GROWTH AND INNOVATION IN OCEAN ECONOMY – GAPS AND PRIORITIES IN BALTIC SEA BASIN OBSERVATION AND DATA

Second Data Adequacy Report
EMODNET Baltic Sea CheckPoint
Executive Summary

Total number of pages: 11
Leading partner: Danish Meteorological Institute

Workpackage	15	D15.1 The first Data Adequacy Report	
Main authors	Jun She, Jens Murawski, Kristine S. Madsen		DMI
	Grete E. Dinesen, Margit Eero		DTU Aqua
	Pekka Alenius		FMI
	Darius Daunys, Sergej Olenin		MARSTEC/KU
	Stella-Theresa Stoicescu		MSI/TUT
	Ralf Lindgren, Thomas Hammarklint		SMA
	Anders Soderberg, Åsa Johnsen		SMHI
	Sigurd Bund Lauritsen		SWECO
Edited by	Jun She, js@dmi.dk		

Contents

Disclaimer

The information and views set out in this report are those of the author(s) and do not necessarily reflect the official opinion of the Commission. The Commission does not guarantee the accuracy of the data included in this study. Neither the Commission nor any person acting on the Commission's behalf may be held responsible for the use which may be made of the information contained therein.

Executive Summary

The value of data can only be realized when they are used. Therefore one major factor to determine the extent of the value of data is their level of "fitness-for-the-use (FFU)". The purpose of the Baltic Sea Check Point Data Adequacy Report (DAR) is to assess the FFU levels of the Baltic Sea data in areas of air, water, biota, seabed and coastal zone and human activities for their usages in social-economic benefit areas and marine knowledge generation, which are presented by eleven challenge areas predefined by DG-MARE (European Commission Directorate-General for Maritime Affairs and Fisheries). The data 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.

The eleven challenge areas are 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 assessment is mainly qualitative with focus on the availability and accessibility, e.g. completeness/coverage, resolution and precision when using the data for pre-defined tasks in each challenge areas, e.g., wind farm site suitability design, generate 100 year time series of sea level for the Baltic coastal stretches etc. The procedure of the assessment is taken in four steps:

i) to describe the pre-defined data use cases and objectives;
ii) to specify data requirements;
iii) to investigate the data availability and
iv) to assess the data adequacy in terms of the "fitness-for-the-use" of data in the selected challenge areas by comparing the data availability with the data requirements.

The first DAR report has been published in September 2016[1], in which the data adequacy has been assessed in relation to the use of data in generating products in the 11 challenge areas. After the first report, and for past 18 months, more data-use applications have been made, hence new data needs and adequacy assessment have been processed. This leads to an updated (Second) Data Adequacy Report (DAR2). In addition, the DAR2 also addressed comments from the first BSCP Expert Panel Report, Stakeholder meeting and DG-MARE on the first DAR. The DAR2 includes following three components:

- Eleven sub-DARs, one sub-DAR per challenge areas
- An Executive Summary report
- A Glossary document

[1] http://www.emodnet-baltic.eu/

The DAR2 evaluates the accessibility, data quality and appropriateness (in terms of adequacy) of the marine data. Major outcomes of the project are presented in the reports on the individual challenge areas.

1 Data accessibility

Easiness of access: in general EMODnet provides a convenient data access service (sometimes including a view service) in most of the themes e.g. Physics, Human Activity, Seabed Habitat, Geology and Bathymetry. However, there is space for further improvement of EMODnet data access, especially for Chemistry and Biological data. For example, the biological data search and download can be improved with more aggregated features while the chemistry data access can be improved by e.g., i) dividing data into fast track (data with automatic quality control)) and pending for approval; ii) integrating chemistry data from sources other than SeaDataNet; iii) generating value-added products e.g. monthly climatology.

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 oceangraphic 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

2 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 for extreme analysis and bathymetry data for modelling.

The above examples suggest that quality, format and supplementary information for these data should be improved. It is recommended to implement systematic quality control measures in the EMODnet data portals. Thorough check of the quality, format and complementary information of EMODnet data is needed.

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 seems not to be the case for the moment.

3 Data gap identification

During the project, data gaps are identified against data needs in the eleven challenge areas. Among the gaps identified, in some cases the needed data do not exist while in the other cases the needed data exist but are not accessible. It was found in most of the cases marine data can fit for the use. In the following, we mainly focus on the data gaps.

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.

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 results are shown in Tab. 1. The data adequacy is assessed with 4 categories for each of the 17 sub-basins: HIGH: >15 obs./season); MODERATE: between 6-15 obs./season; LOW(1-5 obs./season) and NO DATA. Major gap areas are and parameters are marked with red.

Table 1. Data adequacy for assess eutrophication in the Baltic Sea sub-basins by using HELCOM and EMODnet data. H-HIGH; M: MODERATE; L: LOW; ND: NO DATA

	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

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.

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 ad coastal surveys.

Coastal profiles: extensive efforts are necessary for making real use of the data from different coastal profiles. As the amount of data is fairly small (normally <1000 entries per profile and service), such an action (i) is financially feasible, (ii) will create an extremely important basis for understanding of the past changes to the entire coastline of the Baltic Sea and (iii) will serve as an indispensable resource for projections of the future of the Baltic Sea shores.

Orthophoto maps: the collections of orthophotos are reasonably organised and mostly available for the public. Even if a few is requested for the use of such photos for some years and countries, it is likely that older sets of photos will become free after some time. It is also likely that they will be widely used in local studies that require processing of a few photos. However, the use of orthophotos for more detailed evaluation of sediment budget on the Baltic Sea coast is highly questionable because it requires massive involvement of human resources. The same considerations apply to the use of historical maps for this purpose. The amount of additional work rapidly increases for even older maps.

LIDAR data: all countries have created high-resolution LIDAR and/or laser scanning data sets of their mainland, including the shoreline. While for Germany these data exist since 2002, in most of countries the first data of this kind were recorded less than ten years ago. Owing to the limited temporal coverage their use for establishing the relocation of the shoreline is questionable as it may reveal just short-term fluctuations of the sediment transport patterns. However, in many occasions the quantification of such fluctuations is highly important for understanding of how reliable are other means of estimates of coastline changes and retreat of the coastal scarp.

The sets of high-resolution topography of the mainland created by contemporary LIDAR or laser scanning measurements are already mostly open to public whereas some resources (e.g. in Germany) are free for research purposes. As in most cases they only cover a short time interval, they are today commonly used for identification of the location of the contemporary coastline. However, the use of repeated laser scanning snapshots for the evaluation of short-time sediment budget has already started.

Coastal migration: EMODnet Geology provides coastal migration data according to the classifications accretion, erosion and stable. Such information are useful but still too coarse for quantitative assessment of the coastal sediment balance.

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. A summary of bathymetry data adequacy is given in Tab. 2.

Table 2. Bathymetry data adequacy (based on the public available databases)

Application areas	Resolution, depth quality
Wind farm siting (macro-design)	FFU
Wind farm siting (micro-design)	Not FFU
Marine Protected Area	FFU
Coastal protection	Not FFU
Ocean modeling	FFU^{-}
Habitat, Fishery	Not FFU
Marine geology	Not FFU
Nautical charting, navigation, generally	Commercial solution
Navigation shallow water	Commercial solution
Engineering	Commercial solution
Marine archaeology	Commercial solution

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 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.

3.5 Human activity data

Marine protected areas: information required for identification of IUCN (The International Union for Conservation of Nature) categories for approximately 15% 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.

4 Future needs on new products and new challenge areas

It was found that there are quite many important issues in the existing challenge areas which have not been addressed, for example:

- Offshore wind farm siting: more in-depth siting study with cost-benefit analysis
- Marine protected area: potential impacts of novel pollution types on MPA's network
- Oil platform leak: data adequacy study for oil leaks due to shipping activities and oil spill in icing waters.
- Climate change: adequacy of biogeochemistry data in identifying long-term climate variability
- Coastal protection: adequacy of sediment grain size and evolution of substrate
- Fishery management and fishery impact: data adequacy for management of industrial fishery and consumption fishery; abrupt changes of the fishery in Baltic Sea and their causes;
- Eutrophication: data adequacy for assessing impacts of river loads on eutrophication status
- River discharge: data adequacy for estimating inputs of pollutants (plastics, heavy metals, toxic chemicals, radionuclides)
- Bathymetry: inter-comparison of different datasets on data quality; data adequacy in shallow waters (<20m) which may not be covered by large survey vessels.

Based on recommendations from expert panel and users, new challenge areas such as Marine Spatial Planning, operational oceanography, ocean acidification, hypoxia, marine pollutant,

underwater noise and atmospheric deposition, are proposed for future check point research consideration for the Baltic Sea.