EMODnet Phase III
The EMODnet Sea-basin data stress tests
Synthesis of results

Contents

Disclaimer

Synthesis of the EMODnet Sea-basin Checkpoints for EOOS Conference

1 The Sea-basin Checkpoint concept: do we have the data we need?

The EU Green Paper 'Marine Knowledge 2020: from seabed mapping to ocean forecasting'[1] highlights the opportunity offered by the 2014-2020 financial framework, “to develop a more sustainable governance structure in which collection, assembly and dissemination of marine data moves from being a set of projects defined by the Commission to a continuous, integrated process with priorities based on the needs of users in industry, public authorities and the research community”. Putting the user in the focus, should be a target for a better coordinated European ocean observing capacity and this means relying preferably on them rather than on producers to assess existing data sets and data sources and promote recommendations for a better satisfaction of their needs.

Data may as well be absent. On the one hand, data gathered through the monitoring programmes currently in place may not be enough for the increasing needs derived from an economy that is turning to blue. Many efforts in the past, have been focused on analysing current observation networks from a relatively static perspective, identifying areas which were undersampled or variables which should be better monitored, generally taking as reference the already existing networks. These studies can be really sophisticated and define the optimal observation strategy or network design to maximize data and minimize costs. Despite their value, those studies proposed directions to improve the on-going observation systems in place (data provider’s perspective) more than trying to understand whether those systems were really satisfying the end user’s needs.

Furthermore, even if data are gathered, institutions in charge of the data collection may impose restrictions on their delivery to others, which may delay its use by third parties or even block it altogether. In the latter case, even if the data exists, it may result in a data gap in practice.

To tackle all these issues and introduce the user-perspective in the assessment of whether marine data actually meet the needs of private, public and research users, DG MARE established a series of 'Sea-basin Checkpoints' projects, starting with the Mediterranean and North Sea in 2013 and extending to the Arctic, Atlantic, Baltic Sea and Black Sea in 2015.

For each of the sea-basins, a team acted as surrogate users attempting to address a number of stress tests exercises or challenges (e.g. determining the best area for wind farm siting, predicting the fate of an oil spill at sea, determining whether the marine protected areas in each sea-basin constituted a coherent network etc.) and generate a number of products (see Table 1 for details). By facing the challenges and comparing the products obtained with the expected ones, the teams were able to assess the adequacy of the data, in terms of its availability and fitness for use, bearing in mind the particular purpose (the challenge) the assessments were aiming to address. Each of the six Sea-basin Checkpoints teams approached these assessments using different methods, whilst always striving to maintain the user perspective.

This user-oriented focus and perspective makes this exercise unique and original, facilitating the development of more concrete and practical recommendations for the future development of Europe’s ocean observing framework.

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[1] European Commission (2012) Marine Knowledge 2020 from seabed mapping to ocean forecasting. Green Paper, Publications Office of the European Union, Luxembourg.

https://ec.europa.eu/maritimeaffairs/sites/maritimeaffairs/files/docs/body/marine-knowledge-2020-green-paper_en.pdf

Table 1. Description of the Challenges that the Checkpoints had to attempt with their corresponding expected outputs (products).

Challenge	Description of products
Wind Farm siting	Determine the suitability of sites for development of a wind farm. All aspects should be considered Q wind strength, seafloor geology, environmental impact, distance from grid, shipping lanes – even if one of the factors makes this a no-go scenario.
Marine Protected Areas	Analyse the existing network of marine protected areas and: (i) categorize them according to the classification used by the International Union for Conservation of Nature; (ii) determine whether the network constitutes a representative and coherent network as described in article 13 in the Marine Strategy Framework Directive; (iii) determine how they are likely to be affected by climate change.
Oil Platform Leak	The contractor will be informed that there is a leak from an oil platform at a time to be decided by DGQMARE. The contractor will not receive an advance warning of the exercise. The contractor will determine the likely trajectory of the slick and the statistical likelihood that sensitive coastal habitats or species or tourist beaches will be affected. The contractor will indicate what information can be provided within 24 h and 72 h.
Climate	Determine: - change in average temperature at surface, 500 metre depth and bottom on a grid, over the past 10 years and 50 years - time series of average annual temperature at sea surface and bottom - time-series of average annual internal energy of sea - average extent of ice coverage over the past 5 years, past 10 years, past 50 years, past 100 years plotted on maps - total ice cover in sea (kg) over the past 100 years plotted as time series.
Coasts	Determine: - In the coasts of all coastal states, the average annual seaQlevel rise per stretch of coast (absolute and relative to the land), and for 10, 50 and 100 years. This should be provided in tabular form and as a map layer; - In the coasts of all coastal states, average annual sediment balance (mass gained or lost per stretch of coast) for 10, 50 and 100 years. This should be provided in tabular form and as a map layer.
Fisheries management	Produce tables for the whole sea-basin of : 1. mass and number of landings of fish by species and year; 2. mass and number of discards and bycatch (of fish, mammals, reptiles and seabirds) by species and year.
Fisheries impact	Produce data layers (gridded), showing the extent of fisheries impact on the sea floor, in particular estimate: 1. area where bottom habitat has been disturbed by bottom trawling (number of disturbances per month); 2. change in level of disturbance over the past ten years; 3. damage to sea floor to both living and non-living components.
Eutrophication	Produce data layers (gridded) showing: 1. seasonal averages of eutrophication in the basin for past ten years; 2. change in eutrophication over the past ten years.
River inputs	For each river bordering the sea-basin, a time series of annual inputs to sea of: - water (mass and average temperature) - sediment - total nitrogen - phosphates - salmon

	- eels
Bathymetry	Sea-basin digital map of: - water depth - contour map of water depth for sea-basin in vector format in interval of 100m, including coastline priority areas for surveying for safer navigation taking into account emerging needs - uncertainty in water depth for Black sea-basin
Alien species	Table and digital map of alien species in the sea-basin: - species name - family (fish, algae, mammals, sponges etc.) - year of introduction - season for introduction (climate change, ballast water discharge etc) - geographical area - impact on ecosystem and economy

2 How do we assess the data adequacy?

In order to fully appreciate the results and conclusions of the Checkpoints we need to understand how they undertook the following tasks:

- Task 1 - Undertake a number of Challenges or stress tests, generating products (see Table 1) from input datasets that experts had to find and use within a limited time period.
- Task 2 - Assess the “data adequacy” of the inputs data sets and report the results in a Data Adequacy Report, which was reviewed by a Panel of Experts and groups of Stakeholders (Workshops).

No indication was given as how the job had to be done, in particular for Task 2. This freedom resulted in the development of a variety of approaches and methods. We will present now an overview of the different approaches or assessment frameworks.

It all begins with the question: **what do we understand by data adequacy**?

Introducing the user perspective implies that we will consider that a dataset is adequate when it meets user needs. This is a twofold question: we need to characterise the dataset in its different aspects as well as to understand which user requirements are needed for each of those aspects. At the end, it all boils down to comparing two groups of characteristics: those that the datasets present, and those that the user requires.

Listing the characteristics of a dataset or listing the requirements of a user who attempts to generate products required by challenges and comparing them may seem straightforward. However, there are a number of pitfalls.

To begin with, it is important to clarify that user needs may differ depending on the challenge. For instance, a bathymetry dataset which may be totally fit for use to study a Marine Protected Areas network, may not be useful to assess the best location for offshore wind farm siting.

In addition to this, the number of characteristics that we may wish to consider when doing the comparison cannot be infinite. These characteristics can be intrinsic to the data in the dataset: the coverage and the resolution, for instance. Besides, as we have already mentioned, they could be related to other aspects like the visibility of the dataset, its accessibility, how often the dataset is updated or if it has any cost. Some Checkpoints present a long list of lower level characteristics that they evaluate, whereas others focus on a smaller number of higher-level indicators, or a more targeted set.

Also, the reports reveal a different sensitivity to certain characteristics that seems to be modulated by another extra factor: time. So, for certain cases, the higher cost of a dataset that prevents its use by one of the Checkpoints, seems acceptable for another in view of other characteristics, like a lower processing time, or better resolution.

It is also important to bear in mind, that the comparison between the dataset characteristics and the user requirements is also not always devoid of some subjectivity. Deciding how far from the ideal the dataset is (and hence, how fit for use it is), can be a matter of opinion to a certain extent, especially in the cases where the assessment relies heavily on the expertise of the teams attempting the challenge (like in the North Sea or the Baltic Sea). In other cases, like the MedSea, Atlantic and Black Sea, a more fine-grain and quantitative assessment framework has been put in place, using ISO principles and following INSPIRE rules. This requires investing resources to build a metadata base where the they describe the input datasets (using the indicators in Table 2). In addition to that they use the same metadata base to describe the product specifications (following their own understanding of the challenges described in Table 1), which they compare with the products that they actually obtain after attempting the challenges. Their assessment is based in this comparison which strictly follows some pre-defined thresholds to decide when the products they obtained are sufficiently close to the products they expected to obtain for each challenge. This makes this assessment traceable and more easily repeatable, but it also requires many resources. The Arctic is somewhat in the middle, having also developed a Content Management System that enables getting access to all the datasets they have evaluated and the results of that evaluation, but simpler.

In order to present a synthetic view, a table listing all the indicators (also called criteria or characteristics) used by the Checkpoints in their assessments is presented (Table 2). The Table shows how the level of granularity or detail is different amongst the Checkpoints. There are a core number of indicators that are present in all the Checkpoints, but some others are only used by one of them. Also, there are some indicators with a very specific definition and scoring (MedSea, Atlantic, Black Sea), while in other cases, the criteria encompass several aspects (North Sea).

Table 2. Indicators considered in the assessment (i.e., those that appear in the browser, so they have effectively been used and their number may be smaller than the complete list). Items in green are common to all Checkpoints and in red, those which only one of the Checkpoints considers.

MED SEA	NORTH SEA	ARCTIC	ATLANTIC	BALTIC	BLACK SEA	DEFINITION[2]
Easily found			Ease to find		Easily found	Can the datasets or series of datasets be found easily?
EU catalogue system					EU catalogue system	Is the dataset referenced by an EU catalogue service or another national or international (non EU) service?
Visibility of data policy			Visibility of data policy		Visibility of data policy	How visible is the data policy adopted by the data providers?
Data delivery mechanisms		Accessibility	Data delivery mechanisms		Data delivery mechanisms	What services are available to the users to access data?
Data policy	Commercial	Accessibility	Data policy	Delivery type	Data policy	What is the data policy?
Pricing	Commercial	Cost		Delivery type	Pricing	What is the cost?
Readiness	Usability[2]	Processing level	Readiness (format)		Readiness	How ready is the format for operational use?
Responsiveness	Delivery	Responsiveness	Responsiveness	Delivery time	Responsiveness	How long does it takes from data request to data delivery?
	Contribution					Were the parameters offered by the dataset useful for solving the challenge?
				Completeness		Percentage of data that account for the complete dataset (Baltic Sea definition)[3]. In other words, are there gaps in time or space?
Horizontal Coverage	Location	Spatial Coverage (XY)	Horizontal Coverage	Spatial Coverage (XY)	Horizontal Coverage	What surface the dataset covers?

[2] The definitions follow MedSea terminology unless stated otherwise. More information can be found in the respective Data Adequacy Reports available online in http://www.emodnet.eu/checkpoints/reports.
[3] In Atlantic, Black Sea, MedSea, XYZ coverage are indicators included in a broader category called "completeness", where completeness has a different meaning than for the Baltic (it does not refer to gaps in the time series).

MED SEA	NORTH SEA	ARCTIC	ATLANTIC	BALTIC	BLACK SEA	**DEFINITION**[2]
Vertical Coverage	Location		Vertical Coverage		Vertical Coverage	What depth the dataset covers?
Temporal Coverage	Location	Temporal Coverage	Temporal Coverage	Temporal Coverage	Temporal Coverage	What time span the dataset covers?
Horizontal Resolution	Attributes	Spatial Resolution	Horizontal Resolution	Horizontal Resolution	Horizontal Resolution	Size of the smallest object measured
Vertical Resolution	Attributes	Vertical Resolution	Vertical Resolution	Vertical Resolution	Vertical Resolution	Size of the smallest object measured
Temporal Resolution	Attributes	Temporal Resolution	Temporal Resolution	Temporal Resolution	Temporal Resolution	Size of the smallest time interval measure
				Precision		Data deviation and its scatter from true value (Baltic Sea).
Thematic accuracy						Thematic compliance with respect to the data product specification (only in MedSea)
		Temporal window				Historical, hindcast, forecast (Arctic); in situ, publications, model, obs. (Baltic)
			Data type			In situ, publications, model, observations
			Number of items			Count of occurrences of object (e.g. country, species etc.) Only in Atlantic
Number of characteristics			Number of characteristics		Number of characteristics	Count of input characteristics
Temporal validity			Temporal validity			Data freshness (time since last update)

3 Checkpoint results

3.1 General overview of data gaps and data inadequacy

The products listed in the challenged areas could always be generated (in requested quantity and quality) due to different reasons:

1. **Data do not exist**: this was generally related either to a lack of coverage (certain areas were not sampled) or a lack of resolution (the sampling density was not enough for the application pursued). This can be solved with not only enhanced monitoring but also with a better integration of data from satellites and models. Some examples of those data gaps are sediment mass data and river inputs (concentration of nutrients, sediments, species like eel and salmon), and this was irrespective of the sea-basin. Data on phytoplankton abundance, birds' routes and invasive species were also not adequate in terms of coverage and resolution. Physical data (waves, currents, wind, temperature) generally have better coverage and resolution and some data gaps can be filled by integrating in-situ data?, remote sensing and models. However, for certain applications (e.g. wind farm siting, MPA connectivity), only commercial physical data have enough resolution.
2. **Data exist but are not available**: this can happen when the data cannot be found easily, or even if it is found there are restrictions of access. This can hinder fulfilling the challenges in a reasonable time or under a certain cost. Promoting Open Data Policy and extended basin scale cooperation are part of the solution, as well as supporting data assembly through initiatives like EMODnet. The Checkpoints identified many clear examples of this kind: for instance, fisheries data, collected by the DCF programme, are not re-distributed by most of the EU Member States. The same holds for bathymetric survey data, which normally have a very high cost. Most of the chemistry data is only accessible after a moratorium. Vessel traffic data is another example that requires no data collection, only assembling efforts. In fact, most of the data related to human activities at sea are very scattered and need to be assembled.
3. **Data exist but are not appropriate for the use**: This can encompass many characteristics like timeliness, accuracy, precision, completeness, update-rate of the series or the type of format (more or less standard). The key point highlighted by all the checkpoints is the importance of metadata. Accurate, complete, meeting ISO and INSPIRE-standards metadata can inform users about those characteristics and allow them to assess whether it is worth downloading and processing the data or not. This is clearly not the case for many types of data (in particular for human activities and bathymetry). Another issue which affects all kinds of data is the importance of a good unequivocal identification, which could be supported by a further use of DOIs for datasets.

3.2 List of harmonised indicators to assess data adequacy

We can follow the sequence and present it in a flow diagram with steps (Table 3) where the user first has to find the data, then has to get access to it, then has to process it, etc. At each step data may be inadequate due to faults that could be evaluated with a number of indicators. The 7 Core Indicators, considered to be indispensable, are indicated in bold.

Table 3. Flow between data discovery and data usage and how data adequacy can be assessed at each step.

1	Do data exist?	NO →	**Data Gap**		
	YES↓				
2	Are data visible?	NO →	Data Inadequate	INDICATORS	DEFINITION
	YES↓			• **Easily found** • EU catalogue system	- Can the datasets or series of datasets be found easily? - Is the dataset referenced by an EU catalogue service or another national or international (non EU) service?
3	Are data accessible?	NO →	Data Inadequate		
	YES↓			• Visibility of data policy • Data policy • **Pricing** • Data delivery mechanisms • **Responsiveness**	- How visible is the data policy adopted by the data providers? - What is the data policy? (restricted, moratorium…) - What is the cost of the data? - What services are available to the users to access data? - How long does it take from data request to data delivery?
4	Are data easy to process?	NO →	Data Inadequate		
	YES↓			• **Readiness**	- How ready is the format for operational use?
5	Are data of good quality?	NO →	Data Inadequate		
	YES↓			• **Coverage (XY,** Z, **T)** • **Resolution (XY**, Z, T) • Precision • Temporal validity • Number of items • Number of characteristics	- Area/time-span covered by the dataset - Size of the smallest object/time interval measured - Data deviation and its scatter from true value - Data freshness (time since last update) - Count of occurrences of object (e.g. country, species etc.) - Count of input characteristics
	Data adequate				

3.3 Identified data gaps and data inadequacy and possible solutions by thematic matrix

3.3.1 Matrix Air

	GAP	SUGGESTION
Wind	• Wind profiles observations above 10 m height (required for wind farm siting) are scarce and generally not public. • Wind data for applications at the coast do not have enough resolution (this is also the case for currents and waves).	• LiDAR could be an alternative for cost-effective monitoring, but it needs in-situ wind profiles for calibration. • High Frequency Radars (HFR) can become a key tool for monitoring currents, waves and winds near the coast. • Some Checkpoints used commercial solutions that provided fit-for-use data that enabled them to fulfil Wind farm siting challenge.

3.3.2 Matrix Marine Water - physics

	GAP	SUGGESTION
Ocean currents	• Horizontal resolution of publicly available current data (models) is not enough for Wind farm siting and Oil spill. More observational data would be desirable. Horizontal coverage is also an issue for Atlantic Checkpoint.	• As for wind data, HFR can be an alternative. • Improved resolution models nested in CMEMS should be developed for the near coastal areas.
Waves	• Public wave data (models) do not have enough horizontal resolution for Wind farm siting and Oil spill. Wave data are also important to study sediment transport at the coast. Again, resolution is too coarse for this kind of studies.	Same as above
Sea level	• The number of sea level stations providing long-enough time is insufficient and there should be more GPS-colocated tide gauges to fulfil the Coasts challenge (all but Baltic).	• Tide gauges should be maintained in time and new stations equipped with GPS could be added (but this is very expensive). Baltic combined in-situ and model reanalysis data to successfully undertake the Coasts challenge.
Sea ice	• Sea ice coverage is less of an issue than sea ice thickness, in particular for the Climate challenge (for Wind farm siting purposes it seems enough, because there are recent data).	• Satellite data and models could be an alternative.

3.3.3 Matrix Marine Water – chemistry

	GAP	SUGGESTION

Nutrients (nitrogen, phosphates)	• The coverage and resolution are not enough (except in the Baltic Sea), in particular at the coastal zone, and this hinders achieving the challenge in eutrophication.	• Increase monitoring but, above all, ease access to existing datasets whose access is often restricted (moratorium).
Chlorophyll-a	Same as above	Same as above
Dissolved oxygen	Same as above	Same as above

3.3.4 Matrix Marine Water – biology

	GAP	SUGGESTION
Phytoplankton	• Visibility and accessibility of the datasets is good, but the coverage is not enough to fulfil the challenges (MPA, Climate).	• More monitoring is needed (CPR program is mentioned).
Reptiles, Sea mammal, Birds counts, Birds migration routes	• These data are needed in several challenges (Wind farm siting, MPA) and in general there is a lack of coverage but also when available, data are too scattered and difficult to aggregate.	• More monitoring and harmonisation of analysis protocols and descriptions.
Alien species	• Same as above: lack of data and too much heterogeneity in the sampling protocols.	• Same as above

3.3.5 Rivers – Matrix Fresh Water

	GAP	SUGGESTION
Water discharge	• Availability of river discharge data has recently improved thanks to EMODnet Physics, but at the moment of undertaking the River challenge, most Checkpoints (except Black Sea) identified a lack of coverage and resolution.	• Rivers should be monitored regularly, standards for monitoring best practices to be established.
Sediment load	• There is a clear gap for this parameter, which is very relevant for Coastal and River Input Challenges. Except for the Black Sea, there are not enough observational data.	• More rivers should be monitored regularly. • Satellite data (MedSea) and models (Baltic) are offered as complementary to improve sediment mass balance estimation in the absence of data.
Nutrients (nitrogen, phosphates)	• Very few observations, scattered, low coverage and resolution.	• More river inputs should be monitored regularly.

		• Models could be useful to simulate temperature (Baltic) but would nevertheless require more observations for validation.
Eels/Salmon	• These variables proved not too relevant for some of the sea-basins (Black Sea, and Arctic). They were sufficient for the smaller basins (North Sea and Baltic), but insufficient in Atlantic and MedSea.	• More rivers should be monitored regularly for fish-abundance.
River temperature	• Same comment than for Nutrients in rivers	• Same comment than for Nutrients in rivers

3.3.6 Bathymetry

	GAP	SUGGESTION
Bathymetry and Elevation	• For many of the challenges, aggregated datasets like EMODnet bathymetry are enough. This is the case of wind farm siting (in some areas), marine protected areas or oil platform leak. However, for other challenges that require a better resolution bathymetry, especially at the coast, there are less data and they are normally accessible with restrictions (costs, delays), generally country dependent.	• Obviously, a solution to improve resolution would be to increase the sampling, but this is extremely costly. Better metadata would in any case be advisable in order to select the right type of dataset and decide whether it is preferable to opt for a commercial solution in order to save processing time. • Encouraging lower fees for bathymetric datasets that are within national Hydrographic offices would also be desirable.

3.3.7 Seabed/Riverbed

	GAP	SUGGESTION
Lithology	• Much greater resolution would be needed to address challenges like Wind farm siting.	• More surveys
Sediment balance data	• Data on sediment data is clearly insufficient to obtain a basin-scale view of shoreline advance or retreat all over European coasts, and this is highlighted as a priority by MedSea.	• More in-situ monitoring and/or combination with satellite monitoring and modelling, monitoring best practices to be established.
Habitat extent and characteristics	• Needed for MPA, Oil spill impact forecasting and to assess impact of Fisheries on the seabed. In general, their availability and resolution are considered insufficient (with the exception of the UK, that has a Marine register database). In terms of quality, the data normally also lacks a reference to the uncertainty of the habitats description.	• Increase efforts both in new surveys but also in creating aggregated datasets.

3.3.8 *Human Activities*

	GAP	SUGGESTION
Pipe-lines and cables, Military activities areas, Aquaculture activities sites, Industrial activities, Leisure activities, Scientific activities…	• Data on human activities were needed for several of the challenges (Wind farm siting, Marine Protected Areas, Oil Platform Leaks). Even though the visibility through EMODnet Human Activities is good, responsiveness is not always fast enough. Also, there are a number of gaps (countries that do not provide data), depending on the variable.	• This seems clearly more a question of improving the accessibility than of increased monitoring.
Maritime traffic data	• Vessels tracking data deemed necessary for many challenges (Wind farm siting, MPA, Oil spill, Fisheries Impact and Alien Species) but they were not available for download.	• Another case where the problem lies on the accessibility of the data, and not in a gap in monitoring. Human Activities portal is currently working with EMSA to deliver maps using Vessel Monitoring System data.
Fisheries catches/landings	• The Data Collection Framework (DCF) obliges the EU Member States to collect this type of data, which is managed by JRC for scientific purposes. However, with the exception of Black Sea, where data obtained through this source (JRC) were available and with enough quality, most of the Checkpoints detected deficiencies: data were not available, or took too long to obtain, or did not have the right format. There are other sources of data like ICES.	• Access to data on catches and landings from DCF clearly should improve.
Fisheries bycatch and discards	• Data discards (especially discards in numbers vs discards in mass) is very scarce, only for certain species and when they exist, their quality is doubtful. All Checkpoints (except the Black Sea) coincided in highlighting this problem. Bycatch data is even more difficult to find, in particular for mammals and birds.	• More monitoring could become part of the DCF to obtain data on discards and bycatch. In the Baltic, bycatch data may improve once a suitable monitoring scheme is agreed upon at the Baltic Sea level.

3.4 Concluding considerations and recommendations

The EMODnet sea-basin checkpoint assessments have generated a wealth of insights on adequacy of the current marine data collection and management landscape in Europe. In addition to the specific results of the stress tests, here we present some high level considerations and key recommendations:

- The EMODnet Checkpoint concept is unique and innovative as it incorporates the user perspective. It could become (combined with other quantitative assessments like OSE/OSSEs[4]) a service for the assessment of the monitoring systems in place, which could be carried out regularly every 3-5 years.
- The Checkpoint service would benefit from a greater involvement and feedback from stakeholders in the definition of the challenges, including industry, the general public, or public authorities, in particular in connection with Directives like MSFD or MSP. User feedback can also be incorporated in the assessment of the datasets ("Data advisor" concept).
- Some of the gaps due to an insufficient sampling coverage (temporal or spatial) can be filled in by a better partnership with the satellite and modelling community (Physical variables).
- In other cases, modelling or satellite data are not an option and more intense monitoring for larger areas is just not affordable. The suggestion there would be to focus on a certain number of variables which are considered more important or on representative Essential Ocean Variables (EOV), and concentrate monitoring efforts in those in order to have longer time series and with a better spatial coverage and resolution.
- Many biological variables would also benefit from a better standardisation of parameters and a more systematic approach to monitoring between nations.
- When assessing the fitness for use of a dataset, the time dimension (how long it takes to actually employ the dataset) is also extremely relevant. In this sense, accurate, complete metadata can be key in informing users about the characteristics of the dataset, and hence help them discern if it is worth downloading it or not. The use of ISO and INSPIRE-standards, together with common vocabulary lists like SeaDataNet ones, is advised. Likewise, to avoid confusion when finding the same dataset in different databases, the use of DOI to unequivocally identify a dataset can be a solution.
- To obtain products as the ones proposed in the stress tests (or challenges) covering the whole sea-basins, collaboration with non-EU countries is fundamental. This is particularly important in the Arctic (Russia), for the Mediterranean (north African countries), and the Black Sea. This sea-basin scale view would also benefit from an even tighter collaboration with other international organisations like ICES, the Barcelona Convention, the Black Sea Commission, OSPAR and HELCOM.

[4] Observing System Simulation Experiment (OSSE) is a data denial experiment using real observations. Observing System Simulation Experiment (OSSE) is a data denial and data adding experiment with simulated observations.