



MARITIME FORUM

How fit for purpose is Europe's marine data infrastructure?

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reports from the sea basin stress tests - background information for the stakeholder conference 14-15 February 2017



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Summary of Findings

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Parameter	Seabasin	Results
Bathymetry		
water depth	Arctic	<ul style="list-style-type: none">• The quality of the bathymetric data in the Barents Sea and Norwegian Sea is good enough to use the available data to determine where suitable water depths occur that are compatible with either a fixed or a floating offshore wind turbine.• Bathymetry data for the complete Arctic Ocean are available from EMODnet portals; SeaDataNet; Copernicus marine service; ACCESS; ICES; NOAA National Geophysical Data Center; Marine Cadastre; Geographic Information Network of Alaska; Bureau of Ocean Energy Management; USGS Alaska Geospatial Data Committee; US Coast Guard; National Weather Service but the datasets are extremely large. These datasets provide information on where water depth information exists for the study area, and where information is currently not yet available. While sufficient for general research and interest, the data is insufficiently granular to be used for navigation.
	Atlantic	<ul style="list-style-type: none">• Bathymetry data product overall scored very high availability. However visibility of the data policy is not always optimal (see reasons under "legal framework").• Some restrictions were found with the data policy of EMODnet bathymetry "background datasets". In the North Atlantic a high proportion of 88% of the 10,000 survey data occurrences were obtained by negotiation. Part of these restrictions are due to national or international legal constraints (defence, mining law, UNCLOS, ...). It should be noted that 'by negotiation' does not mean that the data are not available but it clearly slows down the data access process.• The literature survey indicates that higher DTM resolution than 250m is required for many applications (e.g. 50m to 100m for applications such as wind farms, sea level estimates or hydrodynamic modeling).• There is a need for better metadata completeness (e.g. soundings timestamp).

Parameter	Seabasin	Results
	Baltic	<ul style="list-style-type: none"> • Data are available from BSHC Baltic Sea Bathymetry Database (BSBD) and EMODnet, in 500m resolution; • Due to national regulations, data availability varies greatly with countries. In Lithuanian and Russian waters, BSBD uses data from GEBCO 30" bathymetry data. Sweden and Finland have restrictions on the resolution of released bathymetry, i.e., 500m, while other countries e.g., Denmark and Germany release data up to 4m resolution; • The existence of good quality bathymetric data sets is gradually improving but bathymetric surveys are expensive and time consuming operations. In a substantial area of the Baltic Sea the quality of available bathymetry is still low. This seems to be especially the case for shallower waters that are not of interest for commercial shipping.
	Black Sea	<ul style="list-style-type: none"> • The availability indicators for bathymetric data are mostly "partly adequate" and "not adequate" (see Annex 1). • There is no clear data policy or its visibility is low and pricing information is often missing. • The datasets do not provide a full EU Inspire catalogue service.
	Mediterranean	<ul style="list-style-type: none"> • The availability indicators for this theme are dominantly "fully adequate" (see Annex 1). Only 6 data sets were used for the evaluation. • The appropriateness indicators are "not adequate" (see Annex 1) for temporal coverage and temporal validity (last time the data set was updated).
	North Sea	<ul style="list-style-type: none"> • The wind farm siting challenge found that resolution of bathymetry varies with territorial waters, so comparison of boundary areas ended up with variable resolution. Less processing of data was required by using the SeaZone product (as against that from the bathymetry portal) which was preferred for this challenge.
Geology	Atlantic	<ul style="list-style-type: none"> • Only 7 metadata entries related to geology datasets were recorded, which hampers reliable statistics. Most of them concern the coastline. Two only are about seabed sediments,. The literature survey stressed insufficient scale of the seabed substrate due to lack of resolution in coastal zones and lack of knowledge in deep waters. • A wealth of sediment samples in analogue form are still unexploited. • There is a lack of information on vertical land motion (see point on GPS measurements in physics/sea level section)
	Black Sea	<ul style="list-style-type: none"> • General geological maps exist but the resolution should be improved. - There is a general lack of the sediment sea bed data.
	Mediterranean	<ul style="list-style-type: none"> • The characteristics categories in this theme are several: coastal geomorphology, concentration of suspended particulate material in the water column, depositional environment, lithology, sedimentary structure. • The availability indicators for this theme are dominantly "fully adequate" with the exception of sedimentary structure data sets where the score is "not adequate". • The appropriateness indicators are dominantly "not adequate" and "partly adequate". • A sediment mass balance cannot be developed for any part of the basin. Data are not available only in the literature. This is the single one product that cannot even be started to be developed. • Coastal geomorphology is the most unfit for use with all "partly adequate" and "not adequate" appropriateness indicators.
sea bed slope	Baltic	<ul style="list-style-type: none"> • Finer seabed slope products are needed, especially for Wind farm siting.
sediments	Atlantic	<ul style="list-style-type: none"> • (...) models will need to use finer grid resolutions to account for local effects, such as coastal evolution and sediment transport.

Parameter	Seabasin	Results
	Baltic	<ul style="list-style-type: none"> • There is a lack of sediment concentration observations in river discharge; • Existing seabed sediment and substrate type data are useful in general wind farm siting assessment but not in refined wind farm siting design.
	North Sea	<ul style="list-style-type: none"> • The Climate and Coastal Protection challenge found that, on the scale of the North Sea basin, no sediment data was discovered that could enable calculation of annual sediment mass balance at the coast for each NUTS3 region. Indeed, any usable data for non-experts is rare, since those datasets that are available require expert processing. For example, geology data from EMODnet, OneGeology or the European Atlas of the Seas provided only a rough indication of sediments near the coast.
Physics	Atlantic	<ul style="list-style-type: none"> • Gridded models outputs provided by Copernicus typically have a resolution of around 7km. Some applications such as broad-scale habitat mapping or MPA connectivity require oceanographic data with ideally hectometric resolution. • Copernicus provides GIS layers on physical variables that are generally archived time series averaged over a predefined time period (e.g. temperature daily averaged), which may not meet the data user's need such as the same variable averaged over another time period or a percentile or a standard deviation rather than a mean value. With a view to broadscale habitat mapping over extensive areas (e.g. EU basins), Vasquez et al (2015) mention that there is a lack of high resolution modelling (e.g. 200-300m nearshore, 3-4 km offshore) of some key variables (e.g. wave or current energy, temperature, salinity) • There is a need for a spatial assessment of the confidence in the datasets provided by physical oceanography models: typically these models (e.g. currents, waves, light, temperature, etc.) provide little information on the reliability of the values they compute. Applications (e.g. habitat mapping, offshore energy) need an estimate of how confident they can be in the value provided by the model at any location.
	Mediterranean	<ul style="list-style-type: none"> • The characteristics categories in this theme are several: Horizontal velocity of the water column (currents), Light extinction and diffusion coefficients, River flow and discharge, Temperature of the water column, Salinity of the water column, Sea level, Spectral wave data parameters, Wave direction, Wave height and period statistics, Wind strength and direction. • The availability indicators for this theme are dominantly “fully adequate” with the exception of the INSPIRE Catalogue and the visibility indicators that are “not adequate” to “partly adequate” for most of the characteristic categories. Spectral wave input data sets score “not adequate” in the data delivery. • The appropriateness indicators are “partly adequate” for the majority of the input data sets and “not adequate” for vertical and temporal coverage, horizontal resolution, temporal validity (last time the data set was updated). • For most of the characteristic categories in Physics the major gap is the horizontal coverage and horizontal resolution. • Top of the list of unfit for use data is waves and all wave parameters both in terms of availability and appropriateness.

Parameter	Seabasin	Results
Ice	Arctic	<ul style="list-style-type: none"> Starting from 2010 estimates of ice thickness are available from the European Space Agency's CryoSat-2 satellite. ESA Data are available from Centre for Polar Observation and Modelling at the University College London. However, there is no dataset available on change in average ice cover, and estimates must be made from available data on ice extent and ice thickness (assuming a constant density of sea ice). Obtaining good measures of average ice thickness over the last decade is challenging because of sparsity of data in space and time. For the past 50 and 100 years it was not possible. Arctic data on ice cover in sea expressed in kg are not available. The choice was made to focus on sea ice extent and sea ice thickness instead of cover in kg. The data on this topic is widely spread and freely available.
	Baltic	<ul style="list-style-type: none"> High-resolution (1-3km) weather and ocean-ice assimilation and reanalysis (>30years) should be developed; The total mass of ice is difficult to measure and there is a lack of long-term time series;
waves	Mediterranean	<ul style="list-style-type: none"> The appropriateness indicators for waves and winds are "not adequate", meaning that the monitoring system is not capable to produce wave data at the needed horizontal and temporal resolution. Availability of both waves and winds is low because they are commercial also from Met Offices.
wind speed	Arctic	<ul style="list-style-type: none"> The quality of the wind speed and strength data in the Barents Sea and Norwegian Sea is good enough to use the available data to determine suitable areas for wind park farms on a less detailed level. However, we might lack information on vertical profiles for detailed assessment (to be assessed during the second phase of the project).
	Atlantic	<ul style="list-style-type: none"> The literature survey stressed the lack of appropriate information on wind vertical distribution. Wind data are highly available, probably because they serve the two large communities of oceanography and meteorology.
	Baltic	<ul style="list-style-type: none"> Offshore wind profile and current measurements are not sufficiently monitored and shared; Quality of modelled winds and currents in the shallow coastal regions need more validation and to be improved.
	North Sea	<ul style="list-style-type: none"> The wind farm siting challenge found that datasets for key parameters e.g. wind and wave conditions, were available for the challenge. These were either charged for at a cost per point of data, making them expensive for a site selection study, or had a coarse resolution meaning that their usefulness for site selection was limited. For example, the UK Met Office charges £5000 per data point for its wind and wave 35 year re-analysis data time series in the North Sea. The Oil Platform challenge identified that some wind data was difficult to locate from freely accessible sources at a sufficient spatial scale, particularly the hind and forecast information that would be needed for this type of assessment. The spatial resolution of some data sets, for wind and currents, near the coast was quite coarse leading to some interpolation of data. Also, oil spill trajectories sometimes did not reach the shore due to the coarseness of the MyOcean data around the coast.
temperature and salinity	Arctic	<ul style="list-style-type: none"> There are data available for both surface temperature and bottom temperature, but not very detailed; more data can be found on surface temperature; old data are more scarce than recent. Questions on spatial and temporal developments can only be partly answered.
	Baltic	<ul style="list-style-type: none"> Spatiotemporal distribution of long time series for temperature and salinity (>50 years) are uneven, and are available only from a limited number of locations.

Parameter	Seabasin	Results
	North Sea	<ul style="list-style-type: none"> The Climate and Coastal Protection challenge found that the only sources of data for mid-water and sea-bottom temperature are from global numerical models with reanalysis. Moreover, modelled data tends to be supplied in very large files, sometimes several gigabytes. Sometimes long downloads failed as a result, for example, downloads from the NOOS website either failed or appeared to be successful, but gave a corrupt zip file.
current	Mediterranean	<ul style="list-style-type: none"> Sea level does not have an INSPIRE catalogue service and from the point of view of appropriateness spatial and temporal resolution indicators the monitoring system is lacking resolution and coverage, both spatial and temporal. Temperature follows the same behaviour of the sea level.
	North Sea	<ul style="list-style-type: none"> The oil spill challenge required water current data which was retrieved from the MyOcean.eu website. Some grid cells near the coastline do not give a value for the current. This complicated the oil spill modelling in an area of particular importance, that of predicting whether the oil would reach the coast. It is recommended to investigate the feasibility of providing water current data at grid cells close to the coast, or providing downscaled options. Also, MyOcean current forecasts are limiting the length of time that an oil spill simulation can be taken into the future.
sea-level	Arctic	<ul style="list-style-type: none"> Sea levels are measured on 95 stations in the Arctic Ocean, and 52 have data over a time frame of more than 40 years. There are no long term data available in Greenland, Canada and the USA.
	Atlantic	<ul style="list-style-type: none"> Sea level data scored about average for all criteria, meaning there is ground for improvement on all availability items. However, according to Slangen <i>et al.</i> (2016) sea-level change should be estimated on a national level, which is what coastal planners are interested in, but the spatial resolution of the current sea-level projections is still relatively coarse. Sea level models will need to use finer grid resolutions to account for local effects, such as coastal evolution and sediment transport. Likewise an increase in the number of GPS measurements at tide-gauge locations is needed (Church and White, 2011; Slangen <i>et al.</i> 2016) to provide information on vertical land motion. This applies in particular to the use of in situ data to monitor the accuracy of satellite altimeter measurement systems.
	Baltic	<ul style="list-style-type: none"> By combining existing sea level data with models, it is possible to reconstruct high quality monthly sea level data in entire Baltic Sea in the past 100 years. Most of the sea level data from Poland, Lithuania and Latvia are not included in EMODnet database. Some historical data may be recorded in paper, therefore will need digitization.
river	Arctic	<ul style="list-style-type: none"> The data availability is very different for the requested parameters. Most data is available for the volume of water discharge. For some large Russian rivers time series are quite long, more than 70 years, up to more than 100 years. But many time series are relatively short, a few decades in many cases, and often incomplete. It is worrying that stations have been closed and data are delayed.
	Baltic	<ul style="list-style-type: none"> The river temperature dataset has few observations, discharge observations are available from different databases but with major data gaps. The BHDC is no longer updated. The E-HYPE model is used to fill in the gaps and has shown good results.
	Mediterranean	<ul style="list-style-type: none"> River flow and discharge together with current velocities and wind strength and direction score RED for 3 out of 8 appropriateness indicators.
Chemistry		
nutrients	Arctic	<ul style="list-style-type: none"> Nutrient data are rather scarce in the Arctic Rivers. Only nutrients and a couple of chemicals are described in the six largest rivers, and the data are recent. It is difficult to create time series from the available data.

Parameter	Seabasin	Results
	Atlantic	<ul style="list-style-type: none"> • Nitrate and Phosphate concentration in rivers: data is scattered, often available from local sources only, with the metadata sometimes incomplete (e.g. measuring date). • In the North Atlantic, in EMODnet Chemistry 44% of all raw datasets (i.e. 178 000 occurrences) are available by negotiation, which may lower data access. • Problems with robustness of EMODnet chemistry data access services were reported.
	Baltic	<ul style="list-style-type: none"> • River nutrient load is calculated using discharge and nutrient concentration. The observed concentration is often too sparse to calculate loads, while the E-HYPE model can be used to fill in the gaps with good results. • High data confidence for eutrophication is only found in less than half of all sub-sea basins. • Both EMODnet and ICES have data that others do not have, but it is more time consuming to download EMODnet data. • Generally, the sub-basins in transition waters and icing waters were lacking sufficient amount of data for the high confidence assessments. For DIN and DIP, more observations are needed in Danish Straits, Gulf of Finland, Åland Sea and The Quark; for Chlorophyll-a, more observations are needed in Great Belt, Åland Sea, Bothnian Sea, The Quark and Bothnian Bay; for secchi depth, more observations are needed in Danish Straits, Western Gotland Basin, Åland Sea, The Quark and Bothnian Bay.
	Black Sea	<ul style="list-style-type: none"> • There are significant amounts of data available, mainly for coastal waters. • The number of water column profiles in open sea was dramatically decreased during last decades.
	Mediterranean	<ul style="list-style-type: none"> - While data for “rivers” score “fully adequate” for availability, appropriateness is scarce especially for resolution and temporal coverage. • The characteristics categories in this theme are several: Dissolved oxygen parameters in the water column, Dissolved total and organic nitrogen concentrations in the water column, Dissolved total or organic phosphorus concentration in the water column, Nitrate concentration parameters in the water column, Nutrient fluxes between the bed and the water column, Phosphate concentration parameters in the water column, pollution events. • The availability indicators for this theme are dominantly “fully adequate” except for the Pollution events for which all the indicators are “not adequate”. • The appropriateness indicators show a “not adequate” score for Horizontal resolution and coverage for all the characteristic categories and for almost all of them “not adequate” is the score for temporal coverage and validity.
	North Sea	<ul style="list-style-type: none"> • River inputs data is very patchy. For example, total nitrogen as reported to OSPAR, of rivers into the North Sea between 2002 and 2013, has no data for Belgium and only two years for Denmark, Germany and the Netherlands and only three years for France and the UK. • The Marine Environment challenge was not able to collect ‘whole-basin’ data for an assessment of Eutrophication. • There was a considerable amount of data on water chemistry available through EMODnet on nitrates, phosphates, silicates and ammonium. The primary issue with these data is the way in which dates are formatted. These are not in an immediately usable form and the link to the metadata online returns a blank page.
Biology		

Parameter	Seabasin	Results
	Black Sea	<ul style="list-style-type: none"> • Phytoplankton generic biomass and zooplankton wet weight biomass are not adequately covered by input data set. The data found was not up-to-date. • Chlorophyll pigment concentrations and Bird taxonomy are partly adequate
	Mediterranean	<ul style="list-style-type: none"> • The characteristics categories in this theme are two: bird counts and Chlorophyll pigment concentrations in water bodies. • The availability indicators for these two characteristic categories are: “fully adequate” for Chlorophyll and “not adequate” for the visibility of the Bird counts. • The majority of the appropriateness indicators for Chlorophyll have a “partly adequate” score and the “not adequate” score is associated with Bird counts for vertical and horizontal coverage.
species	Arctic	<ul style="list-style-type: none"> • Most studies focus on primary production in the broader sense of the word, mostly focusing on chlorophyll concentrations and not on individual species. • There are gaps in both time and space of monitored areas when it comes to individual species of phytoplankton. The data found was not up-to-date. • The IUCN offers to deliver data on species distribution on their website. We have asked for 14 sets of distribution data, but multiple requests were not responded to.
	North Sea	<ul style="list-style-type: none"> • The Wind Farm challenge identified limitations of using biological and ecological data, particularly fisheries data and information on the migration routes for birds and marine mammals. For example, CEFAS spawning and nursery data proved to be the most accessible data on fisheries. It is, however, coarse and last updated in 2010. Beyond ICES, OSPAR and CEFAS, there is little data readily available online for planning purposes. Indeed, the main data gaps identified through the wind farm siting challenge were in spatial datasets for ecology and fishing activities. Aggregated, baseline data is found, but precise data was not practically available. It is therefore recommended that ecology and fishing data be made available in more structured and fine grain forms. Until then, interpreted AIS and VMS datasets (such as those published by the MMO in the UK) can be used, but need to be made more discoverable. • The Marine Protected Areas challenge identified that, generally, the data sets provided by the Biology Portal relate to data collected over short time periods or in relation to specific species in target locations, which was not useful for basin-wide analysis. No basin-wide studies were found which looked at the connectivity of species between MPAs. It is recommended that a list of ‘priority’ species be drawn up and associated methods then derived for analysis of MPA connectivity. • Also, there was a lack of spatial information with regards to certain and larval dispersal patterns within the MPAs. • The Oil Platform challenge identified gaps in the data supporting distribution of seabirds and marine mammals, also fisheries activity on a timescale shorter than a whole year. • Overall, data concerning fisheries and marine species (and bird) migration was a recurring inadequacy across the challenges. It is recommended that this be made a priority area for attention.
migration from rivers	Arctic	<ul style="list-style-type: none"> • There is no ready-to-use information on fish migration from and to the Arctic rivers. Only combining results from monitoring programs in and outside rivers gives an impression of the fish migration.
	Baltic	<ul style="list-style-type: none"> • Little observations of salmon in river runoff were found.

Parameter	Seabasin	Results
	North Sea	<ul style="list-style-type: none"> The River Inputs challenge found that the data, for species of salmon and eel, only the UK (specifically England) held comprehensive datasets that included abundance of the fish. Several datasets were not fully useable due to the lack of metadata detailing location or dates of collection. Where data was not geo-referenced it was difficult to determine if it was useful for the challenge.
alien species	Arctic	<ul style="list-style-type: none"> There are about 94 alien species which invaded the Arctic Ocean. Some invasive species in the Arctic altered the habitat locally.
	Atlantic	<ul style="list-style-type: none"> The European Union lacks a comprehensive framework to address the threats posed by the introduction and spread of non-indigenous species (NIS). Current efforts are fragmented and suffer substantial gaps in coverage. One of the problems facing the designers of roadmaps, programs and management measures of NIS is the lack of standardisation of terminology and metrics to describe the status of biological invasions, influenced, in turn, by quality, validity and potential bias of the underlying data. At present, data are rarely if ever gathered through standardized surveys specifically designed to detect NIS. Poorly studied NIS taxa, NIS in poorly-studied habitats and regions, small-bodied species and additional lacunae impede our understanding of NIS diversity. Existing data suffer from being referenced a lot in publications, so although data are easily found and get 75% of easy download, responsiveness and readiness are low. Data policy and its visibility are very low, probably due to the absence of these indicators in web sites dealing with this topic which are still in their early development.
	Baltic	<ul style="list-style-type: none"> Alien species data are available from AquaNIS database, ICES and research communities; monitoring data is completed by the geo-referenced information from literature sources; it is recommended that point information should be completed by empirical modelling to show the areas where Non-Indigenous Species (NIS) are already present and may spread in the future.
	Black Sea	<ul style="list-style-type: none"> There is no comprehensive data set for alien species in the Black Sea.
fish	Arctic	<ul style="list-style-type: none"> Collected data on fisheries discards and/or bycatch is less readily available than landings or catch data. It was therefore not possible to generate overall comprehensive overview of discards and bycatch in the Arctic area; only fragmented data has been found. For fisheries catch data used in the checkpoint assessment it is not always clear whether it relates to commercial fisheries catch or fisheries landings.
	Atlantic	<ul style="list-style-type: none"> Fisheries data are not covered by the EMODnet "Human activities" lot but by the Data collection framework mechanism (DCF). Data on discards and incidental bycatch (e.g. marine predators) are not available for many countries in the Atlantic and only available on special data call from Member States. More specifically, data on PETS (Protected, endangered and threatened species) bycatch is scarce. In general there are no programs collecting landings in terms of number of fish, thus this information is not available in the DCF database, an issue for the "fisheries management" challenge which has to report these figures.
	Baltic	<ul style="list-style-type: none"> Fish landing data are adequate for stocks where relevant/available and used for stock assessment and subject to continuous improvements of sampling programs. Fish discard data are acceptable for stocks where used in stock assessment and subject to uncertainty check. No regular monitoring on the fish bycatch, the data generally adequate for the purpose when available and availability limited.
	Black Sea	<ul style="list-style-type: none"> The Challenge 06-Fisheries and Challenge 07-Fishery impact have the best scores, probably due to the fact that source of data is well defined and available.

Parameter	Seabasin	Results
	Mediterranean	<ul style="list-style-type: none"> • Fishery data, such fish catch and by-catch, fish abundance in the water column are at the top of the list for their inadequate availability and appropriateness indicators. The key inadequate quality attributes for this monitoring are: visibility, EU INSPIRE catalogue, data policy visibility, readiness, data delivery and data policy, horizontal and temporal coverage, temporal validity.
Habitats	Arctic	<ul style="list-style-type: none"> • There are also different European initiatives, e.g. EUNIS and MAREANO project, that provide some kind of habitat information for specific Arctic parts of the Northeast Atlantic.
	Atlantic	<ul style="list-style-type: none"> • There's a need for better availability of habitat-related sample point data: the UK Marine recorder is a huge habitat-related database that has stored and made available for years all sample point data that were collected in the UK and Irish waters with a view to produce habitat maps. For each sample point the habitat type is characterised together with other descriptive attributes such as species, salinity or temperature regime, sediment type, etc. Unfortunately in Europe the Marine recorder is an exception. Elsewhere such data are held at best in national databases, and sometimes on personal computers, making access to this information difficult or impossible. • The literature survey reports a lack of habitat maps giving a full biological detail (maps from surveys), even in the coastal zone. Complete coverage is achieved by the EMODnet broadscale map, however with insufficient thematic resolution. • Many deep sea offshore habitats are under-studied and poorly inventoried. The most prominent data gaps involve the lack of consistent, region-wide surveys of biological data on marine species across taxa and trophic groups. This especially applies to the abyssal plain, which is under-represented, with available biological data being more restricted to surface or shallow water regions in and around coastal areas (Patricio et al, 2014)
	Black Sea	<ul style="list-style-type: none"> - The characteristics categories in this theme is habitat extent. • The availability indicators for this characteristic are dominantly “partly adequate” for data delivery mechanisms, easy found, INSPIRE services, pricing and “not adequate “ for responsiveness.
	Mediterranean	<ul style="list-style-type: none"> • The characteristics categories in this theme are two: habitat characterization and habitat extent. • The availability indicators for these two characteristic categories are “not adequate” for pricing, data delivery mechanisms and responsiveness. • The appropriateness indicators are dominantly “partly adequate” TO “not adequate”: temporal coverage scores “not adequate” as well as vertical coverage, horizontal and temporal validity (last time the data set was updated).
fisheries impact	Arctic	<ul style="list-style-type: none"> • For fisheries impact on habitats, habitat information has been obtained from various sources. Different working groups within the Arctic Council provide some kind of information on important areas within the Arctic area.
		<ul style="list-style-type: none"> • Arctic: Information on fishing impact is scarce and mostly on low-spatial level resolution; it was not possible to generate an overall overview of fishing impact in the Arctic area.

Parameter	Seabasin	Results
	Mediterranean	<ul style="list-style-type: none"> • The VMS maps cover only EU MS fishing in the Mediterranean Sea. Moreover, the data were not available for all the countries (Italy, Croatia, and Spain did not provide them) while partially available for the other EU countries, and the time series does not cover the same period in the different countries. The greatest limitation of the characteristics and respective data sets is that they fail to meet the scope of the product due to the incomplete spatial and temporal coverage of the data sets. Hence, also the change of the level of disturbance of trawling on the seabed could be calculated on a shorter time period in respect to that required by the Tender. • The AIS data have a higher spatial coverage in respect to VMS data mainly because also non-EU vessels are equipped with this system. Therefore, although in the available time period there are no data for a part of the fishing fleets due to the fact that the obligation of adopting this system was gradually extended over the years, they allow to get a more spatial complete coverage of the overall Mediterranean basin in respect to VMS.
Human activities	Atlantic	<ul style="list-style-type: none"> • Overall availability is quite good for Human activities data, with reservations in delivery mechanisms of which 40% are only moderate (simple online downloading) and also unclear data policy for 40% of them. • Most of the data products currently available on human maritime activities seem regionally clustered or are scarce. • For the assessment of impact of an oil spill on tourist beaches the dataset used as a proxy was the EMODnet dataset 'Quality of bathing water' which might not be comprehensive. • Aquaculture sites are often found as point locations rather than polygons boundaries. Data on shellfish aquaculture currently available on the EMODnet Human activity portal are clearly not satisfactory, as they are still mostly in point form from many sources. GIS compliant cadastre data were found for Ireland and France but are still missing elsewhere. More efforts are needed from the community to provide an effective representation of aquaculture activities suitable to address the challenges. • The Oil Platform challenge required fast data provision to support real-time operations for a variety of parameters. Among other issues, it was found that data concerning certain managed areas was difficult to obtain. • After 24 hours there was no data obtained on the locations of tourist beaches and shipping lanes and this limitation persisted through the challenge into 72 hours, particularly for the locations of tourist beaches in the Shetlands.
		<ul style="list-style-type: none"> • EMODnet human activity Lot should be extended to include more data necessary (e.g. cables and pipelines, navigation data) for the wind farm siting.
	North Sea	<ul style="list-style-type: none"> • The Oil Platform challenge required fast data provision to support real-time operations for a variety of parameters. Among other issues, it was found that data concerning certain managed areas was difficult to obtain.
ship traffic	Atlantic	<ul style="list-style-type: none"> • Maritime traffic data (AIS vessel tracking), deemed useful for challenges such as "Oil leak" (impact of spill on traffic), "Windfarm siting" (competition for space) or "Invasive species" (ballast water as vector of species transport), are not available for download.
	Baltic	<ul style="list-style-type: none"> • AIS data are required for oil platform leak and wind farm siting, but is lacking in EMODnet. • Information required for identification of IUCN categories for approximately 15% of MPA's is not readily available, scattered among different sources and mostly in national languages. However, when access to the needed information is set, data are usually adequate for assigning IUCN categories.
	Black sea	<ul style="list-style-type: none"> • Maritime traffic data provided by VTMS are very useful but should be made freely available for scientific use.

Parameter	Seabasin	Results
	Mediterranean	<ul style="list-style-type: none"> Maritime traffic data are essential for the assigned task and input data sets are totally inadequate because of negative scores for visibility, INSPIRE Catalogue, responsiveness, horizontal and temporal coverage, temporal validity. In addition data should be made available to the research community following a protocol to be developed as soon as possible.
	North Sea	<ul style="list-style-type: none"> After 24 hours there was no data obtained on the locations of tourist beaches and shipping lanes.
tourist beaches	Arctic	<ul style="list-style-type: none"> It appears there are not too many tourist beaches in the Arctic (yet).
	North Sea	<ul style="list-style-type: none"> After 24 hours there was no data obtained on the locations of tourist beaches and shipping lanes.
fishing	Arctic	<ul style="list-style-type: none"> For assessing fishing impact, the coding of the presented unit of effort data is not always clear, making it not possible to use the data. Due to privacy issues high-spatial resolution data on fishing impact is not readily available for general use. Specific organisations that were addressed to identify accessible data did not reply. Information on fishing impact is scarce and mostly on low-spatial level resolution; it was not possible to generate an overall overview of fishing impact in the Arctic area.
	Atlantic	<ul style="list-style-type: none"> To date the most comprehensive and recent datasets available on bottom fishing effort and intensity are a series of maps generated in 2016 by the ICES Working Group on Spatial Fisheries Data (WGSFD) who assembled VMS data from vessels, coupled with log book data obtained via a data call to 21 countries of the NE Atlantic and Baltic Sea (four of them did not submit data and in another case data was worthless). These maps only cover the OSPAR area, their time coverage is from 2009 onwards and their resolution 0.05 degrees (~5 km). If the purpose is to assess fisheries impact on seabed habitats, this resolution is significantly lower than that of the broadscale habitat maps provided by the EMODnet Seabed Habitat lot (250m). Quality assurance is non-existent and this needs to be rectified.
	Baltic	<ul style="list-style-type: none"> Fisheries data (VMS-data) are spatially and temporally restricted, they are only available at a scale of grid-cell size of approx. 10 km x 5km for the years 2009-2013 at a yearly scale. For fishery impact assessment, species data are considered available and adequate, but variable in quality, e.g., variable prediction confidence in modelled data and substantial extrapolations due to lack of ecological data in some areas.
	North Sea	<ul style="list-style-type: none"> Some fishing datasets have been aggregated to a level which hampers their use. For example, the ICES WGSFD dataset has aggregated fishing data across countries, leaving no possibility to assess which countries are connect with fisheries in a given area.
		<ul style="list-style-type: none"> JRC and ICES datasets were free. National datasets, however, were potentially expensive. For example, when quotes were requested to provide several years of landings and effort data, Denmark quoted €20,000 - €30,000 and the Netherlands €15,000 - €20,000.
	Mediterranean	<ul style="list-style-type: none"> Fishery data, such fish catch and by-catch, fish abundance in the water column are at the top of the list for their inadequate availability and appropriateness indicators. The key inadequate quality attributes for this monitoring are: visibility, EU INSPIRE catalogue, data policy visibility, readiness, data delivery and data policy, horizontal and temporal coverage, temporal validity.
Cross-cutting issues		

Parameter	Seabasin	Results
Legal frameworks		
marine directive	Atlantic	<ul style="list-style-type: none"> • Within the framework of the DEVOTES Project, Patricio <i>et al.</i> (2014) performed an analysis of the successes, failings and opportunities in the present monitoring systems, especially in relation to the biodiversity-related MSFD descriptors of good environmental status namely D1 (biological diversity), D2 (Non-indigenous species), D4 (Food-webs) and D6 (seafloor integrity). Below are the main weaknesses that the study identifies for the North Eastern Atlantic region. • The Macaronesian biogeographic region and the wider Atlantic (offshore areas) are poorly monitored; • Microbes, cephalopods and reptiles have limited coverage; • Monitoring of bathyal and abyssal habitats is not undertaken in many subregions (e.g. monitoring programmes in the Bay of Biscay and Iberian Coast subregion do not cover “upper bathyal rock and biogenic reef” or “upper bathyal sediment”); • Pressure “extraction of Maerl and Seaweed” is poorly covered; • In the Macaronesian subregion only 11 out of the 37 pressures considered in the analysis are addressed by the monitoring programmes; • The number of monitoring programmes that address D2 and D6 is limited compared to the number of programmes that address D1 and D4; • For a number of biodiversity components quality assurance is non-existent. This needs to be rectified.
	Black Sea	<ul style="list-style-type: none"> • EC directives are applicable for Bulgaria and Romania, but all Black sea countries are members of the Convention on the protection of the Black Sea against pollution.
	Mediterranean	<ul style="list-style-type: none"> • The fishery impact product was produced with upstream data sets that “fail the most” to meet the scope of the product due to the incomplete spatial and temporal coverage. • Another problem to compute fishery impact is that VMS data processing and production of anonymous maps requires technical capabilities not always developed in each country and, also in the case that the country has such competence, accessibility to the data set is still not easy as the competent authorities and/or the scientific bodies responsible for the data storage and processing do not often facilitate data access (e.g., Italy).
	North Sea	<ul style="list-style-type: none"> • The INSPIRE themes which relate most strongly to the challenges are Hydrography, Oceanographic geographical features, Atmospheric conditions, Habitats and biotopes, and Species distribution. • The key issues affecting access to data include commercial sensitivity, intellectual property and cost. This means that it may be difficult to obtain relevant data, leading to the use of inferior or patchy data for projects where timescales do not allow for more complete information to be accessed. • EU data standards were helpful for basic information on designations of MPAs but countries implement MPA management plans at different paces and so availability of these data varies. Language was also a restriction when locating national information in some countries.
	Arctic	<ul style="list-style-type: none"> • The World Database on Protected Areas contained 90% of the MPAs, but is not complete.
The challenges	Atlantic	<ul style="list-style-type: none"> • Eleven challenges were defined by DGMARE in their tender. We found in Atlantic that several topics were left out of this list. This is the case for “pollution of the water column” in general, but more specifically by contaminants, micro-plastics, acidification, sound etc. • Coastal surge (under the action of either storms or tsunamis) and related issues around coastal defence is also an important block of applications not dealt with by the checkpoints.

Parameter	Seabasin	Results
	Black Sea	<ul style="list-style-type: none"> - Starting with the Challenges, it is evident that the Challenge 06-Fisheries and Challenge 07-Fishery impact have the best scores - mostly “fully adequate”. The worse cases are for Challenge 01-wind farm siting, Challenge04-Climate, Challenge10-Bathymetry and Challenge11-Alien Species where the “not adequate” and “fully adequate” values are in equal proportion or “not adequate”-yellow is dominant. - The Challenges refer to different data sets for the same characteristics. This highlights a gap in the sharing of information across disciplines in the marine community. While this could generate low quality products in one Challenge that uses multidisciplinary data sets, it might also be an indication of a duplication of efforts in the monitoring system. - The analysis clearly shows that most “red” and “yellow” scores are related to the Easily found, INSPIRE catalogue service and Visibility of Data policy indicators. This highlights the lack of an adequate data management infrastructure at the Black Sea basin scale level. <ul style="list-style-type: none"> • Whenever the characteristic category is monitored by “observations” instead of “model” outputs, the availability indicators for the data sets are less adequate, highlighting the lack of adequate availability of the observational data sets with respect to the model ones. • The input data sets regarding atmospheric characteristics are not adequate to meet the needs of the Challenges, which is probably due to the lack of an open data policy at the level of meteorological organizations.
	Mediterranean	<ul style="list-style-type: none"> • Challenge products quality (79 different Challenge products were generated) was assessed by means of appropriateness indicators and expert opinions. The results show that: (1) most of the products have consistent quality with respect to the Product requirements established before designing the product except for the sediment mass balance product that was not produced because of total absence of adequate data; and (2) the largest Challenge product errors are linked to inadequate horizontal coverage and resolution and to temporal validity of the resulting product.
	North Sea	<ul style="list-style-type: none"> - Overall, it was found across all the challenges that the metadata describing potential datasets wasn’t sufficient to evaluate whether it could be used - the data had to be obtained and analysed before this could be ascertained. About 15% of datasets initially identified were used, whereas only 30% were rejected after a first evaluation. It is therefore recommended that initiatives be undertaken to introduce a simple, structured standard for marine metadata, focusing on clarity of parameters described, spatial and temporal coverage and resolution.

Parameter	Seabasin	Results
Data visibility	Atlantic	<ul style="list-style-type: none"> • To address poor data visibility, there is a need for: • data indexing: many datasets are indexed in thematic catalogues however finding these catalogues requires some expertise. Assembly data initiatives such as EMODnet attempt to fill this gap, however users are faced with a huge amount of data. A Master Directory to route end users towards the appropriate data sources is needed. NASA's Global Change Master Directory (http://gcmd.nasa.gov/ [12]) is an example which could be considered although it is limited to climate change. • better website indexing and design: Search engines are now the main tool to search and hopefully find data. However data portals and data providers' web sites suffer from several limitations entailing a waste of time and potential gaps due to sources of data being hard to locate. Most users do not go further than the first 2 pages of their search, which means data providers have to optimize their sites to be easily found among the top 40 results returned by a search. The Search Engine Optimization (SEO: https://en.wikipedia.org/wiki/Search_engine_optimization [13]) is a series of techniques to meet users' needs which are probably overlooked by data providers, especially institutional and academic bodies. In addition the lack of standard and guidelines for harmonised web sites is a brake to the use of existing data. • further use of DOIs: DOIs provide persistent links to contents, helping users get to the authoritative, published version of the contents they are searching for, even when contents change location or ownership. Assigning DOIs to datasets and other research objects supports simple and effective methods of data citation, discovery and access. Citable data become legitimate contributions to scholarly communication. The use of data DOI should improve data search by providing links from scientific papers to datasets and their descriptions and will contribute to a better indexing of dataset by search engines in directories and catalogues thanks to the name provided for citation. • common vocabularies: one of the difficulties in finding data is the lack of a vocabulary common both to data providers and end users allowing discovery not only at catalogue but at portal level. To increase the relevance of a website to specific keywords, the use of the SeaDataNet common vocabulary lists (P03 and P02 in particular) by both providers and end users as tags and user words would make searches more efficient • Identifiers: common vocabulary and definitions have to be adopted by the different data providers. • Low visibility of data policy: data policy, when existing, is available either in a document related to the whole data collection, or within a web page, or attached to each dataset description in data catalogues, or in a README file for download with the data file (e.g. Scripps Global Topography). When the data policy is available on a web site, it is often difficult to find due to a lack of consistency in portal design. It can be found in menus such as: "Service commitment and licence" (Copernicus), "Acknowledgment" (Emodnet Chemistry), "Terms of use" (EMODnet Geology), "Disclaimer" (GEBCO) or sometimes "Data policy" etc. The lack of guidelines about the legal constraints make it difficult to know if data can be used and the lack of Service Level Agreement ensuring that users get the information in due time are potential sources of gaps. Guidelines for writing and displaying data policy in an understandable manner on data web sites would be useful and these conditions should be specified in EU calls for tenders. As a result this low visibility prompts end users to wrongly equate the presence of a downloading service with open data access.

Parameter	Seabasin	Results
	Atlantic	<ul style="list-style-type: none"> • Low data sharing: in the Atlantic more than 25% of the datasets required by the challenges suffer from restrictions or lack of information on the conditions of use. Restrictions concern mainly the Fisheries management, Bathymetry and Invasive Species challenges. It is noteworthy that most data available through publications fall in these categories. Data status is complex, depending on the kind of use: open to any kind of application, only to academic use, at a cost for commercial use or fully restricted. This variety of constraints is described using various wordings making it difficult to understand the policy and then to report it in a unique
	Mediterranean	<ul style="list-style-type: none"> • Adequacy of availability indicators is low for 19 categories of monitoring data at the basin scale. Sub-dividing them into “themes” they are: • for geology: sedimentary structure data is totally inadequate in terms of Data Policy, Pricing and Readiness and quite inadequate for INSPIRE Catalogue and responsiveness; • for physics: wave data (spectra, wave height and direction) is totally inadequate for the visibility, the EU Catalogue and the Data Policy visibility; • for chemistry: pollutants in the water column (oil) are totally inadequate for almost all the availability indicators (7 over 8); • for biology: sea birds and fish characteristics (abundance, reproduction, behaviour) are totally inadequate for visibility, INSPIRE Catalogue and Data Policy Visibility; • for habitat: habitat extent is totally inadequate for Data Policy, Data delivery and and responsiveness • for human activities: fish catch and by-catch, horizontal platform movement (maritime traffic), marine archaeology, marine environment leisure usage are totally inadequate for visibility, INSPIRE catalogue, and readiness. • for others: atmospheric conditions in general are totally and partly inadequate.

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