EMODnet

European Marine Observation and Data Network

EMODnet Sea-basin checkpoints

Lot n° 3 - Baltic

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Final Report

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1. Executive summary

There are two important issues in marine data service: one is data accessibility, i.e., to ensure users can effectively and efficiently access the data, the other is that the data have to fit for the purposes of user applications. The first issue is resolved by EMODnet thematic data portals on bathymetry, biology, chemistry, coastal mapping, geology, habitat, human activities and physics, while the second issue is handled by EMODnet Sea Basin Checkpoint projects. The objective of the Baltic Sea Check Point (BSCP) project is to assess the Baltic Sea marine data adequacy in terms of fitting for the purpose of user applications in eleven challenge areas, i.e., wind farm siting, marine protected areas, oil platform leak, climate change, coastal protection, fishery management, fishery impact, eutrophication, riverine inputs, bathymetry and alien species. The methodology is stepwise: i) to review accessibility, quality and appropriateness and usage of existing marine data, ii) for each challenge area, to identify needs of the marine data in air, water, biota, seabed and human activity in order to generate pre-defined products, and collect the data, iii) to produce the products and present them on a project website, iv) to assess the adequacy of existing marine data for fit-for-the-purposes in step iii), v) to identify gaps and give recommendations for future sustained ocean observing. Outcomes of step one are documented in a Literature Review report; results in step three are presented as products and displayed in BSCP website; for step two, four and 5, results are documented in two Data Adequacy Reports (DARs) and Sustainability Report. The outcomes from the project were reviewed by BSCP Advisory Expert Panel, both in the mid-term and upon the project completion. Two panel review reports have been submitted.

Literature Review: the data requirements from the eleven challenges sums up to a total of 140 different characteristics: 10 in Air, 38 in Water, 31 in Biota/biology, 19 in Seabed and 42 in Human Activities. The identified data sources have been evaluated with regard to accessibility, quality and appropriateness. The literature survey has demonstrated that we have a good understanding and overview of characteristics need for a variety of stakeholders here represented by the eleven challenges. Based on the survey we also have a good overview of where to find relevant characteristics for the Baltic Sea within the five environmental matrices: air, water, biota/biology, seabed and human activities.

Product generation and website presentation: during the project period, 405 products have been generated for the eleven areas. The products are presented on the BSCP website http://www.emodnet-baltic.eu. This provides a demonstration of user-oriented data and map service. The website has been running for the past 30 months and will continue after the project end.

Data adequacy assessment: The DARs evaluate the accessibility, quality and appropriateness (in terms of adequacy) of the marine data for their usages in social-economic benefit areas. The assessment focused mainly on in situ observations but also include satellite observations, model data, human activity data and integrated data by combining models and observations when necessary. For data accessibility, it is found that i) more aggregated search functions in EMODnet data portal can facilitate the user up-taking; ii) most of the ship data are delivered too late to be used in rapid environment assessment; and iii) a great amount of data exists at national level (both from public and private sectors) but not collected by public available data portals such as EMODnet. For data quality and format, it is found that data from different portals show overlaps and differences, leading to inconveniences for users. It is also found that

it is important to update the operational, less quality controlled data with reprocessed, well quality controlled data, e.g. in EMODnet Physics. For data coverage and resolution, major data gaps are identified as a lack of observations on wind profiles up to 250 m, sedimentation rate and grain size, shore evolution profiles, fishery bycatch, riverine inputs of nutrients and commercial species, detailed bathymetry in shallow waters, profile measurements of nutrients, chlorophyll and secchi-depth in half of the sub-basins, historical ice thickness, ice ridges, consistent phytoplankton etc.

Sustainability analysis: based on the gaps identified and inputs from stakeholders and the expert panel, recommendations are made for improving the existing marine data infrastructure and make them an integrated part of a Sustained European Ocean Observing System (EOOS).

2. Introduction

Since its beginning, EMODnet has been designed to realize and enlarge the value of European marine observations: "collect once, use it many times" (Fig. 1). This leads to the establishment of 8 integrated marine data portals on bathymetry, biology, chemistry, coastal mapping, geology, habitat, human activities and physics. On the other hand, for users, data should not only be accessible but also fit for the purposes of their applications. In order to assess the fitness-for-the-purpose level of existing marine data, EMODnet launched Sea Basin Checkpoint (SBCP) projects for the Arctic Ocean and European Seas. Baltic Sea Check Point (BSCP) is the project for the Baltic Sea, aiming at assessing the Baltic Sea marine data collection, observation, surveying, sampling and data assembly programmes in terms of fitting for the purpose of user applications in eleven challenge areas, i.e., wind farm siting, marine protected areas, oil platform leak, climate change, coastal protection, fishery management, fishery impact, eutrophication, riverine inputs, bathymetry and alien species. The project is also expected to analyse how the existing marine data management can be optimised and to deliver the findings to stakeholders through an internet portal.

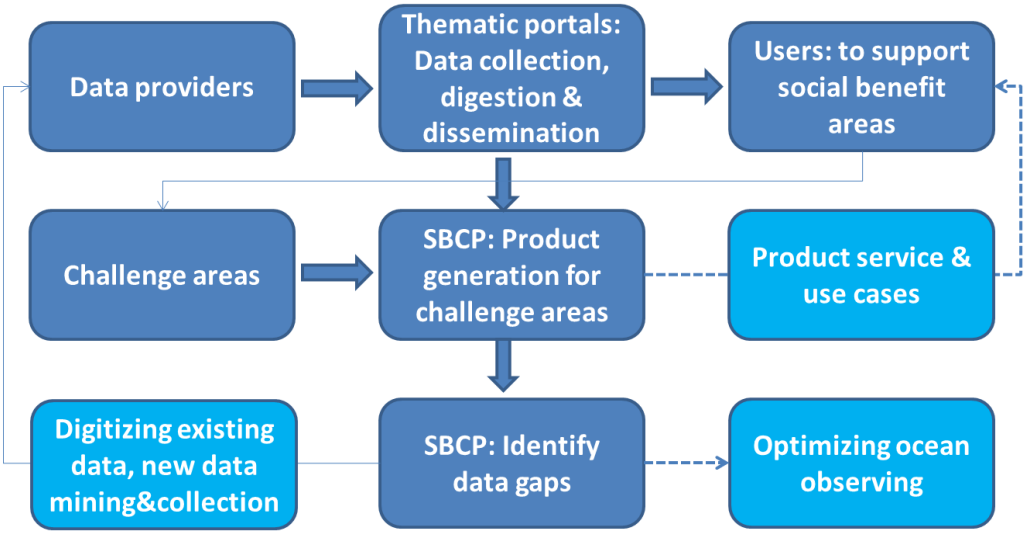

Figure 1: EMODnet value chain: to facilitate marine data usage. The solid lines and arrows refer to actions already implemented. The dashed are on-going or potential activities.

The project started 17 June 2015 with a project period of 36 months. It is undertaken by a consortium of 10 partners (including 1 subcontractor) from seven European countries, consisting of necessary expertise covering the eleven challenge areas and marine data assessment. The partners are listed alphabetically by partner organisation name, below:

Partner Number	Partner organisation name	Acronym	Country
1	Danish Meteorological Institute	DMI	Denmark
2	Technical University of Denmark	DTU	Denmark
3	ETT SpA	ETT	Italy

4	EuroGOOS AISBL	EuroGOOS	Belgium
5	Finish Meteorological Institute	FMI	Finland
6	Klaipeda University	KU	Lithuania
7	Swedish Maritime Agency	SMA	Sweden
8	Swedish Meteorological and Hydrological Institute	SMHI	Sweden
9	Tallinn University of Technology	TUT	Estonia
Subcontractor	Grontmij A/S	Grontmij	Denmark

The project has five components:

- WP1 – Literature review: to review the usages of existing marine data, as well as the assessment of the data accessibility and appropriateness in the literature
- WP2 – WP12: Demonstration of using marine data in 11 challenge areas: to identify needs of the marine data in air, water, biota, seabed and human activity in order to generate pre-defined products, and collect the data; and to produce the tailored products
- WP13 – Website presentation: as a site for project communication and dissemination for the consortium, users and public. Especially all products generated in WP2 -12 are presented on the website through a data and map service (http://www.emodnet-baltic.eu)
- WP14 – Data adequacy assessment: to assess the adequacy of existing marine data for fit-for-the-purposes and to identify gaps and give recommendations for future sustained ocean observing.
- WP15 – 17: Communication and management: to ensure efficient project coordination and communication with stakeholders, expert panel, EMODnet secretariat and EC (EASME and DG-MARE) through meetings, reports and publications. The meetings include project annual meetings (3), EMODnet Steering Group meetings (5), Stakeholder conference (1), expert panel meetings (2) and other conferences for presenting BSCP results.

Outcomes of the above activities are delivered as deliverables

- Literature review report: review marine data and their usages
- Web portal: demonstrated use of marine monitoring data in the 11 challenge areas
- Data adequacy reports: assessment on the adequacy of Baltic Sea marine data
- Sustainability report: analysis on the gaps of existing marine observations and potential future integration in the sustained European Ocean Observing System (EOOS)
- Expert panel report: outcomes from the project should be reviewed by BSCP Advisory Expert Panel, both in the mid-term and upon the project completion. The reviews are summarized as two panel review reports
- Management reports: bi-monthly and tri-monthly periodic reports, mid-term interim report and final report.

3. Summary of the work done

As described in annex I Tender specifications and in annex IIa of the contract (technical offer), the project has three tasks: literature survey, challenges and assessment, as described in section 1 – Introduction. Under each task, activities are defined in the tender specifications and the contract. BSCP consortium has worked on the definition of the tasks and fulfilled the work on required time and quality.

Task 1: Literature review

A literature survey was carried out to summarise findings of previous studies of the adequacy of data in the Baltic Sea. Existing data entries and characteristics (accessibility, quality and appropriateness) in the Baltic Sea was reviewed. Data requirements from the eleven challenges were summed up to a total of 140 different characteristics: 10 in Air, 38 in Water, 31 in Biota/biology, 19 in Seabed and 42 in Human Activities. The identified data sources have been evaluated with regard to: accessibility, quality and appropriateness. The report has been published in the BSCP website.

Task 2: Challenges

In the 11 challenge areas, existing and available data were collected and used in an integrated way to generate the tailored products, as predefined by the tender specifications. The aim of this practice is to provide a user application basis for the data adequacy assessment in the Task 3. Products from the challenges are shown in the BSCP website with both map viewer and digital data layer for downloading (in total 405 products). The product viewing and downloading page is http://www.emodnet-baltic.eu/Map/. The service is divided into input layers (data sources and metadata) and output layers where users can view and download products according to challenge areas. The data repository is hosted by ETT ApS.

1. Windfarm siting: wind power production, met-ocean conditions, human activities, sea floor geology distance to the grid and environmental impact were considered to determine the suitability of sites at points where waters of Estonia, Latvia, Lithuania, Poland and Sweden meet. Since the waters considered are shallow, only fixed foundations are considered. 191 products are generated and shown in the website.
2. Marine Protected Areas: existing network of marine protected areas were analysed and categorised according to the classification used by the IUCN. The network was evaluated to identify if they constitute a representative and coherent network as described in article 13 in the MSFD. Potential impacts of climate change on the MPAs were also studied. 1 product was generated and shown in the website. The results are further summarised in the DAR 2 report for Marine Protected Areas.
3. Oil Platform leak: upon receiving a real-time warning of the oil platform slicks, an operational response was made by using two oil drift forecast systems at DMI and SMHI, including to determine the likely trajectory of the slick and the likelihood that sensitive coastal habitats or species or tourist beaches would be affected. The 24hours and 72hours forecast and evaluation reports have been produced, sent to European Commission in near real time and then published in the website.
4. Climate: following products are generated: i) change in average temperature at surface, mid-water and sea bottom shown on a grid over past 10 years, 50 years and 100 years, ii) time series of average annual temperature at sea surface and bottom, iii) time-series of average annual internal energy of

sea and iv) average extent of ice coverage over past 5 years, past 10 years, past 50 years, past 100 years plotted on maps. It was found that the data were not sufficient to generate tender required "total ice cover in sea (kg) over past 100 years". Efforts were made to generate "abundance of three most abundant species of phytoplankton expressed as time series". It was found that the data quality from EMODnet and ICES is not good enough to make a consistent trend analysis. 68 products are shown in the website.

5. Coasts: by integrating in-situ and model observations, average annual sea-level rise per stretch of coast (absolute and relative to the land) were produced for 10, 50 and 100 years. Efforts were made for generating average annual sediment balance per stretch of coast) for 10, 50 and 100 years. It was found the data are not sufficient to make this product, both due to lack of sediment observations as well as little data sharing in national coastal sedimentary and morphology data. 12 products are shown in the website.
6. Fishery management: mass and number of landings and discards of fish were generated by species and year. There are not sufficient data to make discards product for mammals, reptiles and seabirds and all bycatch products. The products have included data from before and after the Data Collection Regulation came into force, to make the time-series as long as possible. 26 products are shown in the website.
7. Fisheries Impact: gridded data layers were produced for i) area where bottom habitat has been disturbed by bottom trawling: surface and subsurface swept ratio in 2009-2013; ii) change in level of disturbance over past ten years: qualified data are not sufficiently long to generate the 10 year changes; iii) damage to sea floor: swept area ratio, both surface and subsurface, was generated for different seafloor types: sand, mud and coarse sediment. 16 products are shown in the website.
8. Eutrophication: a comprehensive eutrophication assessment was made, showing seasonal averages of eutrophication in the basin for past ten years and change in eutrophication over past ten years (i.e. where eutrophication has reduced and where it has increased). 72 products are shown in the website.
9. River inputs: multi-decadal time series of monthly and annual Baltic Sea river discharges of water mass, total nitrogen and phosphate were produced and shown in the website. The existing data are not sufficient to generate a long-term time series of river average temperature, inputs of sediment, salmon and eels.
10. Bathymetry: existing BSBD portal and OGC web service are used to provide a digital map of water depth and its uncertainty. Priority areas for surveying for safer navigation have been identified.
11. Alien species: information product on the Baltic Sea alien species in the sea basin were generated, including e.g. species name, family, year of introduction, reason for introduction and geographical area. There are no sufficient data to study the impact on ecosystem and economy were investigated. 5 products are shown in the website.

Task 3 Assessment

The purpose of the assessment task is to assess whether the accessibility, quality and appropriateness (e.g. resolution, coverage etc.) of the marine data are sufficient for the applications in the 11 challenge areas. It should be noted that the identified gaps are totally challenge-dependent. In other words, a dataset may be perfectly fit for purpose for some challenge but not for another just because the purpose is different, so results must be interpreted with this in mind.

Data adequacy report (DAR): The report providing a view of the monitoring effort in the Baltic Sea; BSCP delivered two DARs - the first after 13 months, then after 33 months. The reports have taken into

account the literature survey, the outcome of the challenges, the inputs from stakeholders, the expert panel and new information from on-going EU and Baltic Sea projects to report on the adequacy of marine data. User requirements, data needs, existing characteristics of the data and their adequacy have been assessed per challenge area and per key variable. Detailed outputs of the data adequacy report will be summarised in section 4.

Panel: an expert panel including both experts and EC representatives was set up, based on a Terms of Reference. Two panel meetings were organised, followed by two panel reports and replies from the consortium to the reports.

Stakeholder workshop: BSCP has assisted EMODnet to organise a general assembly of Stakeholder conference. A Baltic Sea brain storm session was hold and outcomes of the session were used in writing the second DAR.

4. Main results for the respective challenges - data adequacy assessments

During the project, data gaps are identified against data needs in the eleven challenge areas. The gaps are identified whenever user needed products cannot be generated properly through an integration of current in-situ and satellite observations as well as modelling tools. Data gaps may be caused by several reasons: i) data exist but lack of access; ii) data exist but lack of good quality or formality and iii) data do not exist.

4.1 Gaps due to data accessibility

Easiness of access: EMODnet provides a convenient data access service which can be further improved with more aggregated features e.g., for biological data.

Timeline of access: most of the ship data are only accessible by public in years' time after the measurements are made. This makes the near-real time and short-range data use impossible, e.g., in operational forecast, ocean state assessment and rapid environment assessment, thus the value of these data cannot be effectively exploited. It is strongly recommended that the ship-based monitoring data should be delivered as much as possible in near real time or shorter time range especially when the data owner is a public/governmental agency.

Inter-comparison of data access from different portals: it is found that the available data from different data portals, e.g., SeaDatNet, ICES, EMODnet and HELCOM, from oceanographic, chemical to biological

measurements, can be quite different. It is suggested that EMODnet should enhance data exchange with other data portals. Specifically, extra data are found in non-EMODnet portals, e.g.

- Historical oceanographic measurements from ICES
- Seabird and marine mammal data from HELCOM
- Nutrients and chl-a from ICES
- Phytoplankton data from ICES
- Human activity data (e.g., cables, AIS data) in HELCOM

Access to existing national data: it is found that a great amount of data exists at national level (both from public and private sectors) but not collected by public available data portals such as EMODnet, for example:

- Offshore wind profiles both from masts and LiDARs
- Current observations from research and commercial projects
- Historical sea level data from Denmark, Estonia and Poland
- Coastal profiles, orthophoto maps and Lidar data on shore evolution
- Substrate data collected in national fishery survey
- Sediment grain sizes and corresponding accumulation rates
- Bathymetry data from Lithuania, Russia, Latvia and Poland
- river discharges and nutrient loads from SMHI
- Fishery catches on both industrial and consumption species from national databases

4.2 Gaps due to data quality, format and readiness for use

Examples of use cases are analyzed which reveal needs for improving the data quality, format and readiness for use in existing data portals, e.g., phytoplankton data in ICES and EMODnet for climate trend analysis, sea level data in EMODnet and bathymetry data for modelling.

For operational data, EMODnet (Physics) is taking data directly from CMEMS In-Situ TAC (Thematic Assembly Centre) without further quality control. In CMEMS, operational observations still contain many erroneous data without corrected in operational mode. Offline quality control has been conducted in CMEMS which gives a dataset with much better quality. Therefore EMODnet data should be updated accordingly. This issue has been notified to EMODnet Physics and now most recent quality controlled CMEMS in-situ observations data are available in the EMODnet portal.

4.3 Gaps due to lack of data

4.3.1 Air data

Winds: there is a lack of public available wind profiler observations. The amount of existing data is quite limited, and most of them are not open and free. Existing observations from masts are not high enough (most of them are lower than 100 m). LiDAR provides cost-effective monitoring for wind profiles but needs in-situ wind profiles to calibrate the data.

4.3.2 Water data

Ocean currents: in general current data are not adequate for user needs. The quality of simulated currents should be further improved. More in-situ observations of currents should be made available especially in the eastern Baltic Sea coastal waters. Currents data from national monitoring projects such as in Estonia and Finland should be collected for public access.

Water level: By combining in-situ and model reanalysis data, a long-term monthly sea level time series can be reconstructed for the past 100 years. The independent validation shows that the results are good for deriving trends of both relative and absolute sea level in the Baltic Sea coast. This means existing sea level data can fit for the use in coastal protection study. For the EMODnet Physics database, it is suggested to collect more historical sea level data from Denmark, Estonia, Poland and Lithuania etc. which are currently missing.

Waves: wave induced along-shore sediment transport are important to the evolution of sedimentary coastline. The wave direction towards the shoreline plays a very important role in the sediment balance, especially in large waves and small scale sedimentary beaches. Information of waves in such a small scale are currently not available from either observations or models.

Sea ice: satellite data have sufficient length, coverage and resolution on sea ice edge, concentration and thickness for offshore wind farm siting. However, sea ice grounding and ridging information are not available but needed for planning cable routes. For climate research, the existing sea ice thickness time series is not long enough. The amount of ice mass in the sea will be difficult to observe e.g. because of the ridging of ice and because the ice thickness is given as a range rather than a single value. On the other hand, remote sensing methods improve the quality of the charts and models continuously.

Nutrients and secchi depth: the data adequacy is assessed for each of the 17 sub-basin (Tab. 1)

Table 1. Data adequacy to assess eutrophication in the Baltic Sea sub-basins by using HELCOM and EMODnet data. : HIGH: >15 obs./season); MODERATE: between 6-15 obs./season; LOW(1-5 obs./season) and NO DATA. basinsMajor gap areas are and parameters are marked with red.

	DIN		DIP		Chl-a		Secchi depth	
	HELCOM	EMODnet	HELCOM	EMODnet	HELCOM	EMODnet	HELCOM	EMODnet
Kattegat	H	M	H	M	H	L	M	ND
Belt Seas	L	L	M	L	L	L	L	ND
The Sound	L	L	L	L	L	L	ND	ND
Kiel Bay	L	M	M	M	L	L	L	ND
Bay of Mecklenburg	L	M	M	M	M	L	L	ND
Arkona Basin	M	H	H	H	H	L	L	L
Bornholm Basin	M	M	H	H	H	L	H	L
Gdansk Basin	M	M	H	M	H	L	H	L
E. Gotland	L	L	L	L	M	ND	M	ND
W. Gotland	L	L	M	M	M	L	L	L
N. Baltic Proper	L	H	H	M	H	L	M	L
Gulf of Riga	L	L	L	L	L	L	L	L
Gulf of Finland	L	H	L	L	L	L	L	L
Åland Sea	L	L	L	L	L	ND	L	L
Bothnian Sea	L	H	H	M	L	ND	M	L

The Quark	L	L	L	L	L	ND	L	L
Bothnia Bay	M	H	H	M	L	ND	L	L

4.3.3 Biota data

Phytoplankton: The phytoplankton dataset in the ICES/HELCOM database needs to be improved by data providers via inclusion of more monitoring data. Still, phytoplankton monitoring efforts need to be increased to fulfil the HELCOM minimum requirements. For future phytoplankton monitoring the shared efforts of neighbouring countries should be discussed.

Fish catches: Discards are generally considered more uncertain catch component compared to landings. The data are considered of acceptable quality when used in stock assessments. For some fish stocks a longer time series of discards of acceptable quality are available, for others, data are considered adequate for only latest years. Discard ban may affect the data quality of discards that are estimated to still take place. For bycatch of marine mammals and seabirds, no agreed numbers exist for the Baltic Sea, because so far no adequate observation coverage has been achieved with existing monitoring programs such as DCF and Regulation 812/2004. Consequently, only sporadic data from scientific and pilot studies exist. In order to increase the confidence of the bycatch estimates, annual monitoring data of incidental by-catches has to be applied to all relevant fisheries, based on a sufficient number of observer days, and associated with well-described fishery effort, is a prerequisite. The bycatch estimates are expected to be improved once a suitable monitoring scheme is agreed upon at the Baltic Sea level in the frame of the EU Data Collection Multiannual Programme (DC-MAP) that requires member states to sample protected marine mammal and bird species.

Fishery impact: the VMS data is limited to short period (2009 – 2013). Prior to the introduction of VMS, data was aggregated at the level of the ICES squares, and which represents a very coarse level resolution of fisheries data. From the point of view of this Challenge, the unrestricted provision of VMS data would represent an ideal situation – allowing for assessment at much greater spatial and temporal scales. However, due to the commercial (and associated political nature) of VMS data, this is considered unlikely at any time in the near future. To try and best meet the objectives of the Challenge, other avenues have been explored. One likely solution is the BalticBOOST project; a currently ongoing initiative that will help bridge data gaps for the Baltic Sea.

Non-indigenous species (NIS): The essential precondition for the empirical modeling is the availability of the physiological tolerance data for NIS, i.e. data showing the limits of environmental parameters for their survival and normal functioning such as feeding, reproduction and larval development. Data mining on species physiological limits and empirical modeling of species distribution are needed for NIS assessments and prognosis should be taken into account in the future.

4.3.4 Seabed and coastal zone data

Sediment transport: currently there is no sediment transport information in EMODnet. It is recommended to build up a sediment transport dataset in EMODnet Geology through both collecting in-situ monitoring data and sediment modelling data.

Shoreline evolution: the relevant data include coastal profiles, orthophotos, historical maps and high-resolution LIDAR/laser scanning measurements. EMODnet does not have such type of data. They are mainly collected by the national geological and coastal surveys.

Sedimentation: EMODnet Geology provides sediment accumulation rate based on mainly radiation element dating. However, sediment grain size and corresponding sedimentation rate are needed for quantitatively estimating sediment balance and calibrate the coastal morphological and sediment transport models. Currently EMODnet is lack of this information. There are also no such publically available dataset. It is recommended that this type of data should be collected and made available.

Bathymetry: it is found that the publicly available bathymetry data are adequate (fit for the use) for preliminary offshore wind farm siting design, marine protected areas, ocean modelling for oil platform leak and climate change. However, they are not adequate for detailed offshore wind farm siting design which need very high resolution bathymetry and seabed slop data, and also not adequate for coastal protection, shipping and coastal/offshore engineering. For these purpose, specific commercial solutions have to be applied.

River data: the available river temperature dataset has few observations of varying spatial and temporal coverage. The E-HYPE model is now simulating river temperature, model performance is considered sufficient but it could be improved by increasing the availability of existing datasets.

Discharge observations are available from different databases but with major data gaps. The Baltex database is no longer updated. The E-HYPE model is used to fill in the gaps and has shown good results over the Baltic Sea drainage area but with overestimations in the south east and under in the northern part. To further improve input data on human impact: water extraction and river regulations are recommended to increase the performance.

Nutrient load is calculated using discharge and nutrient concentration. The observed concentration is often too sparse to calculate loads without the help of advanced statistical techniques and /or models. The E-HYPE model can be used to fill in the gaps with a good result. Extended monitoring and homogenisation of input datasets would further improve the performance.

4.3.5 Human activity data

Marine protected areas: information required for identification of IUCN (The International Union for Conservation of Nature) categories for approximately 78% of the Marine Protected Area (MPAs) is not readily available, scattered among different sources and mostly in national languages. it is highly unlikely that the network of HELCOM MPAs is ecologically coherent. It was also noted, that important basic information needed for appropriate analyses, for example on the spatial distribution of species and biotopes, is still missing.

5. Main gaps encountered for the respective challenges

Main gaps	Measures taken/solutions proposed
Many data are not available due to lack of open access: • Offshore wind profiles • Currents data from research and commercial projects • Coastal profiles, orthophoto maps and Lidar data on shore evolution • Historical SST and salinity data • Substrate data collected in national fishery survey • Sediment grain sizes and corresponding accumulation rates • Bathymetry data from Lithuania, Russia, Latvia and Poland • River temperature, discharges, nutrient loads and salmon observations • Fishery catches on both industrial and consumption species from national databases; coastal fishery; Big limits in VMS data in terms of resolution and spatiotemporal coverage	- National data mining - Improved data sharing by engage national data owners - Improved data policy
Some data are not available due to delayed data delivery • Ship measurements	- To promote near real time delivery of CTD data, e.g., via regional cooperation BOOS and HELCOM
Some data are not available due to quality and format • Un-digitized ice data in Finland • Un-digitized sea level data in Poland, Latvia, Lithuania and Estonia • Low quality of phytoplankton data in ICES and EMODnet • Low quality of operational data in EMODnet Physics	- To provide seed funding for data rescue - Improved data quality control
Most of the research observations are not available due to • Research interests • Lack of explicit data policy linking EMODnet with research programs	- To adopt data policy explicitly defining the responsibility of research data delivery to EMODnet
Data gaps due to lack of observations • Wind data in elevartion higher than 150m • 78% of MPA's is not readily available and scattered among sources for information for identification of IUCN categories . • Information for assessment of the network coherence according	- Make new observations or construct the observations by integrate models and existing observations

to MSFD Article 13 is currently Inadequate. • Oil spill detection: gaps found in Latvia, Lithuania and Russian waters • The available datasets are still not long enough and the data density by sub-basins is not satisfactory to get statistically significant trends • For eutrophication assessment, more than half of the sub-basins are inadequate in chl-a, DIN, DIP and secchi depth • Sediment transport, grain size of sediments • Bycatch estimates • River data are not complete (only available for certain years) • Bathymetry raw data in shallow waters • lack of centralised databases for compiling and analysing data on alien species impacts on ecosystem and economy	

6. Outreach and communication activities

3 manuscripts and 10+ conference presentations have been made during the project period.

Date	Media	Title	Short description and/or link to the activity
2017	Earth Syst. Dynam., 8, 697-706	Kudryavtseva, N. A. and T. Soomere, 2017: Satellite altimetry reveals spatial patterns of variations in the Baltic Sea wave climate	Journal publication
2018	Proceedings of *The 8th EuroGOOS conference,* Bergen, Norway, p79-87.	She J. 2017. Assessment of Baltic Sea observations for operational oceanography.	Conference paper
2018	*J. Opr. Ocean.*	*Jun She and Jens Murawski:* Integrated use of marine data to fit for the purpose of social benefit in Baltic Sea.	Journal paper, submitted
7/10/2015	Copenhagen Denmark	Prepare BSCP inputs to DG-MARE Booth in the Danish Maritime Days	A BSCP fact sheet was produced and disseminated in the Danish Maritime Days.
20/04/2016	*EGU General Assembly, 2016*	Madsen et al., Sea level trends for all sections of the Baltic Sea coastline	Oral presentation
14-15 Feb. 2017	*EMODnet Sea-basin checkpoints Stakeholder conference,* Brussels	She J., EMODnet Sea-basin Checkpoints Biology stress test	Oral presentation, invited
3/03/2017	*EU-China Blue Year Workshop on marine science and data cooperation*, Brugges	She J., Stress test on Baltic marine data – summary of method and results.	Oral presentation, invited
9/03/2017	*DG MARE expert workshop on Environmental Monitoring Technology in the Baltic Sea Region*, Hamburg, Germany	She J., Challenges for sustained European marine data infrastructure, lessons learned from EMODnet Baltic Sea Basin Checkpoint Project.	Oral presentation, invited
29-31 March 2017	"Baltic Sea from Space" Workshop, Helsinki.	K. Madsen and J. She, Baltic Sea Checkpoint Project – a fit-for-purpose assessment of marine data	Oral presentation, invited
24-29 April 2017	EGU General Assembly 2017, Vienna.	Jun She and Antonio Novellino, 2017. An integrated assessment of marine data needs, availability and adequacy in the Baltic Sea.	Oral presentation
22-24 May 2017	BOOS Workshop on operational oceanography	Jun She, 2017. EMODnet in Baltic Sea.	Oral presentation

	Copenhagen.		
1-2 June 2017	EU-China Blue Year Event on forecasting, monitoring, data and planning. Brussels.	Jun She, 2017. Research and challenges towards operational ecology and adaptive ecosystem management: Baltic Sea.	Oral presentation, invited
3-5 Oct. 2017	*The 8th EuroGOOS conference,* Bergen, Norway	She J. 2017. Assessment of Baltic Sea observations for operational oceanography	Oral presentation

7. Recommendations for follow-up actions by the EU

R1: Assessment and optimization of European Ocean Observing System (EOOS):

- The SBCP "fit-for-purpose assessment" should be further combined with existing quantitative assessment (e.g. OSE/OSSEs) and optimization research in EU projects ODON, ECOOP, OPEC, JERICO and AtlantOS
- New areas of "fit-for-purpose assessment" have been proposed by the stakeholders and expert panel, both on new products for existing 11 challenge areas and new challenge areas, e.g.
  - Marine Spatial Planning,
  - Operational oceanography,
  - Ocean acidification,
  - Hypoxia,
  - Marine pollutant,
  - Underwater noise
  - Atmospheric deposition
  - MSFD Reference state reconstruction

R2: To elevate value of marine observations through breaking institutional barriers in ocean observing, i.e., integration between operational, environment and research monitoring; between physical, biogeochemical, food web and human activities and between in-situ, remote sensing and modelling (demonstration of high impact, win-win cases for MSFD, blue growth and climate change adaptation and mitigation) (see Fig. 2)

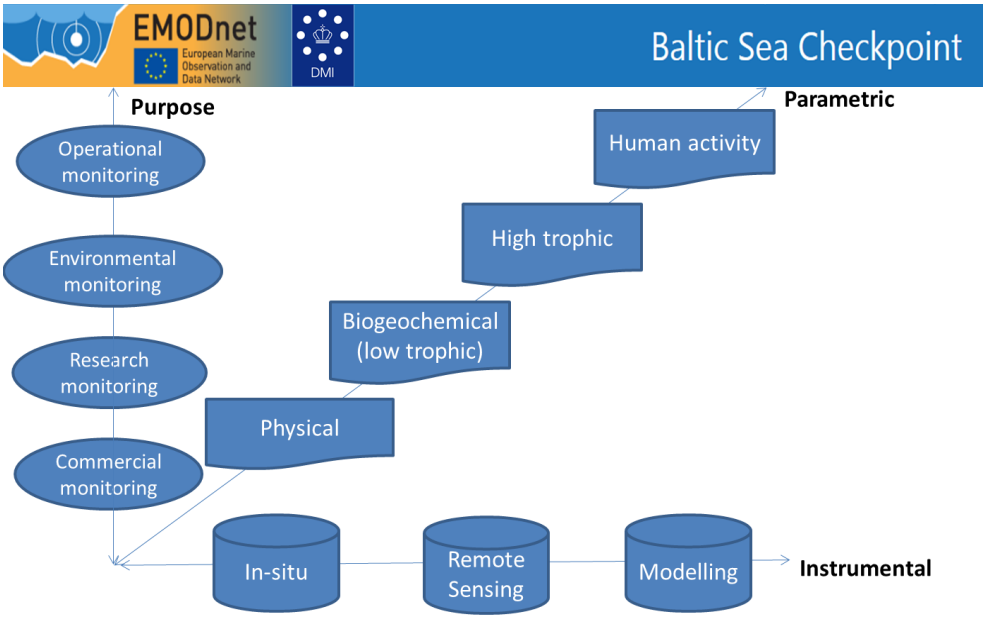

Figure 2: Release the value of marine data through integration - breaking institutional barriers

R3: A sustained marine data service platform by integrated use of multidisciplinary data: the existing product and map demo service in the 11 challenge areas on the BSCP portal can be further developed into a formal service platform to show the value of the marine data. This platform gives users opportunity to combine multi-source and multi-category marine data, not only to generate new tailored products but also new knowledge as "integrated knowledge generator", "citizen knowledge generator" and "sectorial knowledge generator".

List of abbreviations and acronyms

AIS	Automatic Identification System, Marine Transportation
AtlantOS	Optimising and Enhancing the Integrated Atlantic Ocean Observing Systems
Baltex	The Baltic Sea Experiment, now Baltic Earth
BalticBOOST	Baltic Sea project to boost regional coherence of marine strategies through improved data flow, assessments, and knowledge base for development of measures
BOOS	Baltic Operational Oceanographic System
BSBD	Baltic Sea Bathymetry Database
BSCP	Baltic Sea Check Point
CMEMS	Copernicus Marine Service
DAR	Data Adequacy Report
DCF	Data Collection Framework
DIN	Dissolved Inorganic Nitrogen
DIP	Dissolved Inorganic Phosphate
EC	European Commission
ECOOP	European Coastal-shelf sea operational observing and forecasting system
EMODnet	European Marine Observation and Data Network
EOOS	European Ocean Observing System

HELCOM	Helsinki Commission, the Baltic Marine Environment Protection Commissions
ICES	International Council for the Exploration of the Sea
IUCN	International Union for Conservation of Nature
JERICO	Towards a Joint European Research Infrastructure network for Coastal Observatories
LiDAR	Light Detection and Ranging
MSFD	Marine Strategy Framework Directive
ODON	Optimal Design of Observational Networks
OGC	Open Geospatial Consortium
OPEC	Operational Ecology Project
OSE	Observing System Experiment
OSSE	Observing System Simulation Experiment
SBCP	Sea Basin Checkpoint
SeaDataNet	Pan-European infrastructure for ocean and marine data management project
TAC	Thematic Assembly Centres, Copernicus Marine Service (CMEMS)
VMS	Vessel Monitoring System