0 = 4187 J/Kg*K is the specific heat at constant pressure for ocean water and T is the temperature. Figure 65 shows the internal energy in the Gulf of Trieste calculated with data from Slovenian Environment Agency for a short period

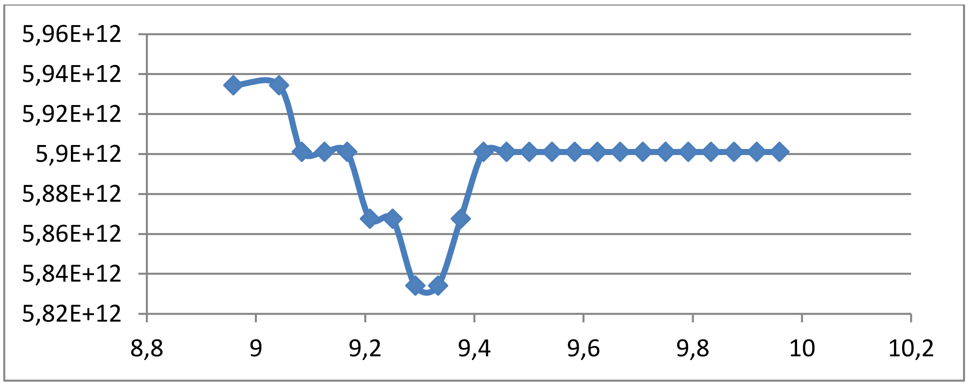


Figure 65 - The internal energy in the Gulf of Trieste calculated with data from Slovenian Environment Agency for a short period. On the X axis are days (8 – 10 April 2016) and on Y axis internal energy in J/m^2

4. Conclusions

A series of products that can support the 'blue economy', or environmental management, can be produced with EMODnet Physics data. For sea level data, important work has been done to assure relevancy, reliability, adequacy, comparability and compatibility of data.

Due to the objectives of the existing monitoring systems, this assurance cannot be extended to other data. EMODnet Physics is participating in efforts to assure that the same QA/QC procedures are applied by all data providers. However, no exercise on comparability and compatibility has yet been done.

5. References

- Cahill, B., Lewin, T., 2014. WAVE PERIOD RATIOS AND THE CALCULATION OF WAVE POWER Proceedings of the 2nd Marine Energy Technology Symposium, METS2014, April 15-18, 2014, Seattle, WA
- Holgate, S.J., Matthews, A., Woodworth, P.L., Rickards, L.J., Tamisiea, M.E., Bradshaw, E., Foden, P.R., Gordon, K.M., Jevrejeva, S., Pugh, J., 2013. New Data Systems and Products at the Permanent Service for Mean Sea Level. J. Coastal Res., 29, 3, 493-504.
- IAPSO, 1968. Publications Scientifique No. 26. Association Internationale des Sciences Physiques des Océans, IUGG. (available from: http://www.psmsl.org/about_us/other_reports/iapso.php).
- Oort A.H et al., 1989. "Available Potential Energy in the World Ocean". Journal of Geophysical Research, Vol.94, p. 3187-3200.

Annex 4. Interoperability services

Table 25 – WS methods

Method	method description	provided parameters	description
GetAllDataOwner ()	it gives the list and details of the data owners/contributors	DataOwnerID	EMODnet Physics internal DataOwner ID
		Code	Acronym
		Descr	DataOwner full name description
		website	website
		country	Country
		EDMO	EDMO code
GetAllLatestData60Days (PlatformID)	it gives the latest data (60 days) for the specified platform	LatestPlatformID	EMODnet Physics internal Platform ID
		PlatformID	EMODnet Physics external Platform ID
		Date	yyyy/mm/dd hh:mm:ss
		Depth	measurement depth
		ParamValue	ParameterCode 1 and value; ParameterCode 2 and value; … ; ParameterCode N and value;
GetAllLatestDataCode (PlatformID, ParamCode)	it gives the latest data (60 days) for the specified platform and parameter	LatestPlatformID	EMODnet Physics internal Platform ID
		PlatformID	EMODnet Physics external Platform ID
		Date	yyyy/mm/dd hh:mm:ss
		Depth	measurement depth
		ParamValue	ParameterCode and value
GetAllLatestDataFromTo(PlatformID, StartDate, EndDate)	it gives the latest data (up to latest 60 days) for the specified platform within the specified time window	LatestPlatformID	EMODnet Physics internal Platform ID
		PlatformID	EMODnet Physics external Platform ID
		Date	yyyy/mm/dd hh:mm:ss
		Depth	measurement depth
		ParamValue	ParameterCode 1 and value; ParameterCode 2 and value; … ; ParameterCode N and value;
GetAllLatestDataFromToCode(PlatformID, ParamCode, StartDate, EndDate)	it gives the latest data (up to latest 60 days) for the specified platform and parameter within the specified time window	LatestPlatformID	EMODnet Physics internal Platform ID
		PlatformID	EMODnet Physics external Platform ID
		Date	yyyy/mm/dd hh:mm:ss
		Depth	measurement depth
		ParamValue	ParameterCode and value
GetAllLatestDataParameterGroup (PlatformID, ParameterGroupID)	it gives the latest data for the specified platform and parameter	LatestPlatformID	EMODnet Physics internal Platform ID
		PlatformID	EMODnet Physics external Platform ID
		Date	yyyy/mm/dd hh:mm:ss
		Depth	measurement depth
		ParamValue	ParameterCode and value
GetAllParameters ()	it gives the prameters description and codes	ParameterID	EMODnet Physics internal parameter ID
		ParameterGroup	parameter description

		Code	international code acronym
		CFStandardName	standard parameter full name
		Descr	parameter description
		MeasurementUnit	measuremetn unit
GetAllParametersGroup ()	it gives the parameters groups	ParameterGroupID	EMODnet Physics internal parameter group ID
		Descr	parameter group description
GetAllPlatforms ()	it gives the platforms list and details	PlatformID	EMODnet Physics external Platform ID
		PlatformType	Type of the platform
		DataOwnerCode	data owner acronym
		HistoricalPlatformCDI	is the platform connected to any SeaDataNet CDI?
		PlatformCode	platform name
		WMOPlatformCode	WMO code (if available)
		MyOceanNumber	internal code to link to crosslink the platform and MYO products
		Parameters	recorded parameters (international code acronym)
		Latitude	Latitude
		Longitude	Longitude
		EDMO	EDMO code
		LastDataMeasured	date of the last measurement
		YearDataMeasured	list of the years when the platform worked
		Provider	data owner acronym
		InstitutionReference	data owner website
		Contact	principal investigator - data curator emails
		DataAssemblyCenter	data assembly full name
GetPlatformId (PlatformID)	it givest the platform details for the specified platform	PlatformID	EMODnet Physics external Platform ID
		PlatformType	Type of the platform
		DataOwnerCode	data owner acronym
		HistoricalPlatformCDI	is the platform connected to any SeaDataNet CDI?
		PlatformCode	platform name
		WMOPlatformCode	WMO code (if available)
		MyOceanNumber	internal code to link to crosslink the platform and MYO products
		Parameters	recorded parameters (international code acronym)
		Latitude	Latitude
		Longitude	Longitude
		EDMO	EDMO code
		LastDataMeasured	date of the last measurement
		YearDataMeasured	list of the years when the platform worked
GetAllPlatformsDataOwner (DataOwnerCode)	it gives the list of the platforms and details for the specified dataowner/contributor	PlatformID	EMODnet Physics external Platform ID
		PlatformType	Type of the platform
		DataOwnerCode	data owner acronym
		HistoricalPlatformCDI	is the platform connected to any SeaDataNet CDI?

		PlatformCode	platform name
		Parameters	recorded parameters (international code acronym)
		Latitude	Latitude
		Longitude	Longitude
		EDMO	EDMO code
		LastDataMeasured	date of the last measurement
		YearDataMeasured	list of the years when the platform worked
		Provider	data owner acronym
		InstitutionReference	data owner website
		Contact	principal investigator - data curator emails
		DataAssemblyCenter	data assembly full name
GetAllPlatformsParameterGroup (ParameterGroupID)	it gives the list of the platforms and details for the specified parameter group	PlatformID	EMODnet Physics external Platform ID
		PlatformType	Type of the platform
		DataOwnerCode	data owner acronym
		HistoricalPlatformCDI	is the platform connected to any SeaDataNet CDI?
		PlatformCode	platform name
		WMOPlatformCode	WMO code (if available)
		MyOceanNumber	internal code to link to crosslink the platform and MYO products
		Parameters	recorded parameters (international code acronym)
		Latitude	Latitude
		Longitude	Longitude
		EDMO	EDMO code
		LastDataMeasured	date of the last measurement
		YearDataMeasured	list of the years when the platform worked
		Provider	data owner acronym
		InstitutionReference	data owner website
		Contact	principal investigator - data curator emails
		DataAssemblyCenter	data assembly full name
GetAllRoos	it gives the ROOSs list and codes	RoosID	EMODnet Physics internal ROOS ID
		Code	ROOS acronym
		Descr	ROOS full name
GetAllPlatformsRoos (RoosID)	it gives the list of the platforms in the specified ROOS	PlatformID	EMODnet Physics external Platform ID
		PlatformType	Type of the platform
		DataOwnerCode	data owner acronym
		HistoricalPlatformCDI	is the platform connected to any SeaDataNet CDI?
		PlatformCode	platform name
		WMOPlatformCode	WMO code (if available)
		Parameters	recorded parameters (international code acronym)
		Latitude	Latitude
		Longitude	Longitude

		EDMO	EDMO code
		LastDataMeasured	date of the last measurement
		YearDataMeasured	list of the years when the platform worked
		Provider	data owner acronym
		InstitutionReference	data owner website
		Contact	principal investigator - data curator emails
		DataAssemblyCenter	data assembly full name
GetPlatformMonthlyCDIAvailability (PlatformID)	it gives the list of avaialble monthly data files and the list of available CDIs for the specified platform	PlatformID	EMODnet Physics external Platform ID
		PlatformType	Type of the platform
		PlatformCode	platform name
		EDMO	EDMO code
		Parameters	recorded parameters (international code acronym)
		Latitude	Latitude
		Longitude	Longitude
		LastDataMeasured	date of the last measurement
		Provider	data owner acronym
		CDISeriesID	list of available CDIs
		MonthlyAvailability	list of year-month when the platform worked
GetPlatformMinMaxAVG (PlatformID)	it gives the parameters monthly average, monthly max and min for the specified platform	PlatformID	EMODnet Physics external Platform ID
		Year	yyyy
		Month	the month (1 -12)
		Parameter	recorded parameters (international code acronym)
		Min	the min recorded value for that month
		Max	the max recorded value for that month
		AVG	the avg recorded value for that month
		Depth	depth of the measurement
		QC	quality flag of data (0 no QC, 1 good, >3 not good/problems) - only QC = 1 are used
		RoosID	EMODnet Physics internal ROOS ID
		TotalRecordAVG	internal code
		TotalRecord	internal code

Table 26 – available WMS and WFS layers

layer	WMS Linking information	WFS

all active platforms	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
	
	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new OpenLayers.Protocol.HTTP(wfs_options),
		});

platforms of type: mooring	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_MO**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
	
	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_MO
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_MO**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new OpenLayers.Protocol.HTTP(wfs_options),
		});

platforms of type: ferrybox	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_FB**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_FB**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",

	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_FB	geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new OpenLayers.Protocol.HTTP(wfs_options),
		});

platforms of type: HF radar	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_HF**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
	
	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_HF
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_HF**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new OpenLayers.Protocol.HTTP(wfs_options),
		});

platforms of type: glider	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_GL**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
	
	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_GL
		ar wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_GL**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new OpenLayers.Protocol.HTTP(wfs_options),
		});

platforms of type: argo	var customLayer = new OpenLayers.Layer.WMS("Name custom layer",	var wfs_options = { url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",

	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_AR**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
	
	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_AR
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_AR**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new OpenLayers.Protocol.HTTP(wfs_options),
		});

platforms of type: drifting buoy	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_DB**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
	
	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_DB
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_DB**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new OpenLayers.Protocol.HTTP(wfs_options),
		});

platforms of type: profiler	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_PF**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
	
	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_PF**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {

	2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_PF	strategies: [new OpenLayers.Strategy.BBOX()], visibility: true, protocol: new OpenLayers.Protocol.HTTP(wfs_options), });

water temperature parameters	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_water_temperature**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
	
	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_water_temperature
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_water_temperature**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new OpenLayers.Protocol.HTTP(wfs_options),
		});

waves and wind parameters	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_waves_wind**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
	
	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_waves_wind
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_waves_wind**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new OpenLayers.Protocol.HTTP(wfs_options),
		})

water salinity/conductivity/density parameters	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_water_sal_con_den**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_water_sal_con_den**
		
		},
		format: new OpenLayers.Format.GML({

	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_water_sal_con_den	featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new OpenLayers.Protocol.HTTP(wfs_options),
		});

currents parameters	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_currents**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
	
	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_currents
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_currents**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new OpenLayers.Protocol.HTTP(wfs_options),
		});

chemical paramaters	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_chemical**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
	
	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_chemical
		ar wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_chemical**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new OpenLayers.Protocol.HTTP(wfs_options),
		});

biological parameters	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {

	{ "format": "image/png", "transparent": true, "layers": ["**platforms_biological**"] }, { isBaseLayer: false, opacity: 1 }); http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_biological	request: "GetFeature", service: "wfs", version: "1.0.0", typeName: **platforms_biological** }, format: new OpenLayers.Format.GML({ featureNS: "http://ng.org/sf", geometryName: "wkb_geometry" }) } var wfs = new OpenLayers.Layer.Vector("WFS", { strategies: [new OpenLayers.Strategy.BBOX()], visibility: true, protocol: new OpenLayers.Protocol.HTTP(wfs_options), });
sea level parameters	var customLayer = new OpenLayers.Layer.WMS("Name custom layer", "http://151.1.25.219:8181/geoserver/emodnet/ows", { "format": "image/png", "transparent": true, "layers": ["**platforms_sea_level**"] }, { isBaseLayer: false, opacity: 1 }); http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_sea_level	var wfs_options = { url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?", params: { request: "GetFeature", service: "wfs", version: "1.0.0", typeName: **platforms_sea_level** }, format: new OpenLayers.Format.GML({ featureNS: "http://ng.org/sf", geometryName: "wkb_geometry" }) } var wfs = new OpenLayers.Layer.Vector("WFS", { strategies: [new OpenLayers.Strategy.BBOX()], visibility: true, protocol: new OpenLayers.Protocol.HTTP(wfs_options), });
light parameters	var customLayer = new OpenLayers.Layer.WMS("Name custom layer", "http://151.1.25.219:8181/geoserver/emodnet/ows", { "format": "image/png", "transparent": true, "layers": ["**platforms_light**"] }, { isBaseLayer: false, opacity: 1 }); http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,90	var wfs_options = { url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?", params: { request: "GetFeature", service: "wfs", version: "1.0.0", typeName: **platforms_light** }, format: new OpenLayers.Format.GML({ featureNS: "http://ng.org/sf", geometryName: "wkb_geometry" }) } var wfs = new OpenLayers.Layer.Vector("WFS", { strategies: [new OpenLayers.Strategy.BBOX()], visibility: true,

	48672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_light	protocol: new OpenLayers.Protocol.HTTP(wfs_options), });

other parameters	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_others**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
	
	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_others
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_others**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new OpenLayers.Protocol.HTTP(wfs_options),
		});

air pressure parameters	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_air_pressure**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
	
	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_air_pressure
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_air_pressure**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new OpenLayers.Protocol.HTTP(wfs_options),
		});

atmosphere parameters	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_atmosphere**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_atmosphere**
		
		},
		format: new OpenLayers.Format.GML({

	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_atmosphere	featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new OpenLayers.Protocol.HTTP(wfs_options),
		});

region: global	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_GLOBAL**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
	
	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_GLOBAL
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_GLOBAL**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new OpenLayers.Protocol.HTTP(wfs_options),
		});

region: north sea	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_NORTH_SEA**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
	
	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_NORTH_SEA
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_NORTH_SEA**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new OpenLayers.Protocol.HTTP(wfs_options),
		});

region: mediterranean sea	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {

	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_MEDITERRANEAN_SEA**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
	
	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_MEDITERRANEAN_SEA
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_MEDITERRANEAN_SEA**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new OpenLayers.Protocol.HTTP(wfs_options),
		})

region: black sea	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_BLACK_SEA**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
	
	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_BLACK_SEA
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_BLACK_SEA**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new OpenLayers.Protocol.HTTP(wfs_options),
		});

region: atlantic/bay of biscay/celtic sea	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_ATLANTIC**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
	
	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_ATLANTIC
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_ATLANTIC**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,

		protocol: new OpenLayers.Protocol.HTTP(wfs_options), });

region: baltic sea	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_BALTIC**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
	
	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_BALTIC
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_BALTIC**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new
		OpenLayers.Protocol.HTTP(wfs_options),
		});

region: arctic/barrents/greenland/norwegian sea	var customLayer = new OpenLayers.Layer.WMS(
	"Name custom layer",
	"http://151.1.25.219:8181/geoserver/emodnet/ows",
	{
	"format": "image/png",
	"transparent": true,
	"layers": ["**platforms_ARCTIC**"]
	},
	{ isBaseLayer: false, opacity: 1 }
	);
	
	http://151.1.25.219:8181/geoserver/emodnet/ows?service=WMS&version=1.1.1&request=GetMap&format=image/png&transparent=true&SRS=EPSG%3A900913&BBOX=-2101155.3884615,5291639.887125,1655877.4252884,9048672.700875&WIDTH=768&HEIGHT=768&LAYERS=platforms_ARCTIC
		var wfs_options = {
		url: "http://151.1.25.219:8181/geoserver/emodnet/wfs?",
		params: {
		request: "GetFeature",
		service: "wfs",
		version: "1.0.0",
		typeName: **platforms_ARCTIC**
		
		},
		format: new OpenLayers.Format.GML({
		featureNS: "http://ng.org/sf",
		geometryName: "wkb_geometry"
		})
		}
		
		var wfs = new OpenLayers.Layer.Vector("WFS", {
		strategies: [new OpenLayers.Strategy.BBOX()],
		visibility: true,
		protocol: new
		OpenLayers.Protocol.HTTP(wfs_options),
		});

GeoServer Services Capabilities available at http://151.1.25.219:8181/geoserver/web/

Annex 5. EMODnet Physics platforms list

The EMODnet Physics platform list is attached in an excel file. For each platform, the file reports:

- Country (of the data provider)
- data provider (i.e. institute name)[55]
- platform (platform name or code)
- platform type (MO= mooring buoy/fixed platform, FB=ferrybox, GL= glider, DB = drifting buoy, AR = Argo);
- Data assembly centre
- Information if the platform is providing data (NRT true/false);
- recent data time coverage (from to) and number of files[56] (if the first number is lower than the second there are temporal gaps in the monthly data files, if the first number is higher than the second the platform hosts various data acquisition sets – e.g. Arkona);
- long term time series files (from to);
- Information if there are historical validated data for that platform (CDI) in SeaDataNet-NODCs network (from to, and the number of available CDIs covering the specified time range).
- Recorded parameters

[55] N.D. means that metadata or data is not available yet or is under checking procedure

[56] M: YY/XX → if YY = XX there are no temporal gaps in monthly time series.

Table 27 – columns of the EMODnet Physics platform list file.

Country	Data provider	EdmoCode	Edmo Descr	Platform	Type	Data assembly center	NODC	Recent data From - To	Recent data #files	Long term TS From - To	CDI dataset ID - validated historical data From - To	CDI dataset ID #files	NRT true/ false	Par. group

Annex 6. Service Licences Agreement table

Table 28 shows the comparison between the CMEMS SLA and SeaDataNet SLA:

Table 28 – license agreements comparison

	SeaDataNet	CMEMS - Service Level Agreement (SLA)
Written in	2007	2015
scope	Aimed at striking a balance between the rights of investigators and the need to widespread access through free and unrestricted SDN data, metadata and products	Aimed at outlining the range and level of services that the Copenicus Marine Service (CMEMS) supplies to the user
Parties	The Licensor[57] grants to the Licensee a non-exclusive and non-transferable licence to retrieve and use data sets and products from the SeaDatanet service in accordance with this licence	This Licence Agreement is a legal agreement between the Licensee and MERCATOR OCEAN and sets out the terms for use of the Copernicus Marine Service Products which will apply to the Licensee. Use of the Copernicus Marine Service Products means that the Licensee agrees to abide by all of the terms and conditions in this Licence
Data policy	SeaDataNet makes data available freely and without restriction. “Freely” means at no more than the cost of reproduction and delivery, without charge for the data itself. In practice, no charges at all. “Without restriction” means without discrimination against, for example, individuals, research groups, or nationality.	Costs are fully covered by the CMEMS as provided for in the Copernicus Regulation until the end of the CMEMS (31/12/2020). CMEMS service and products are free of charge to the user until this date.
Confidentiality	Not declared	A user enquiry is treated as commercially confidential and will not be transmitted outside the CMEMS[58]
Service access validation	SDN defines roles for its users; depending on role, accessibility to data varies. The roles are attributed by the NODCs of the user's country (or user-desk by default) after on line registration. Name, email and professional references are mandatory.	Personal data are linked to the generation of the login, the password is encrypted and invisible to the service. Other information regarding the organisation etc. are for internal statistics purposes. User has a right to access and correct his/her personal data. The CMEMS service desk is validated
Data distribution	Meta-data are freely and unconditionally accessible. As soon as registration is completed, the user receives a temporary license and public role, and may access non-restricted data. As soon as the NODC assigns a role, the user can access assets according to the assets access rights and the “role” of the user.	As soon as the SLA is validated by the service desk, the user receives a login and password to access products.
Data delivery delay	SeaDataNet data delivery is managed by RSM in a delayed mode: each CDI record indicates the condition of access of the associated dataset as set by the data set provider. Combined with the user-registered role as user this will determine	Data is downloadable as soon as login is effected. Download scripts – shortcuts are allowed as well as machine-to-machine data fetching robots.

57 the licensee is very well described by the “roles”, the licensor is less clear
58 in application of the Dir 95/46/EC of EP and Dir 2002/58/EC on data protection.

	whether user will get direct access, whether access will be denied to user, or whether user will have to await further consideration of their request by the data set provider. This can be seen in the RSM. Note that user request might concern several data set providers. Once the user has right of access to data, it must be manually downloaded from each NODC within 30 days from data request (after which data is no longer available unless user posts a new data request).	
Dataset updates	SeaDataNet data remains dependent on data contributions.	The service is operational and new data is delivered on a daily base or in delayed mode (according data type).
Permissions and liability	Non-exclusive and non-transferable licence. Retrieval, by electronic download, and the use of Data Sets is free of charge, unless otherwise stipulated. SeaDataNet and the data source do not accept any liability for the correctness and/or appropriate interpretation of the data.	This Licence is granted free of charge. Non exclusive, royalty free, perpetual licence
Citation	Users must acknowledge data sources (in particular for scientific publications). Data Users should not give third parties any SeaDataNet data or product without prior consent from the source Data Centre.	The Licensee will communicate to the public the source of the products and services by crediting the CMEMS[59] Copernicus Monitoring Environment Monitoring Service Credits shall be clearly visible on the home page of the Licensee's website or at least on the page giving access to the products.
Distribution	Data Users should not give third parties any SeaDataNet data or product without prior consent from the source Data Centre.	User can make and use such reasonable copies of Copernicus Marine Service Products: for internal use and back up purposes, as may be necessary; to modify, adapt, develop, create and distribute Value Added Products or Derivative Work from Copernicus Marine Service Products for any purpose; to redistribute, disseminate any Copernicus Marine Service Product in its original form via any media.

[59] In application of the Regulation (EU) n° 1159/2013 of the 12 July 2013 supplementing Regulation (EU) n°911/2010 of the European Parliament and of the Council on the European Earth monitoring programme,