BaltSeaPlan

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Data exchange structure for Maritime Spatial Planning

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Executive Summary

This report is part of the BaltSeaPlan (BSP) project activity stated in the project application as “Development of data model (database) with combined data on uses and ecological features”. The objectives of BSP for Maritime Spatial Planning Data have been defined in Terms of References of the tender and are as follows: provision of broader database, identification and filling of gaps, harmonisation and creation of transnational data sets and development of new methods for data analysis. This report represents prerequisites for the potential future creation of a respective database. The document identifies requirements for spatial planning in maritime areas and the basis for the possible inclusion of the proposed requirements. These requirements will form the principles for the verification of design, implementation and validation of the system.

The general purpose of this study is to develop a concept and propose logical steps towards an integrated data infrastructure for Maritime Spatial Planning (MSP) purposes in the region of the Baltic Sea. In order to achieve these objectives an analysis of the framework conditions for MSP provided by legal entities in Europe and member countries of the Baltic region is carried out. The report gives a summary of transnational, national and regional initiatives, projects and cooperative structures relevant to MSP. Existing databases, geoportals and other data sources, potentially valuable for Maritime Spatial Planning (MSP) purposes in the region of Baltic Sea, are also identified. The analysis leads to the conclusion that MSP should be conducted on the basis of the best available, high quality and “ fresh”/up-to-date information. This information to the largest extent possible should be shared by all organisations involved in MSP. This calls for close cooperation from the relevant GIS and geo-statistical databases, including the HELCOM GIS, monitoring and research, in order to facilitate a trans-boundary data exchange process. It should lead to a harmonised pan-Baltic data and information infrastructure for MSP. This should cover historical baselines, present status and future projections of both environmental aspects and human activities. It should be as comprehensive, openly accessible and constantly updated as possible and compatible with European and global initiatives.

This study also considers the results from pilot MSP projects. Detailed maritime spatial plans or strategic environmental impact assessments (SEA) were developed for pilot areas on the basis of national maritime strategies and scenarios. They envision the allocation of marine space to functions and activities based on new data sets and methodologies of data processing. They also offer a direction and vision as to how the coastal and marine space should be used. The main problem observed and which still exists is data availability and proper quality for MSP purposes. Although for hotspots chosen as pilot project targets, usually in bays and along the coast, plenty of data on current uses and planned activities was easily available and up-to-date, it is problematic to obtain data sets representing areas further offshore. Metadata, even if available in the first place, frequently did not contain sufficient information. Some data sets only contained rudimentary information e.g. “geometry” but no further details on features – sometimes additional information from other sources was necessary to be able to assess data provided. Other problems observed relate to a lack of policy for enabling data accessibility and sustainability. Much of the data is the outcome of scientific research conducted within projects and are not available after the end of the project. . Information is being generated for project purposes and from the project interest perspective. And even if accessible, the data might not be up-to-date, and thus does not offer data suitable or relevant for MSP.

The results of the analysis are summarised in conclusions grouped in sections dealing with decentralised data storage, institutional gaps, knowledge gaps, restrictions on data accessibility and limited transferability of data and planning results. The conclusions identify the deficiencies and most common gaps and drawbacks in the existing marine data infrastructure in the Baltic Sea Region with respect to maritime spatial planning. Moreover, they illustrate the importance of the flow of up-to-date, reliable information for effective MSP processes and correct execution of entire planning cycles. The current information setup in the Baltic Sea Region can be thus characterised by: a well organised community with increasing awareness of the importance of MSP and very promising bottom-up initiatives driven by National Maritime Administrations, agencies and other organisations giving a substantial base for the development of Pan Baltic MSP on the one side, and decentralised data storage, existing administrative and knowledge gaps, restrictions on data accessibility, limited transferability of data and planning results causing problems in the rapid development of MSP for the Baltic on the other side.

The proposed data flow model is validated through the case study demonstrating how a database infrastructure could work and which data are required. As a hypothetical example, the planning problem/ as to where a sand and gravel extraction site should be located will be tackled. The main requirements towards an integrated MSP database as identified throughout the BaltSeaPlan project are:

- applying jointly agreed quality criteria and contents,
- following INSPIRE regulations,
- complete, consistent transboundary datasets,
- generic and universal (for future development),
- convenient tools for data search/browsing,
- solution for source data storage,
- full metadata description,
- hyperlinks to text,
- open for all data providers,
- continuously updated,
- providing data and methods for Strategic Environmental Assessment and other kinds of assessments.

The long term goals for the pan-Baltic MSP data infrastructure are that it should:

- generate increased benefits for society through the use of data based on cooperation across organisational boundaries at the lowest possible price,
- link information resources in a network and
- make them available via homogenous services and uniform descriptions of the information,
- serve all stakeholders in the MSP process and satisfy demands at local, regional, national, and transnational level.

The summary of the analysis draws up recommendations on what has to be developed in order to achieve an "ideal" MSP data infrastructure for the Baltic Sea. These recommendations have been put into a short document " BaltSeaPlan recommendations on the development and implementation of a data exchange network and infrastructure for Maritime Spatial Planning and Management purposes in the Baltic Sea (Appendix 1), an agreement designed to be endorsed by all relevant authorities from the Baltic Sea Region willing to contribute to the provision of a Baltic-wide , data management and exchange infrastructure for MSP with regard to legal recommendations, administrative recommendations, process oriented recommendations (data exchange and up-date procedures, scales, storage etc.) and technical requirements (scales, metadata and data input formats, file format, coordinates etc.).

Recommendations are divided into administrative, legal and process oriented aspects. The model database proposed by BaltSeaPlan attempts to provide an integrated tool for MSP, however its strength should be seen in networking within the existing structures, rather than in an unrealistic centralised solution. Good practice examples could be provided by currently developed national initiatives such as MDI-DE (Marine Data Infrastructure Germany) or the Swedish National Geodata Strategy. The proposed pan-Baltic database and network structure can provide at least a partial solution to this problem, by encouraging all its members, be they public authorities, non-profit institutions or organisations to follow an internal no-cost, no-restrictions policy. Considering the low level of awareness of MSP issues, the network proposed by BaltSeaPlan should also serve a capacity-building purpose. It should have learning functions allowing for the presentation of conceptual ideas and good practices, as well as the exchange of opinions based on concrete planning examples.

The proposed networking structure of the MSP data and information exchange system is similar to the cadastre model, currently applied in the German terrestrial spatial planning system, where all relevant authorities and companies are obliged by law to provide certain data to a coordinating unit at regular intervals. The law also specifies the format and other parameters of the data required. Once ready, the data are accessible to all registered users.

The idea of an integrated pan-Baltic database for MSP purposes is that spatially relevant information should be compiled in a central database in each country (National MSP Contact Point). One conclusion from the BaltSeaPlan pilot projects has been the necessity of arranging data in a hierarchy of importance at the very beginning of the process. Great emphasis should be placed on the issue of which data are indispensable ("must have"), and which are of minor importance ("nice to have") for drawing up the plan. This has an essential impact on the whole process of drawing up a plan, including costs and time.

Modelling and modelling tools can play an important role in supplementing field observations (e.g. filling observational data gaps, investigating and understanding processes, to carrying out 'what happens if' scenarios) and importantly, as described in the above chapter to assist - the setting up of ecological targets within the framework of MSP – though results should always be handled carefully, dependant on the grade of reliability and validity.

Appendix 1 contains the Recommendations (perspective Memorandum of Understanding) for a Baltic Sea Region MSP Data Infrastructure, meant to be adopted by BaltSeaPlan partners and associated institutions, and later also by other public authorities around the Baltic Sea.

Appendix 2 demonstrates the usability of the data model proposed and recommendations presenting a Case Study

Appendix 3 compares some of the GIS systems investigated during the analysis process with regard to suitability for MSP purposes.

Appendix 4 consists of the MSP relevant transnational projects ongoing or already completed. The projects are analysed from the perspective of their relevance to BSP, products generated and possibility of deployment of positive results into a future Data Management System.

Appendix 5 contains an inventory of MSP development and legal status in member countries – Baltic community.

Appendix 6 contains an inventory of data portals as a potential source of information and data for future use within MSP processes

Appendix 7 is a data model developed using Visual Paradigm Modeller.

1. Introduction

1.1 Legal issues

This document is developed according to Public Tender: “Development of a Data Model and Recommendations for a Maritime Spatial Planning Data Infrastructure in the Baltic Sea Region” issued by the Federal Maritime and Hydrographic Agency (BSH), Hamburg Office, 2011.

Processing of the document must be maintained according to the tender Terms of References and other tender documents. No publication (even partial) is permitted without the express permission of the Federal Maritime and Hydrographic Agency.

1.2 Terms of Reference

Section 1.4.7 of the tender Terms of References (ToR) includes a comprehensive description of the work and scope of the Data Model Study. Tasks defined for the bidder are as follows:

1 Analysis of existing databases, tools, and related projects

Within this task an analysis and assessment of the technical context in which BaltSeaPlan is developing its contribution to MSP in the Baltic Sea Region shall be conducted. This comprises a review of ongoing and projected European, national and transnational initiatives and projects with regard and relevance to marine/maritime data and Maritime Spatial Planning (e.g. INSPIRE, SeaDataNet, EMODNET, MESMA, ICES-WKCMSP etc.) relevant existing transnational and national databases and their hosts (e.g. HELCOM, ICES databases, BSH databases - CONTIS etc.), · the way data are being / have been used in MSP processes and for decision making (e.g. in the Netherlands, Scotland, Norway, USA, Germany, Poland, BSP pilot projects etc.)

A comprehensive description shall be delivered and their relevance for MSP assessed. It shall outline how BaltSeaPlan can build upon these experiences, deliver viable additional and practical value and which gaps may be filled for enhanced MSP data and procedures . It should also be elaborated to whom these recommendations shall be addressed.

2 Feasibility / Development of Data Model and Tool-Box

Within this task proposals should be developed on how an effective data model for Maritime Spatial Planning may look, what scope of information it should contain or be able to access, how it may work and be organised, aggregated, maintained and used. Some – exemplary – tools should be described which are matched for MSP purposes to demonstrate the procedures leading to answers to planners‘ questions and to preparation of planning decisions. This should include a transnational approach, taking into account data exchange for transnational planning activities and agreements such as prospects for a Baltic Sea wide database for Maritime Spatial Planning.

The elaborated study must answer following questions:

- Which technical and content-related requirements should be defined for data on human activities, socio-economic data, environmental, ecologic and oceanographic / geologic and climate data?
- Which kind of data processing and procedures may be proposed for answering questions relevant to MSP decisions in the different planning stages which do require spatial data input? (e.g. with regard to spatial distribution, impact assessments, scenarios – some examples to be provided by contracting party) ?
- Which data format(s) / metadata is required / valuable? (e.g. with regard to exchange of data, visualisation, reliability, correctness, up-to-dateness etc.) INSPIRE requirements are to be met, and recommendations may be made for data specifications on relevant themes listed in INSPIRE Annexes II and III
- Which format/aggregation/scale is appropriate in which stage of the ”MSP planning circle“ or other procedures (e.g. with regard to EC guidance on activities in marine areas in accordance with the EU nature legislation“)?
- Can indices based on ecological and other environmental data (e.g. sensibility or vulnerability indices) be useful for MSP decisions and be integrated into the data model?
- Which indices may be most informative and applicable for MSP purposes?

- Which kind of background information about planning context (terrestrial features, sea space related activities and developments, plans and programs) is necessary? How can it be mainstreamed for MSP or even included in a database?
- How should different spatial dimensions (spatial reference of data) be dealt with, e.g. when working with data in a (transboundary) ecological context vs planning requirements and data provided within given administrative boundaries?
- How should temporal aspects of spatial data with regard to activities, species numbers, habitats etc. be dealt with in the data model and in applications?
- How can MSP and Strategic Environmental Assessments (SEA) work be mainstreamed, e.g. with regard to data compilation and use?
- Which data should be held ready for exchange within the BSR? Where and how and by whom should it be stored? Which kind of exchange procedures and standards may be proposed?

2. Background and goals of the study

Answers to the questions and recommendations are developed further in this document.

Marine space is increasingly being regarded by many states as an important and integral part of their territorial space. The demands being placed on the marine environment are growing rapidly, and commercial exploitation of marine resources, combined with a need to protect them for future generations and balance the different uses, means that more effective governance mechanisms (both in terms of structures and processes) are needed. Maritime Spatial Planning (MSP) is seen as an approach that can bring about integrated, both sectorally and spatially (across territories), policy responses to deal with conflict and competing uses for the marine resources. Furthermore, many of these uses have not only spatial impacts on land and sea (land sea interface), but may also lead to cumulative and indirect impacts. On top of this, climate change developments call for special adaptation strategies. Maritime Spatial Planning has yet to operate in challenging framework conditions, not only due to large areas and scattered legal and administrative responsibilities, but also due to the added dimension (three dimensional space, incl. airspace, water column and seabed) and the still substantial gaps in knowledge about the marine environment.

BaltSeaPlan project was a reaction to the call from the EU for its member states to draw up integrated national maritime strategies and implement Integrated Maritime Spatial Planning (IMSP). It realises the HELCOM recommendation on Broad Scale Planning and the VASAB Gdansk declaration and builds on the results of former projects such as BaltCoast, Balance, Coastman and PlanCoast.

BaltSeaPlan brings together some key players responsible for maritime spatial planning as well as scientific institutions and NGOs from Germany, Poland, Lithuania, Latvia, Estonia, Sweden and Denmark. In countries where implementing institutions already exist, these have been appointed as project partners. In the other cases, the leading expert organisations have been appointed, all endorsed by their relevant national bodies.

Maritime Spatial Planning requires not only a sound database, but even more importantly, adequate and efficient methods of data and spatial analysis, impact assessment and scenario building to prepare and support planning decisions. So far, despite the many initiatives described in Chapter 3, such systematic and comparable procedures and methods have not been agreed upon.

Among the objectives of BaltSeaPlan project was to identify data needed for MSP and fill some of the data gaps and try to create transnational data sets as a basis for pilot maritime spatial plans drafted by the project. Moreover, BaltSeaPlan should propose solutions for data harmonisation and analysis, and **a model of a pan-Baltic database for maritime spatial planning purposes**, which would allow existing data sources to be integrated and take into consideration the data and knowledge gaps. The integration of environmental data presents a particular challenge here. Different kind of data on human activities, as well as socioeconomic, ecological and other data, should be stored and processed in a way that makes the information easy to apply throughout the planning process. Another objective is to give recommendations for organisation and planning procedures, including transnational aspects, standards for data exchange, cross-border consultations etc.

The primary goals of this study are therefore:

1. To assess the BaltSeaPlan approach and possible additional value in general in the light of ongoing and/or planned activities and projects on the national and European level
2. To assess the feasibility of creating an integrated database as mentioned (technical and procedural issues, harmonised/standardised data sets, scope/format/source of data etc.) by developing a respective data model, including a show-case with real data for demonstration
3. To give recommendations as to practical application and procedures regarding data compilation, data assessment, processing and standards for data exchange with special focus on transnational MSP.

3. Framework Conditions

3.1. International regulations and recommendations

3.1.1. EU Integrated Maritime Policy (2007)

On 10 October 2007 the Commission presented its vision for an Integrated Maritime Policy for the European Union (the **Blue Book**), which was accompanied by a detailed Action Plan. In 2008 the Commission adopted the "Roadmap on Maritime Spatial Planning: Achieving Common Principles in the EU", which set out 10 key principles as an appropriate basis for the development of MSP at the European level, as well as launching two preparatory actions in the Baltic Sea and the North Sea/North East Atlantic, aimed at developing the cross-border cooperation aspects of MSP.

In 2009 the European Commission presented a progress report, which enumerated the past two years' achievements of the EU's Integrated Maritime Policy and outlined priorities for the future. One of these is support for cross-cutting policy tools such as, maritime spatial planning in particular.

Furthermore, the Commission underlines that "there can be no maritime policy without proper data and knowledge on Europe's seas and coasts, and admits that so far marine knowledge remains very scattered and cost-ineffective. The **European Marine Observation and Data Network (EMODNET)** was one of answers towards reducing the uncertainty in knowledge of the seas as well as operational costs for those who use marine data. Existing databases and observation programs need to be assessed in terms of coverage, resolution and data collection frequency. Data stemming from different sources should be compiled in a comprehensive and compatible way, and made accessible as a tool for better governance. Substantial preparatory actions are underway to assemble data layers for hydrography, geology, biology and chemistry at a sea-basin level."

Recently the European Commission has put forward a proposal for continued financial support for the EU's Integrated Maritime Policy for the period between 2011 and 2013.

3.1.2. EU Marine Strategy Framework Directive (2008)

The Marine Strategy Framework Directive (MSFD) is considered the environmental pillar of the Integrated Maritime Policy. It deals with the implementation of an ecosystem approach to marine and coastal management. Whereas its main concern is achieving a good environmental status for Europe's seas, it also supports **Integrated Coastal Zone Management (ICZM)**, which is a dynamic, multi–disciplinary and participatory process which has much in common with the Maritime Spatial Planning.

MSDF requires that all EU member states draw up their own **national marine strategies**. For this purpose, they should 1) analyse and characterise their marine environment, including human pressures and impacts 2) define the desired good environmental status and the actions to achieve this, and 3) set up environmental targets and monitoring programs for ongoing assessment of the state of the marine waters. All these actions require support from Geographic Information Systems (GIS), thus the MSFD is closely interlinked with the INSPIRE Directive.

3.1.3. EU INSPIRE Directive (2007)

Issues of access to spatial information are high on the EU agenda with the relatively new directive called INSPIRE. "infrastructure for spatial information in Europe" - and requires governments to make geographical data more compatible in the transboundary context. The idea is to ensure that spatial data are collected to the same standards and scales across Europe and freely available to all. In its principles, INSPIRE seeks to ensure that:

- Spatial data is collected only once, at the level best suited to the task;
- Data from different sources should be capable of being shared among many users and applications;
- All levels of government should have access;
- It is possible for spatial data collected at one level of public authority to be shared between other public authorities;
- Data needed for good governance should be available on condition that do not restrict its extensive use.

Although INSPIRE entered into force in May 2007, its implementation in the member states is still far from satisfactory. Currently (June-October 2011) the Annex II and III data specifications are being tested by 45 independent users – organisations, companies and administrations legally mandated for these purposes. The final version (3.0) will be ready in April 2012. Then, in September 2012 implementing rules will be presented which the Member States should transpose into local law.

INSPIRE takes a long and turbulent route from its conception to implementation: the main points of disagreement between member states and the EU Commission are intellectual property rights and derogations to the sharing of spatial data in the light of financial viability of public bodies. Implementation will be expensive and challenging for those European authorities, which maintain electronic maps and spatial databases: metadata will have to be regularly updated, and existing information harmonised.

The INSPIRE Directive addresses 34 spatial data themes needed for environmental applications. These themes are subdivided in the three annexes of the Directive:

Annex I

1. Coordinate reference systems
2. Geographical grid systems
3. Geographical names
4. Administrative units
5. Addresses
6. Cadastral parcels
7. Transport networks
8. Hydrography
9. Protected sites

Annex II

1. Elevation
2. Land cover
3. Orthoimagery
4. Geology

Annex III

1. Statistical units
2. Buildings
3. Soil
4. Land use
5. Human health and safety
6. Utility and governmental services
7. Environmental monitoring facilities
8. Production and industrial facilities
9. Agricultural and aquaculture facilities
10. Population distribution and demography
11. Area management/restriction/regulation zones & reporting units
12. Natural risk zones
13. Atmospheric conditions
14. Meteorological geographical features
15. Oceanographic geographical features
16. Sea regions
17. Bio-geographical regions
18. Habitats and biotopes
19. Species distribution
20. Energy resources
21. Mineral resources

Each EU member state designated a national INSPIRE contact point, usually a public authority, to be responsible for contacts with the Commission in relation to INSPIRE. The role of the contact points is to provide results about the transposition of INSPIRE into national legislation. The contact points are also responsible for providing regular information about the implementation of INSPIRE in the given country and report on behalf of the Member State to the Commission.

INSPIRE Directive, Chapter V, Article 17 (1):

“Each Member State shall adopt measures for the sharing of spatial data and services between its public authorities ...” Those measures shall enable those public authorities to gain access to spatial data sets and services, and to exchange and use those sets and services, for the purpose of public tasks that may have an impact on the environment.

Country	INSPIRE Contact Point	Official web site/geoportal
Germany	GDI-DE office	http://geoportal.bkg.bund.de
Denmark	Danish Ministry of the Environment, Spatial Data Infrastructure Division	www.inspire-danmark.dk http://geodata-info.dk/Portal/
Poland	Ministry of Infrastructure, Head Office of Geodesy and Cartography	www.geoportal.gov.pl/
Sweden	National Land Survey of Sweden	www.geodata.se/
Lithuania	National Land service under the Ministry of Agriculture	http://www.nzt.lt/nzt/changeSite.do?siteId=&inlanguage=en www.geoportal.lt
Latvia	Hydrographic Service of the Maritime Administration of Latvia	under development
Estonia	Estonian Land Board	http://geoportaal.maaamet.ee/
Finland	National Land Survey of Finland and Coordination Body of several authorities	www.paikkatietoikkuna.fi

Tab. 1: INSPIRE Directive national contact points in the Baltic Sea Region (Nov. 2011, source EUROGEOINFO)

To aid the implementation of INSPIRE, on 29.03.2010 the Commission issued Regulation No 268/2010 on INSPIRE Data and Service Sharing, which defines a minimum set of conditions to be respected while sharing spatial data sets and services.

3.1.4. ISO standards

- The following ISO standards and other normative documents are relevant for maritime spatial planning and have to be considered for the creation of maritime databases:
- ISO 19115: 2003 Geographic information – Metadata: defines the schema required for describing geographic information and services. It provides information about the identification, the extent, the quality, the spatial and temporal schema, spatial reference, and distribution of digital geographic data.
- ISO 19116:2004 Geographic information -- Positioning services: specifies the data structure and content of an interface that permits communication between position-providing device(s) and position-using device(s)
- ISO/TS 19103:2005 Geographic information -- Conceptual schema language: provides rules and guidelines for the use of a conceptual schema language within the ISO geographic information standards.
- ISO 19109:2005 Geographic information -- Rules for application schema: defines rules for creating and documenting application schemas, including principles for the definition of features.
- ISO 19110:2005 Geographic information -- Methodology for feature cataloguing
- ISO 19118:2005 Geographic information – Encoding
- ISO 19123:2005 Geographic information — Schema for coverage geometry and functions
- ISO 19135:2005 Geographic information -- Procedures for item registration
- ISO/DIS 19136 Geographic information -- Geography Markup Language (GML)
- ISO 19139 Geographic information -- Metadata -- XML schema implementation
- S-57 ed.4 (S-100) vector interchange format used for maritime charts

3.1.5. Marine Knowledge 2020

"Marine Knowledge 2020 - marine data and observation for smart and sustainable growth" is an initiative of the European Commission with a focus on the assembly of data within the framework of the INSPIRE Directive. Preparatory actions for Marine Knowledge are GMES and EMODnet (read more in Appendix 4)

Marine Knowledge 2020 has three objectives:

1. Reducing operational costs and delays for those who use marine data through:

- helping private industry compete in the global economy and meet the challenge of sustainability;
- improving the quality of public decision-making at all levels;
- strengthening marine scientific research

2. Increasing competition and innovation amongst users and re-users of marine data by providing wider access to quality-checked, rapidly-available coherent marine data;

3. Reducing uncertainty in knowledge of the oceans and the seas and so providing a sounder basis for managing future changes

Principles of implementation of these objectives have been defined in the section 'Towards an Operational Marine Data Infrastructure" of the Marine Knowledge Communication, i.e.:

1. Europe's marine data are presently collected for a specific purpose – for instance safe navigation or fisheries management – but the aim is to move towards a paradigm where, from the outset, a multi-purpose use is envisaged.

2. Data should be maintained as close to the sources as possible. These data should be under proper guardianship in accredited data centres. Any processing of data which constitutes personal data as defined in the Data Protection Directive must comply with the provisions of the Directive.

3. An effective European marine data infrastructure should include a number of thematic assembly groups entrusted with "assembling" data. A thematic assembly group is a consortium of organisations that assembles data on a specific theme such as geological layers or chemical contaminants.

4. In order to achieve sustainable operation of marine observations systems and identification of critical gaps in these systems, an integrated viewpoint at sea-basin level is needed. Existing organisations with a sea-basin mandate such as the Regional Sea Conventions, Regional Advisory Councils for fisheries and EuroGOOS would be expected to contribute.

5. In a limited number of cases it may be appropriate that EU support for the marine data and observation infrastructure move beyond the assembly of data to the analysis and application of these data; for instance to support the provision of indicators for the state of the marine environment.

6. The knowledge architecture requires a decision -making process to decide what data is to be collected and how it should be assembled. It also requires a secretariat to administer the process.

In order to work towards such an infrastructure the Commission has proposed that:

- Knowledge is not only the responsibility of Government. European industry should dedicate adequate resources to ensure adequate safeguarding of knowledge and, when it is no longer commercially valuable, its wider dissemination.
- The Commission will encourage communication amongst national data centres through regular discussions in its marine observation and data expert groups and its maritime internet forum in order to promote good practice in data collection and dissemination.
- To ensure an integrated view of monitoring needs, the Commission will explore how a sea-basin checkpoint might work by setting up pilots in the period 2011-2013.
- The Commission, on the basis of advice from Member States, from sea-basin checkpoints and its own experts, will continue to define priorities for assembling data in ur-EMODnet but in the period 2011-2013 will develop a proposal for more permanent governance.
- The Commission will set up a prototype secretariat to manage the ur-EMODnet process - preparing meetings, assessing the output of thematic assembly groups and sea-basin checkpoints, ensuring deadlines are met and preparing an annual report of activity.

The direct outcome of this communication, which bears an influence on the data model, is deployment of EMODNet on the basis of maritime policy preparatory actions. EMODNet thematic services have to be a source of data and information for future MSP use. This strategy also includes direct recommendations for data model study.

3.1.6. Territorial Agenda of the European Union 2020 (2011)

Territorial Agenda 2020 - Towards an Inclusive, Smart and Sustainable Europe of Diverse Regions, is a policy paper containing recommendations for integrated spatial development, aimed at mobilising the potentials of European regions and cities for sustainable economic growth and increased employment.

The current territorial agenda document for the first time explicitly includes maritime considerations as part of the territorial agenda. Its recommendations include "the introduction of some form of regulatory mechanism

similar to spatial planning to avoid random and excessive sea space allocation to some interests, as well as the inclusion of sea space as an integral part of national, regional and local spatial policy".

3.1.7. Vision 2030 for the Baltic Sea

The BaltSeaPlan project also produced, besides this study and much practical experience on MSP in the Baltic Sea Region, a paper called "Vision 2030: Towards the sustainable planning of Baltic Sea space". This has been jointly agreed by the BaltSeaPlan partners, showing how MSP could ideally have been translated into practice by 2030.

The BaltSeaPlan vision, although published only in November 2011, is receiving growing recognition from supra-national bodies such as HELCOM, VASAB and DG Mare of the European Commission.

Vision 2030 sets objectives and targets the four topics identified as particularly important for the sustainable development of the Baltic Sea:

1. Healthy marine environment
2. Coherent pan-Baltic energy policy
3. Safe, clean and efficient maritime transport
4. Sustainable fisheries and aquaculture

These topics require a pan-Baltic approach. General objectives and targets should not be set nationally, but for the BSR as a whole, allowing all countries to contribute more or less to a particular policy target as long as the overall objective is guaranteed. Transnational MSP solutions should be developed based on these (Gee et al. 2011).

3.2. Transnational cooperative structures

3.2.1. HELCOM

The Helsinki Commission (HELCOM) is the most prominent transnational, intergovernmental organisation dedicated to the protection of the Baltic Sea from all sources of pollution. HELCOM is the governing body of the "Convention on the Protection of the Marine Environment of the Baltic Sea Area" - commonly known as the Helsinki Convention. HELCOM can point to numerous achievements through policy, e.g. stricter controls on industry (permits are now compulsory for industrial emissions), improved joint monitoring of the state of the marine environment, and elimination of illegal discharges by ships into the Baltic Sea.

Broad-scale marine spatial planning was one of the new concepts adopted within the HELCOM Baltic Sea Action Plan. HELCOM partners agreed to jointly develop broad-scale, cross-sectoral, maritime spatial planning principles based on the Ecosystem Approach by 2010, as well as to test, apply and evaluate these by 2012 in co-operation with other relevant international bodies.

The 'HELCOM Recommendation 28E/9 on development of broad-scale marine spatial planning principles in the Baltic Sea area' recommends i.a. that the Contracting Parties:

- fill in data gaps in spatial data e.g. on marine and coastal biodiversity, natural resources, use of land and water areas, demography, traffic, shipping;
- develop joint solutions to the problems associated with access to spatial data;
- provide HELCOM and other relevant parties with the necessary spatial data for marine and coastal broad-scale spatial planning;
- identify and map interacting and/or conflicting interests, obligations and uses of the sea, primarily to broaden the HELCOM GIS as a data source and effective tool for use in marine broad-scale spatial planning (compatible with the European Environment Agency database including spatial data).

In order to implement the HELCOM Baltic Sea Action Plan and the related European legislation on Maritime Spatial Planning, a pilot project HELCOM SCALE was launched to run between 2007 and 2009. It was used i.e. . to develop the HELCOM GIS database and webmap service.

The current PLAN BOTHNIA project in the framework of the EU Maritime Policy is also led by HELCOM (see … for more).

3.2.2. VASAB 2010

Right from its formation VASAB 2010 (Visions and Strategies around the Baltic Sea 2010) – an organisation of ministries from Baltic Sea countries responsible for spatial planning has paid considerable attention to the sea and coastal areas. In 1996 the 4th Ministerial Conference in Stockholm adopted the "Common Recommendations for spatial planning of the Coastal Zone in the BSR". Within its Wismar Declaration adopted in 2001, VASAB then called explicitly not only for an enhanced integrated development of coastal zones and islands, but also for the extension of spatial planning to off-shore areas and initiated the BaltCoast project. At the 6th Ministerial Conference held 2005 in Gdansk the "Connecting Potentials" policy paper was adopted, which calls for the introduction of maritime planning as a tool to prevent conflicts of use in intensively used offshore areas. In consequence a new VASAB working group on "sea use-planning and integrated coastal zone management' was formed.

3.2.3. HELCOM-VASAB MSP Working Group

In order to promote the development of maritime spatial planning in the region and follow up its implementation as outlined in VASAB Long Term Perspective as well as the HELCOM Baltic Sea Action Plan and relevant HELCOM Recommendations, in 2010 both organisations set up a joint co-chaired Working Group on Maritime Spatial Planning. One of the first important outputs were the 10 Principles of Baltic Sea Broad-scale MSP:

1. Sustainable management
2. Ecosystem approach
3. Long term perspective and objectives
4. Precautionary Principle
5. Participation and Transparency
6. High quality data and information basis
7. Transnational coordination and consultation
8. Coherent terrestrial and maritime spatial planning
9. Planning adapted to characteristics and special conditions at different areas
10. Continuous planning

Principle nr 6 is specified as follows: 'Maritime Spatial Planning should be based on the best available, high quality and up to date comprehensive information that to the largest extent possible should be shared by all. This calls for close cooperation between relevant GIS and geo-statistical databases, including the HELCOM GIS, monitoring and research in order to facilitate a trans-boundary data exchange process that could lead to a harmonised pan-Baltic data and information base for planning. This base should cover historical baselines, present status as well as future projections of both environmental aspects and human activities. It should be as comprehensive, openly accessible and constantly updated as possible and compatibility with European and Global initiatives should be ensured' (HELCOM-VASAB MSP WG 2/2011).

3.3. European transnational projects with MSP relevance

On the EU, international and national levels there are currently numerous initiatives and projects attempting to provide information on themes related to marine environment and uses. Other more broadly marine or geospatial initiatives are also exploring ways of making use of marine and other data for MSP. However, the great majority of these projects have a demonstration or research character, limited timeframe and funds, and thus a selective scope of data coverage.

This section contains an overview of the transnational projects and initiatives most relevant for the MSP data basis –, all currently in operation or recently completed. . For more detailed information about the projects please refer to Appendix 4

Project name / funding source	Duration / budget	url	Main theme	MSP relevance
BaltSeaPlan (Baltic Sea Region Programme)	2009 – 2011 3.7 M €	www.baltseaplan.eu	Methods and testing of MSP in pilot areas	very high
MyOcean (7FP)	2010 – 2013 55 M €	www.myocean.eu.org	Integrated European capability for ocean monitoring and forecasting	very high
ESaTDOR (ESPON)	2010 – 2013 0.8 M €		Investigation of current uses of Europe's seas	potentially high
PLAN BOTHNIA (EU DG MARE)	2010 – 2012 0.3 M €	http://planbothnia.org	MSP pilot project of the EU Commission	very high
MASPNOSE (EU DG MARE)	2010 – 2012 0.2 M €	www.surfgroepen.nl/sites/CMP/maspnose	MSP pilot project of the EU Commission	very high
ODEMM (7FP)	2010 – 2014 8.2 M €	www.liv.ac.uk/odemm	Developing a set of ecosystem management options	low, too theoretical
MESMA (7FP)	2009 – 2013 8.5 M €	www.mesma.org	Support the implementation of marine spatial planning in Europe's sea (including data model)	potentially high, but too theoretical
COEXIST (7FP)	2010 – 2013 3.7 M €	www.coexistproject.eu	Evaluation of competing activities and interactions in European coastal areas	medium to low
KnowSeas (7FP)	2009 – 2013 7.4 M €	www.knowseas.com	Tools for ecosystem based marine management	low, too theoretical
GAP2 (7FP)	2011 – 2014 6 M €	www.gap2.eu	Application of science and management to fisheries and the marine environment	potentially high
CHEMSEA (Baltic Sea Region Programme)	2011 – 2014 4.7 M €	www.chemsea.eu	Detection and mapping of underwater chemical weapons	high in some aspects
PlanCoast (INTERREG IIIB NP CADSES)	2006 – 2008 1.9 M €	www.plancoast.eu	Development of tools and methods for MSP	high
BALANCE (Baltic Sea Region Programme)	2005 – 2007 4.3 M €	www.balance-eu.org/	Development of tools and methods for MSP, "blue corridors" concept	very high
MSP Initiative (UNESCO IOC)	2006 – 2010	www.unesco-ioc-marinesp.be/	Collection of worldwide good practice for MSP	medium

Tab. 2: Summary of European transnational projects with MSP relevance

3.4. Current national set-ups for MSP data infrastructure

The following table summarises the main sources (providers) of MSP data in the Baltic Sea Region countries, grouped according to the four topics identified by the BaltSeaPlan Vision 2030 Towards the sustainable planning of Baltic Sea (see Chapter 3.1.7) which are: nature conservation, shipping, energy and fisheries. Cables and pipelines have been added as the fifth topic, as another important subject in transnational maritime spatial planning. For more information on the respective countries refer to Appendix 5.

		Germany	Denmark	Poland	Sweden	Lithuania	Latvia	Estonia	Russia	Finland
Main national authorities and institutes responsible for licencing, planning and/or data provision on…	**CABLES & PIPELINES**	BSH, Mining authorities	Danish Energy Agency	Maritime Institute Gdansk, Maritime Administration	Swedish Maritime Administration	Ministry of Energy ,	Hydrographic Service of the Maritime Administration, Marine and Inland Waters Administration of State Environmental Service	Estonian Maritime Administration		Finnish Maritime Administration
	FISHERIES	vti	Ministry of Food, Agriculture and Fisheries, Danish AgriFish Agency	Marine Fisheries Institute (MIR)		The Fisheries Service under the Ministry of Agriculture of the Republic of Lithuania	Institute of Food Safety, Animal Health and Environment (BIOR)			
	ENERGY	BSH	Danish Energy Agency	Maritime Institute Gdansk	Swedish Maritime Administration	Ministry of Energy , CORPI	Ministry of Economy	Estonian Maritime Administration		Finnish Maritime Administration
	SHIPPING	BSH, Water and shipping directorates	The Danish Ministry of Business and Growth, Danish Maritime Authority	Hydrographic Office of the Polish Navy, Maritime Institute Gdansk, Maritime Administration	Swedish Maritime Administration	Safety Navigation Administration	Latvian Coast Guard Service, Hydrographic Service of the Maritime Administration	Estonian Maritime Administration		Finnish Maritime Administration

		Germany	Denmark	Poland	Sweden	Lithuania	Latvia	Estonia	Russia	Finland
	NATURE CONSERVATION	BSH, Federal Nature Conservation Agency(BFN)	Ministry of Environment, Danish Nature Agency	PAN Oceanographic Insitute Sopot, Maritime Institute Gdansk	Swedish Environmental Protection Agency (SEPA)	National Environmental Protection Agency (LEPA), within Ministry of Environment	Ministry of Environment and Regional Development, Institute of Aquatic Ecology, Hydrographic Service of the Maritime Administration	Estonian Environment Information Centre		SYKE
Responsible for MSP		EEZ: Federal Maritime and Hydrographic Agency (BSH), Territorial sea: coastal federal states	no MSP yet	Maritime Administration	new authority: Agency for Marine and Water Management	Ministry of Environment	no MSP yet	no MSP yet	no MSP yet	no MSP yet
other peculiarities		**Ongoing networking initiative: Marine Data Infrastructure Germany (MDI-DE)**				**In late 2011 tender for LT General Plan extension to marine areas was announced by Ministry of Environment**	**Hydrographic Service of the Maritime Administration of Latvia acts inofficially as the main data contact point**			

Tab. 3. Main national MSP data providers in the Baltic Sea Region countries

3.5. Databases and geoportals with MSP relevance

At present marine data is generally not stored and/or accessible in one database or data-portal, but distributed and held within a multitude of organisations, agencies and institutions, and often not aggregated and processed in a way that might be exploitable for maritime spatial planning processes. Thus, even institutions dealing with MSP often only have compiled and maintain data on issues that are within their own particular field of work, not to mention those limited in geographical scope to national borders . Collection and integration of relevant data for MSP and SEA from other sources might turn out to be quite problematic and time consuming. Different data formats and scales, missing metadata, a lack of spatial focus, various co-ordinate systems etc. all add to the difficulties.

Save for the HELCOM and CONTIS databases, none of them serves explicitly MSP purposes. Still, some can be regarded as good information sources for MSP. EMODNET, MDI-DE and INSPIRE geoportals neither have an MSP focus, nor are they yet finalised, but they should already be regarded as potentially very useful for obtaining unrestricted good quality maritime data free of charge.

The table below contains an overview of databases most relevant (or potentially most relevant) for MSP, available or developed at the moment. They are described once again in detail in Appendix 6.

Database	Available data, scope	Data format	Data sharing/ restrictions	Application for MSP
EMODnet 5 pilot portals: EMODnet -hydrography, marine biology, marine chemistry, marine geology and marine habitats.	GeoPortal to be finalised in 2014. Full evaluation not possible at this time.		No restrictions (free data access for business users)	- scale 1:1 000 000, too large for MSP + due to lack restrictions easy and cheap source of spatial data
INSPIRE GeoPortal www.inspire-geoportal.eu/	At the moment very limited amount of data, but as yet not up and running	Metadata only	Restrictions depend on data owner	- metadata of only limited application for MSP purposes + useful when searching for a specific data set
ICES GeoPortal http://geo.ices.dk/geonetwork	Large amount of data from research programmes and national monitoring activities	Metadata and charts showing data distribution only	No restrictions. It is possible to download the data, but for efficient work (visualisation of CTD-profiles) special software is necessary.	- requires of specialist software and knowledge
HELCOM Map and Data Service http://maps.helcom.fi/website/mapservice/index.html	Covers the whole Baltic Sea. A lot of environmental data from former international projects and national monitoring programs	Based on ESRI's ArcGIS Server and Flex development platform	Allows the user to: Visualise, analyse and search data · Draw and save or print own maps · Download ESRI shapefiles · Access layers in OGCWMS standard protocol	+ Good source of information of marine environment and protected areas. - technical problems with zooming into a better resolution - Data on human activities not very comprehensive and/or reliable. - not always up-to-date
EUROSION GIS Database *www.eurosion.org/* = European Environmental Agency database	Environmental data but also land use, industry, transport, urban environment etc. European data.	Shapefiles for download, however no online visualisation.	no restrictions	- data cannot be viewed before download, so it is difficult to find the right data

www.eea.europa.eu/data-and-maps/data/		GIS software required		
European Atlas of the Seas http://ec.europa.eu/maritimeaffairs/atlas/maritime_atlas/	All EU sea basins,	Data shown as maps only	no restrictions	- very general overview - Practically none - only awareness raising function
ESPON database	World and regional data	Different formats	Some data with no restriction, some for registered project members only	- Database not suitable for marine purposes
Continental Shelftion Continental Shelf Information System (CONTIS) *www.bsh.de/de/Meeresnutzung/Wirtschaft/CONTI* **Continental Shelf Information System (CONTIS)** www.bsh.de/de/Meeresnutzung/Wirtschaft/CONTIS-Informationssystem	German section of the Baltic Sea	Maps in pdf format, shapes of uses upon request	Free access only to certain preselected maps	CONTIS is developed as a special tool for MSP purposes. However, so far it is applicable for general overview only. + Good source for data on imminent human activities - insufficient zooming capability
MDI-DE database Marine Data Infrastructure Germany www.mdi-de.org/	MDI-DE database under development (planned for 2013)			Very interesting idea of decentralised data storage. If the map resolution fine enough MDI-DE portal, could be a perfect tool for MSP purposes.

Tab. 4: Summary of databases and geoportals with MSP relevance

3.5. Data models, scenarios and other tools

3.5.1. Use of data models

The most important benefits of merging modelling and MSP processes have been widely developed in BaltSeaPlan Report 19 “Modelling for Maritime Spatial Planning”. Modelling and modelling tools can play an important role in supplementing field observations (e.g. filling observational data gaps, investigating and understanding processes, to carrying out ‘what happens if’ scenarios) and importantly, as described in the above chapter, to assist in the setting of ecological targets within the framework of MSP. In addition, model applicability and usefulness for maritime management not only depends on the quality of the output, but also on the available range of relevant model products. Within the BaltSeaPlan project, a dedicated working group dealt with the question or whether or not and to what extent models and model results can contribute to the maritime spatial planning process.

Integration of modelling and data observation networks is the most effective approach to produce complete data sets necessary to conduct planning in sea areas, where data availability is not sufficient to assess the state of the environment.

Below is a short overview of models and other decision support tools that are most likely to find application within the MSP data infrastructure:

- **Hydrodynamic models** (e.g. COHERENS, BSHcmod, HIROMB, RCAO, HAMSOM, GETM, MIKE 3, MOM, SHYFEM, WAM)
- **Ecosystem models** (e.g. ERGOM, ECOSMO, ECOPATH, SCOBI, BalEco)
- **Habitat and habitat suitability models** (for vegetation, bottom habitats and species modelling)
- **Atmospheric models** (for meteorological or wave modelling purposes)
- **Management models and tools** (e.g. Baltic NEST decision support system, MarineMap, MARXAN, different public participation tools)

While no all-MSP tools have yet been developed, the above can be successfully applied in a MSP. Vegetation models, for instance, can help to bypass data gaps and save, at least partially, the expensive situ surveying on bottom habitats. Other models can improve the knowledge base for MSP, eg. on the spatial and temporal distribution of oxygen depletion.

Management tools in turn bring useful implications for decision-making within the MSP process. Decision support software such as MARXAN can help to work in a systematic way in complex planning situations where all interests should be considered. MARXAN helps to analyse possible solutions, after the conflicts in an area have been defined and targets set by the planners. The optimisation algorithm tries to find solutions which achieve the targets in an effective way, but it does not do any ecological modelling. The work within the planning team and their understanding of how to use a decision support tool seems quite essential. It has to be kept in mind that the results are directly influenced by the chosen simplification settings and should not be over-interpreted. MARXAN is merely a tool that helps to refine targets and conflicts. During the first runs, some of the settings could be changed due to the unexpected effects of some of the target or conflict definitions. By using MARXAN, changes can easily be documented and several settings tested so that the whole process of finding suitable sites becomes transparent.

In conclusion, models and tools can support MSP by:

(i) improving the existing knowledge base on ecological and other environmental key indicators and their linkages and functioning,
(ii) targeting observational data gaps and processes,
(iii) providing scenario based conflict and sensitivity assessments, and
(iv) providing geospatial data information for GIS applications and other management and spatial planning tools. (BALTSEAPLAN 2011)

1.8.2 Other Tools for Spatial Data Generation: Impact assessments

The following assessment methods are most frequently applied to determine the impact of human activities on an environmental system:

1. Habitat valuation
2. Ecosystem services valuation
3. Vulnerability assessment
4. Cost-benefit analysis
5. Verbally-argumentative method

Habitat value method is a standardised assessment procedure, which due to its practicability, logical and simplified procedure finds broad application, particularly in Environmental Impact Assessment (EIA). The value of areas of habitat and plant communities should be measured against published selection criteria where available. For example, Annex III of the EC Habitats Directive sets out the criteria for selecting sites eligible for identification as sites of Community importance and designation as SAC. Those habitats considered to be particularly vulnerable are identified as 'priority habitats'.

The guidelines for the selection of marine protected areas set out criteria for habitats or plant communities to be designated as being of national importance. Some countries have prepared national criteria for the selection of conservation sites. Where areas of a habitat or plant communities do not meet the necessary criteria for designation at a specific level, the ecologist may consider the local context if appropriate, but should take into account their potential value.

Economic valuation of ecosystem services is becoming more widely used to understand the multiple benefits provided by ecosystems, including nutrient cycling, carbon sequestration, air and water filtration or flood amelioration, to name just a few. A recent case study conducted for Massachusetts Bay offered a transparent and quantitative approach to assessing and communicating ecosystem dynamics and the interactions among

varied ecosystem services and the sectors they support. It has shown the trade offs from different sectors (offshore wind energy, flounder and lobster fishery, and whale-watching) under conditions of MSP and no MSP (single sector management).

This practical application of an **ecosystem services** trade-off analysis method has clearly shown the utility and value of MSP over conventional management and improved the transparency in decision-making, which helped to avoid unnecessary conflicts. (White et al., 2012)

Habitat suitability index (HSI) method is designed to analyse the habitat value of an area for a particular species of interest and is commonly used to evaluate species, communities, and habitats for management or impact assessment. However, many assessments are conducted under strict time and money limitations, and this use of HSI may lead to inappropriate interpretations.

Vulnerability assessments can help to decide what use is best suited where, and whether limits of any kind should be imposed. Vulnerability assessment is a strategic planning tool primarily designed to identify potential environmental threats arising from planned uses ex ante. Added benefits include knowledge exchange among different disciplines and between experts, policy makers and the general public, as well as integration of public value orientations in decisions about spatial planning and management.

The following conditions are required to draw up a vulnerability assessment for an area:

- Environmental and territorial data
- A set of formally approved or commonly agreed environmental protection
- Objectives for the area concerned (including SPAs, water protection areas, agricultural land etc.)
- A set of planned land uses, projects and measures; and their detailed (as far as possible) characteristics relevant for the area
- Knowledge about cause-effect relationships (environmental impacts); usually available as expertise from experts
- Knowledge about priorities, value orientations (collected from relevant stakeholders, general public; reformulated if required during the process)
- Data processing hardware and software

Ideally, the vulnerability assessment is prepared using GIS support. This makes it a dynamic and flexible tool, ready for update with new or refined environmental data and applicable to new planning challenges and requirements. All the potential users should be actively involved in the preparation of the assessment since they will be using it as a support tool for their decision-making and planning.

Cost -benefit analysis is an economic tool to aid decision-making, and is typically used by governments to evaluate the desirability of a given intervention. The aim is to assess the efficiency of the intervention relative to the status quo. The costs and benefits of the impacts of an intervention are evaluated in terms of the public's willingness to pay for them (benefits) or willingness to pay to avoid them (costs). Inputs are typically measured in terms of opportunity costs - the value in their best alternative use. The guiding principle is to list all of the parties affected by an intervention, and place a monetary value of the effect it has on their welfare as it would be valued by them.

However, there are limits to applying cost -benefit analysis in maritime spatial planning. This project-oriented tool tries to quantify the value of certain planning measures as opposed to damage caused by inaction. Measuring the monetary costs and benefits in an ecosystembased approach is, however, very difficult. The very narrow focus on money as equivalence unit, whereas commons such as nature, space or landscape are argued to possess qualities beyond those of simple consumer goods. This is why, while politicians enjoy the simple 0-1 results of the cost-benefit analysis, experts prefer multidimensional evaluation methods based on indicator matrices (facilitated by different GIS tools) or verbally-argumentative qualification instead of quantification.

Environmental Impact Assessment (EIA), **Territorial Impact Assessment** (TIA) and the **Strategic Environmental Assessment** (SEA) are not specifically marine procedures, which ensure that the environmental implications are taken into account before important territorial policy decisions such as investment projects and programmes are made. SEA is especiallyclosely linked to maritime spatial planning. Due to some overlapping between the SEA stages and the MSP planning steps, it is highly recommended that both processes should be mainstreamed, in order to save time and effort. A SEA procedure, if well anchored within the corresponding stages of the MSP process, can provide added value in terms of even better understanding of the environmental, social and economic impacts and interrelations. In any case SEA should not be seen as another bureaucratic requirement only – it is better to regard it as a 'second check' on the overall sustainability of the plan (compare PLANCOAST 2008, 63).

In particular the public participation part (including cross-border consultations!) could be “covered“ in the framework of SEA, while the data collection and mapping, which are prerequisites for a regular maritime spatial planning process, could be derived from the MSP database, once established. The data on i.a. boundaries of the area, assumptions on the marine environment and of the different versions of the planned investment are necessary in the scoping phase of impact assessments. In the Environmental Report, models and other decision making tools could be used to show the possible implications of different planning alternatives.

4. Experiences from BaltSeaPlan pilot project

In the framework of the BaltSeaPlan project eight maritime spatial planning processes were launched for selected pilot areas throughout the Baltic Sea Region, including two cross-border areas. While in the case of countries without an MSP legal basis, these proposals will not immediately come into force, the MSPs were prepared as show cases in order to provoke discussion on the introduction of MSP legislation.

TheBaltSeaPlan MSP pilot areas were:

- Pomeranian Bight (Germany/Poland/Denmark/Sweden)
- Middle Bank (Poland/Sweden)
- Western Gulf of Gdańsk – SEA (Poland)
- Western Coast of Latvia – (Latvia)
- Hiiumaa and Saaremaa (Estonia)
- Pärnu Bay (Estonia)

Within those areas either pilot maritime spatial plans or marine strategic environmental assessments (SEA) were developed, taking into account the analyses on national maritime strategies and scenarios. New data sets, methodologies and the criteria especially were developed jointly in national or transnational working groups.

Those pilot MSPs were not a mere mapping exercise, but they do offer a direction and vision of how coastal and marine space should be used. Transnational cases have been selected in order to also test immediately transnational coordination mechanisms. The application of intensive stakeholder involvement ensured that plans are based on a broad consensus – even if national legislation might not require such procedures yet.

The table below shows, from the example of the transnational MSP pilot project Pomeranian Bight involving Germany, Poland, Denmark and Sweden, how real data needs for MSP have been dealt with, which spatial data and further information was considered, obtained and used:

Topic	Data originally planned / needed / deemed useful		Data obtained (source)	Data missing/ not obtained / problems encountered
	Scope	Detailed information		
Offshore wind farms	All wind farms planned, approved or constructed in pilot area	• Status, • Owner / operator • MW planned, • number of turbines, • type of turbine, • year of approval, year of construction etc.	DE: Full fledged data set (BSH) DK: symbolic locations (via NERI) PL: symbolic locations (MOS)	Except DE no real planning areas, no data for SE (no projects known)

Topic	Data originally planned / needed / deemed useful		Data obtained (source)	Data missing/ not obtained / problems encountered
	Scope	Detailed information		
Shipping/Maritime Traffic	Spatial data • Existing MSP regulations (e.g. priority areas etc. if available) • Maritime regulations (IMO, TSS, other categories: core data like: IMO routes, traffic separation schemes, deep water routes • Shipping (transport) intensity – frequency of use – present situation, (AIS-traffic information) • Regular connections / routes (ferries) • Fishing traffic (AIS) • Leisure traffic (AIS) • Ports / areas • Roadsteads • Anchorages • Closed areas / access restrictions • Obstacles (wrecks etc.) (as shown in nautical charts) • Danger areas (ammunition etc.) (as shown in nautical charts) Additional spatial data (events etc.) • Accidents / strandings / collisions (impact of ship traffic) • Oil spills (temporary feature but indicates some negative impact of ship traffic, mainly along main shipping routes • Pollution (air / water) (some parameters to be defined and available data aggregated for visualisation of impact of shipping) Further Information (additional statistical data) • Number of ships, type of ship (bulk carrier, tanker, container carrier, ferry) • present situation of maritime traffic - predicted development (this information is only available and "desirable" in form of statistics based on actual AIS-data)		• IMO regulations (IMO, CONTIS) • MSP regulations (BSH, Energy Ministry Mecklenburg-Vorpommern) • • AIS data (raster, sample, various kinds of traffic incl. water depth of more / less than 2.5 m, dangerous goods, leisure traffic, fishery traffic) – Landmäteriet Sweden Coastal shipping route, harbour approach Swinemunde/Szczecin (MO Szczecin) • Accidents/oil spills / pollution etc., general shipping routes / future estimates (HELCOM data sets) • Some statistics on predicted developments in shipping / maritime transport (e.g. from national statistics, ports developments plans etc.)	• Shipping – estimates for future shipping routes (not only future numbers but areas affected / needed). HELCOM has estimates, and symbolic increased width of shipping routes, but not in the "right" place, i.e. along the real shipping routes • More detailed and long-year /seasonal information on shipping activities of minor ships (small fishing vessels, leisure boats etc.)
Submarine Cables	• Existing cables • Planned cables	• Type of cable incl. e.g. type of high voltage cable etc., type of data cable • Status • Owner/operator • Dates of approval, dates of construction, dates of initial operation etc • dates of decommission	• DE: existing / planned cables (BSH) • DK: Existing cables (via NERI) • PL: Existing cables (MIG) • SE: Existing cables (Metria)	• No data on planned cables in DK, SE and PL • National data differ widely in scope, detail (content), format, often no coherence of data
Submarine pipelines	• Existing pipelines • Planned pipelines	• Type of pipeline • Status • Owner/operator • Dates of approval, dates of construction, dates of initial operation etc, • dates of decommission	• DE, PL: Existing - NordStream (BSH) • DE, PL: Planned – Baltic Pipe (MO Szczecin) •	• Baltic Pipe (draft new outline of route known / submitted, but no official routing information yet, no further details)
Platforms	• Existing platforms • Planned platforms	• Type of platform • Status • Owner / operator • Dates of approval, construction, initial operation, decommission etc.	• DE: Existing /planned platforms (BSH)	• No data on (planned) platforms in DK, SE and PL

Topic	Data originally planned / needed / deemed useful		Data obtained (source)	Data missing/ not obtained / problems encountered
	Scope	Detailed information		
Sand and gravel extraction	• Existing areas • Planned areas	• Type of extraction (usage, e.g. coastal protection, commercial etc.) • Status (incl. level of approval, e.g. for prospecting, for extraction etc.) • Owner/operator • Dates of approval, dates of initial operation, dates of decommissioning	• DE: Licences, applications, areas in use, coastal protection/commercial use, status etc. (Bergamt Stralsund, BSH, M-V Energy Ministry) • DK: Areas in use, shares of coastal protection/commercial use (via NERI) •	• PL: No official information / data on deposits / planned extraction areas etc, more detailed information for other data sets
Gas / oil extraction	• Existing areas • Planned areas	• Type of extraction (oil gas) • Status (incl. level of approval, e.g. for prospecting, for extraction etc.) • Owner • Dates of approval, dates of initial operation, dates of going out of use	• PL: area for gas exploration (out of use) – MO Szczecin •	• DE: data on newly licenced exploration areas for natural gas not available during project work
Other mining, related information (CCS, brine etc.)	• Existing areas • Planned areas	• Type of extraction / storage • Status (incl. level of approval, e.g. for prospecting, for extraction etc.) • Owner • Dates of approval, dates of initial operation, dates of decommissioning	• No data compiled.	•
Dredging	• Existing areas • Planned areas	• Status • Purpose	• No data compiled.	• PL: No official data on dredging areas (port approaches)
Dumping	• Existing areas • Planned areas	• Material dumped (from dredging, ammunition, etc.)	• DE: small area in Territorial Sea (Energy Ministry M-V)	•
Submarine heritage	• Submerged historic settlement areas & sites • Wrecks	• Types • Value • Status	• DE: wrecks (BSH database) – not used in plan, only sites	• No data for DK, SE and PL
Military	• Existing areas • Planned areas	• Type of exercise • Temporal / seasonal use • Restricted areas	• DE, PL: Various kinds of exercise areas and restricted areas (BSH, MOS)	• No data for DK, SE

Topic	Data originally planned / needed / deemed useful		Data obtained (source)	Data missing/ not obtained / problems encountered
	Scope	Detailed information		
Fisheries	• Fishing effort (areas most intensely used for fisheries, maybe even "translated into values" such as reflecting revenues per spatial unit1 wit h regard to: • Target species • Yield per unit • Fishing gear • Fishing seasons		• Fishing Effort / Gear • Fishery Areas, catch by fishery harbour (statistics) • Intensity Catch of various target species • Data on catch in ICES rectangles • (DE: EMPAS report, WWF, PL: MOS, SE: SMA; ICES) •	• No comprehensive / comparable spatial data for whole project area (vector / raster) on fishing volume, value, type, gear etc. • Results from BSP reports on fishery (WWF) not available in time for project work
Tourism	• Important tourist areas (land/sea) • Tourism infrastructure • Leisure traffic		• PL, DE: Reservation / Priority Areas Tourism (planning documents BSH, Energy Ministry M-V,)	• Spatial data (vector/raster) regarding water sports areas etc.
Ecological Information	• Habitats (key species / communities) • Benthic Habitats • Bird migration routes • Numbers of birds • Numbers of mammals • Fish spawning areas • Fish nursing areas	• Areas / raster data • Species • Seasonal / temporal inform.	• . Wide range of information on species numbers etc (DE: from BSH and other institutions, DK: NERI) • Benthic Habitats (BALANCE / HELCOM) •	• Comprehensive and comparable spatial data for the whole project area, numbers of birds, migration routes, valuable habitats etc. •
Meteorological information	• Wind conditions (speed etc.) • Extreme weather conditions etc.		• PL: Wind speed (MIG)	•
Oceanographic information etc.	average distribution, significant deviance, max./min. distribution: • Currents • Salinity • Hypoxia / anoxia • Temperature • Stratification • Ice conditions • Water levels / highest floods • Historic water levels • Hazardous substances / particles • Eutrophication (nitrate etc.)		• Salinity, • Hypoxia-Anoxia, • Inflow of saline water • Ice conditions (some daily information from 2011, map of estimates of ice probability based on long-term data (BSH) • historic water levels (only maps), etc. (from BSH, IOW/QuantAS Project, NERI)	• Not all information from the left column was requested • Not requested, but probably available: hazardous substances, eutrophication etc.
Geology / geomorphology	• Bathymetry • Seabed / morphology • Geology / sediment characteristics • Development of seabed (dependent on changing water level)		• Geology of project area (SE: Sveriges Geologiska Undersökning, BALANCE data (HELCOM) – sea bed, landscapes)	

1 E.g. applied by; Crow White, Benjamin Hapern, Carrie Kappel: Ecosystem service tradeoff analysis reveals the value of marine spatial planning for multiple ocean uses, in: PNAS, March 20, 2012, vol 109 no 12, pp 4696-4701

Topic	Data originally planned / needed / deemed useful		Data obtained (source)	Data missing/ not obtained / problems encountered
	Scope	Detailed information		
Nature conservation	• Designated areas • Planned areas for designation • Other valuable habitats	• Types of areas • Status • Objects of protection / management objectives • Date of proposal • Date of approval, etc.	• Designated areas: NATURA2000, BSPA, IBA, Biosphere Reserves, national parks etc. (BSH, Maritime Institute Gdańsk / MOS, NERI, Metria, HELCOM, EU)	• Valuable habitats not comprehensively mapped yet
Boundaries	• Base line • Territorial sea • EEZ • Other		• DE/PL/DK/SE available, (BSH, HELCOM, Polish Ministry of Environment), • Additionally: disputed borders (MO Szczecin)	• Available data inconsistent in part
MSP	• Existing regulations • Current plans		• DE: Respective data sets of regulations (BSH, Energy Ministry M-V)	• PL, DK, SE: no such regulations yet
Planning context – development	• Information on the region, spatial / economical / social development on land, planning documents etc.		• DE / PL / DK / SE: Information and maps from planning documents - no data sets (planning agencies, regional / planning authorities)	• Often information not easily available as spatial data to assess relevance for maritime planning

Tab. 6: Data needs versus their real availability in the pilot MSP case of the Pomeranian Bight

BaltSeaPlan partners who were involved in pilot projects can account for many difficulties and unexpected complications during the course of data collection and creation of the plans.

The main problem was and remains **data availability/quality**. Although for chosen hotspots, usually in bays and along the coast, plenty of data on current uses and planned activities was easily available and up-to-date, in some cases it was problematic to obtain data sets representing areas further offshore[2]. Metadata, if available at all, frequently did not contain sufficient information. Some data sets only contained rudimentary information e.g. "geometry" but no further details on elements – sometimes additional information from other sources was necessary to be able to assess the data provided.

Restrictions on data access were another common obstacle for BaltSeaPlan pilot MSPs. Some of the data had to be purchased. Sometimes, to avoid legal problems, planners chose to use only the official map layers with legal status and published by the relevant authorities. This, in some cases, led to limitations in the scope of pilot plans and their informative value. It could be observed that some stakeholders monopolise information and impose restrictions that reveal only a biased picture, which forces spatial planners to draw conclusions desired by those very stakeholders. This has been noted with regard to environmental protection, fisheries, and national defence. Consequently, closed military marine areas have not been discussed, although they could potentially be suitable locations for other uses.

Data sets finally obtained for the pilot MSPs were frequently not only limited in quality, but also missing the **spatial attribution**. For example, adequate information on spatial distribution patterns of migratory marine species, including fish species and sea mammals, was missing, as was information on species of concern regarding over annual cycles or life cycles and seasonal patterns. Moreover, any data regarding the possible susceptibility of species of concern to natural and anthropogenic induced was missing. As a result, it was impossible to define marine ecological corridors (the so-called blue corridors). It was equally difficult to reserve marine spaces for recreational purposes due to the lack of reliable estimates on sea space carrying capacity for e.g. windsurfing or sailing.

[2] The CONTIS database (BSH) covers all German waters, and those of some neighbouring countries'

There was also a controversy as to the relevant **scales**: spatial and temporal resolution of the available data strongly limited resolution, and thus quality, of MSP in relation to spatial and temporal scales which can be actually resolved[3]. However, it has to be mentioned that different pilot project areas demanded different minimum resolutions: the case of the Pomeranian Bight (14,100 km2) was naturally less detailed than, for example, in the case of the Estonian Pärnu Bay (1,990 km2).

Transnationality of some pilot projects as well as the overall interdisciplinarity of MSP created additional challenges during **compilation of data into data sets/maps** required for the planning process. Data from different institutions, even on the same issue, were sometimes submitted in different formats: e.g. cables: some submitted in full length (e.g. across several countries), in part (only part within national waters), in many segments. Data were also provided in **different coordinate systems**. In case of transnational pilot areas, **language** and comprehensibility of information provided was also an issue during compilation of data sets.

Furthermore, BaltSeaPlan partners complained about the lack of **decision support models** for MSP e.g. from basic drifting models on oil spill diffusion up to complex models for assessment of policy options for the sustainable management of maritime space.

[3] e.g some fishery data are only available for the ICES rectangles which offer overgeneralised information with regard to the needs of MSP

5. Gaps and drawbacks of the existing solutions

This chapter summarises the most common gaps and drawbacks of the existing marine data infrastructure in the Baltic Sea Region with respect to maritime spatial planning. It is based on both analysis of the existing framework for maritime spatial planning (Chapter 3) and the practical experience gained in the course of the recent BaltSeaPlan pilot projects (Chapter 4).

The current information setup in the Baltic Sea Region can be characterised by:

- Decentralised data storage
- Administrative gap
- Knowledge gaps
- Restrictions on data accessibility
- Limited transferability of data and planning results

5.1. Decentralised data storage

As illustrated in Chapter 3, there is currently a multitude of initiatives and projects, both national and international, all aimed at providing, to some extent, unified marine databases. This boom certainly results from the attention the EU Commission has been giving the maritime policy in recent years, and its fruits are, among others, the EMODnet concept, WISE Marine, European Atlas of the Seas, MyOcean, but also the BaltSeaPlan, Balance, and PLAN BOTHNIA projects, to name just a few. Other more broadly marine or geospatial initiatives are also exploring ways of making use of oceanographic and other data for MSP. However, the great majority of these initiatives have a research character, limited timeframe and funds, and thus selective scope of data coverage. None can seriously claim to create an integrated database for a whole Baltic Sea basin. Only the HELCOM and CONTIS databases have the ambition and potential resources (plus in the case of CONTIS institutional capacity) to become integrated databases for the management and MSP in the Baltic Sea.

EMODNET, MDI-DE and INSPIRE geoportals neither have an MSP focus, nor they are finalised yet, but even now they should be regarded as potentially very useful for obtaining good quality, unrestricted maritime data free of charge.

No Baltic Sea Region country has an integrated marine database on the national level. However, many are currently implementing interesting networking attempts, usually driven by the need to implement the INSPIRE Directive. Various databases are currently being developed, partly available as Web Map Services or via geoportals. It is no longer the lack of databases, but their impenetrable complexity, which presents the biggest challenge for an integrated marine data infrastructure.

At the same time, it seems that nobody has any real intention of unifying the national/sectoral marine databases. It is in the interest of each institution to keep the data in their own databases, as giving them away would mean losing competence, and besides they have spent decades on surveying, collecting data and developing their databases. On the other hand, keeping the data in professional case databases might be a warranty for validated data sets and for geodata-products of high quality. The challenge is to create geodata-products that may be exchangeable with other case databases and thus accessible for MSP purposes.

5.2. Administrative gap

Except for Germany and since recently Sweden, none of the Baltic Sea countries has a clearly assigned responsibility for MSP. Indirect results of this institutional gap are the lack of the necessary policies, regulations, and policy integration. Poland, Lithuania and Latvia are currently undertaking efforts to create a

legal framework for MSP, and in Sweden a new state agency has been created which has MSP as one of its central responsibilities. In Poland, the responsibility for MSP will most probably lie with the Ministry of Infrastructure, in Lithuania and Latvia the Ministries of Environment. However, it needs to be mentioned that legal responsibility for MSP is often carried out by a different authority than those responsible for data gathering, data storage and data exchange (see Appendix 5 National MSP set ups).

The lack of a special appointed agency adversely affects all aspects of MSP, with greatest impact on framing the planning process and securing its continuity and adaptation. Therefore, although it was not the objective of this

report, BaltSeaPlan would like to recommend informal administrative solutions, which could help overcome, or at least temporarily bridge, the existing deficiencies.

5.3. Knowledge gaps

Another major problem is the still **insufficient knowledge** about the Baltic Sea environment. In the frame work of the national monitoring activities coordinated by HELCOM (COMBINE) a wide variety of marine components have been covered since the early 1980s (hydrography, plankton, benthos, harmful substances, oil spillages). Still, even the basic long-time datasets of the main hydrographical parameters are not yet coherently mapped . Information on migratory species like fish, birds and marine mammals are neither spatially nor temporally collected in a coherent fashion. The same is true with regard to the existing and planned uses in coastal and offshore waters. Exceptions are some hot spots, which are very well known, like the straits of the Western Baltic, areas of harbours or smaller bays. Sometimes – but not in all marine areas – the most striking data gaps are found in offshore areas where there is, as yet, not much economic development . At the same time, it is precisely those areas of the Baltic Sea that are of growing interest for MSP, as foresighted planning can be done much more effectively on a virgin sea space.

Data on marine habitats are especially only fragmentary and often too general. Some gaps were filled by the BALANCE project (currently within the HELCOM database), and the present large-scale habitat mapping projected by the Federal Agency for Nature Conservation will provide more clarity for the Natura 2000 areas in the German EEZ (both North Sea and Baltic Sea section). Research results are scattered and often provided along administrative, and not natural, borders. Another frequent uncertainty, as revealed by the BaltSeaPlan pilot projects, are the ship wrecks and other objects on the sea bottom, which can be easily destroyed by submarine activities. Sunken hazardous substances such as chemical weapons from World War II, large reserves of which still exist in the Baltic Sea, can present a threat to health and environment when disturbed.

On a higher level there is a lack of knowledge on cumulative impacts and interactions of human activities on the marine ecosystem. In terms of ecological information, it is still not clear which parameters are actually needed or are even suitable for maritime spatial planning. There are no established routines or procedures to "translate" ecological (and hydrographic etc.) data into relevant planning information. There is still a need for focused data compilation of other disciplines with regard to MSP purposes.

The "link" is missing which a) selects only the data which is really necessary/relevant for MSP and b) translates it into MSP relevant information (i.e. what does it mean for a planner if there is an area with oxygen deficiency).

Finally, **proper information tools for supporting decision-making processes** are lacking. BaltSeaPlan pilot projects noticed the main deficiencies in monitoring and assessment tools – or the lack of application of existing tools within MSP processes [4] that could have been used for tasks such as sample site selection, the choice and focus of compliance analysis, etc. Consequently, MSPs lack appropriate monitoring and evaluation systems. Relevant information tools for monitoring land-sea interaction such as those that can identify the types of anthropological pressure placed on coastal zones (e.g., urban or tourism pressure) are lacking.

Calculation of model results is a process following a case-to-case approach and it is difficult to standardise (unify) the results of models and cumulate (upload) these results into a database. Nevertheless, it is obvious that any Maritime Spatial Planner requiring data for new maritime uses would be supported by feasibility studies enhanced by model results. Therefore the demand for planning will be accomplished by modelling studies to support the MSP process. Model results could also be a solution for missing information because they can partially cover the data gaps.

5.4. Restrictions on data accessibility

One of the important goals of the INSPIRE Directive was to liberalise geo-data exchange by declaring research data in general a public resource. This is by far the hardest postulate to implement. Besides the administrative reasons mentioned above, it is clear that data about offshore activities (e.g. wind energy, pipeline projects), as well as ecological audits, have a considerable commercial value. As well as this, information on military exercise areas or planned national economic development projects could be considered as confidential from

[4] e.g MARXAN – in BSP applied within Pomeranian Bight Pilot Project

the political point of view. Many providers and owners of such data strive therefore to restrict accessibility, either by banning it completely from open circulation or by imposing fees.

As mentioned above, near shore issues are more or less well covered due to the continuous demand for such information, which is part of different monitoring programs, feasibility studies regarding new developments, port extension, coastal protection and other initiatives, but these data are project specific, with availability restrictions depending on funding source, confidentiality rules etc. There is no obligation to submit expensive marine research results/data to a unified database or responsible authority.

Since there is no real pressure from the INSPIRE Directive on organisations towards marine data (except for setting guidelines on how to collect them, but not setting strict lines on "what" to collect) it is considered rather to be volunteer work. Data shared on such premises are usually aggregations with low resolution and therefore of little value for MSP. Most of the marine geoportals listed in Appendix 6 offer only visualisations of data (of varying quality) without any possibility to download shapefiles or even metadata. They are therefore of only limited use for real spatial planning. Good quality and high-resolution data, is only difficult and expensive to obtain, since they are usually collected by private providers.

5.5. Limited transferability of data and planning results

The INSPIRE Directive provides requirements for dataset contents on a very general level only, without meeting all the needs of maritime spatial planning. Still, implementing it by all countries of the region would provide a good common basis (minimum standards) for further work.

Despite the current attempts of most member states to implement the INSPIRE directive, the marine data exchange in the Baltic Sea Region is still facing many administrative and technical obstacles. Existing databases are insufficiently linked and not always compatible (e.g. alpha-numerical vs. geo referenced data), even within one institution, not to mention regional and international differences. Translation of those parameters is not impossible, but entails a lot of unification work for the future MSP data exchange network.

6. Recommendations for a Baltic Sea Region Data Infrastrucure for Maritime Spatial Planning

BaltSeaPlan recommends the creation of a pan-Baltic data MSP infrastructure for up-to date, transferable, interoperable MSP relevant data and metadata.

> *A short version of these recommendations (Annex 1) has been approved by BaltSeaPlan partner institutions. It is designed to be endorsed by the relevant stakeholders from the Baltic Sea Region who are willing to contribute to the provision of Baltic-wide data storage, management and exchange basis for MSP. A formal agreement based on these recommendations would be in line with Art. 22 of the INSPIRE Directive, according to which Member States should take the necessary measures to prevent practical obstacles to the sharing of data, using, for example, prior agreements between public authorities". The directive should nonetheless be amended with regard to marine space and maritime features to cover all MSP relevant aspects.*

Target users of the data infrastructure would be maritime spatial planners, either representing public authorities (sometimes overlapping with institutions on levels 1, 2 and 3) or non-profit organisations such as environmental NGOs.

6.1. MSP Data Exchange Network for the Baltic Sea Region

6.1.1. Structure of Data Exchange Network

There is much discussion in MSP circles over whether there should be a single**, central agency** to head marine data exchange and storage. From BaltSeaPlan's experience, the centralisation of existing national and sectoral competences is neither possible nor really desirable. No administration or institute would be willing to voluntarily give up their competences or the information they have collected and processed for sometimes decades. Even more difficult would be negotiations with the commercial data owners, who are becoming a dominant player on the Baltic marine data market due to expansion of large investment projects.

The proposal for a data infrastructure by BaltSeaPlan attempts to provide an integrated tool for MSP, however its strength should be seen in **networking within the existing structures**, rather than in an unrealistic centralised solution. Existing networks such as the HELCOM/VASAB WG on MSP should be considered for building up the data exchange network. Good practice examples could be given by the currently developed national initiatives such as MDI-DE or the Swedish National Geodata Strategy.

Nevertheless, effective networking will require coordination and, to some extent, maintenance of a data (knowledge) base as described in Chapter 5. Proposed below is the possible structure of such a network, consisting of the following functional levels:

1) **Pan-Baltic MSP Data Coordinating group** – The Pan-Baltic MSP Data Coordinating Group should consist of representatives from the National MSP Data Contact Points. Its tasks should be: managing the Baltic MSP Infrastructure, making available pan-Baltic MSP relevant data sets, creating harmonised Pan Baltic MSP relevant data sets from national data etc. and maintaining links and communication with relevant similar initiatives and networks (in Europe as well as worldwide)..

2) **National MSP Data Contact Points** – making national MSP relevant data available to MSP Infrastructure: This would be the public authority responsible for the coordination of the data flow on a national level and streaming it in regular intervals (proposed six months) to the central database. It is recommended that this authority at the same time is the authority responsible by law for maritime spatial planning in the given country. Alternatively, it could, but does not necessarily have to be, the INSPIRE contact point.

3) **Regional MSP Data Points**, which make regional MSP relevant data available to the MSP infrastructure in cooperation with National Data Contact Points: This might be an issue for larger states (e.g. Poland) or federal states (Germany) where it might be necessary to create an intermediate level as a focal point for regionally produced / administrated data.

4) **MSP Data Providers,** offering their data to the regional / national MSP Data Contact Points according to the rules set.

A permanent **MSP Data Expert Group** in an advisory capacity to the Pan-Baltic Data Coordinating Group should be created from spatial planners and GIS experts from all BSR countries with further experts on relevant issues to be appointed and/or consulted as necessary. Among its tasks should be:

1) monitoring and proposal of improvements to the content of pan-Baltic data sets and the data exchange system,

2) providing methodology for MSP in relation to data needs and management, and advice on gaps to be filled,

3) ensuring the link to the other data networks as mentioned above,

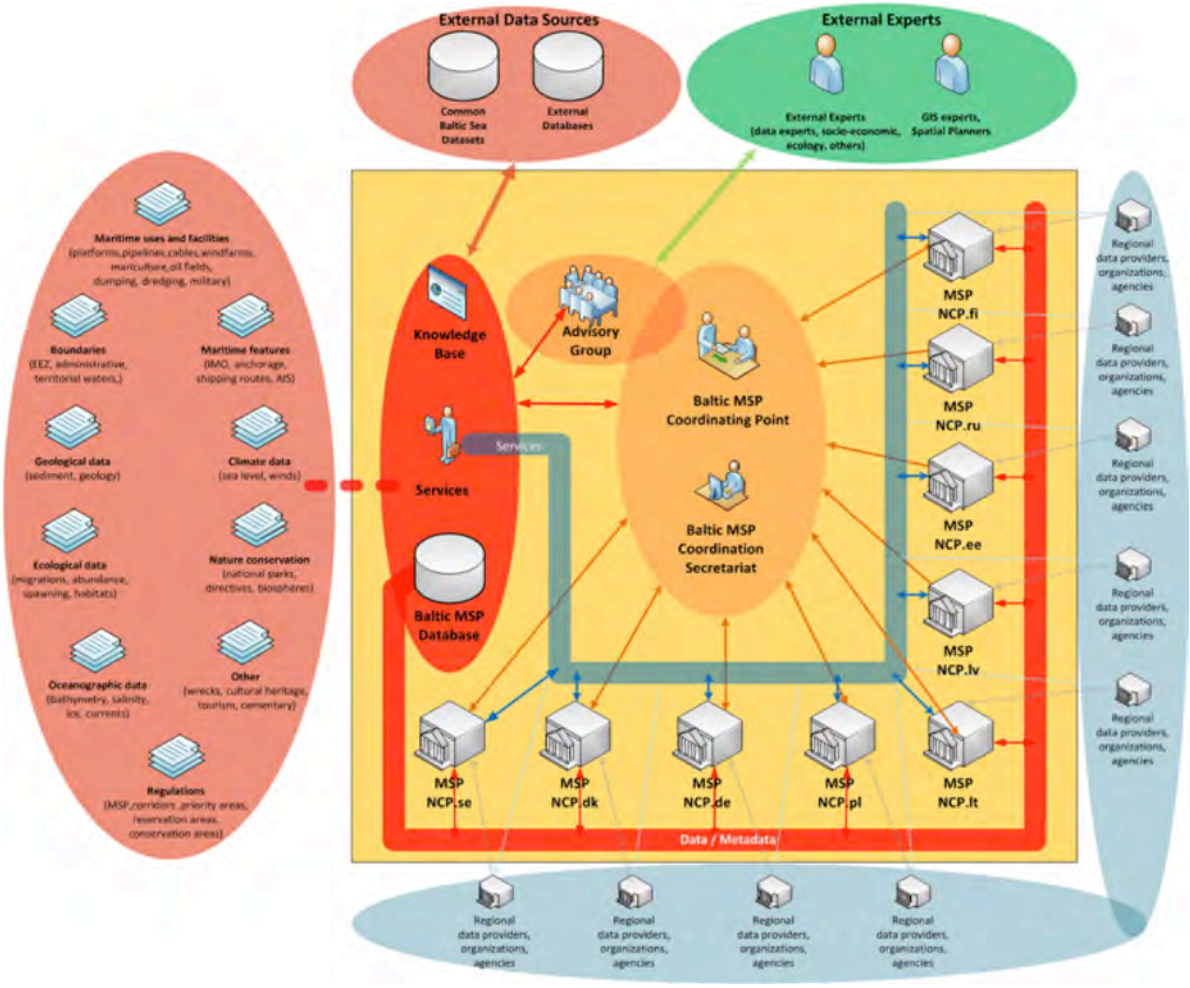

Fig. 6.1 Structure of data exchange network for Pan-Baltic MSP

The Expert Group should consist of at least one member and one deputy member from each BSR country. Their qualifications could range from GIS to spatial planning, maritime governance or intellectual property law. In order to put the BaltSeaPlan network into a wider context, it would be of advantage if some members of the group were at the same time members of HELCOM-VASAB MSP working group, BOOS, ICES or other European data networks as well as of the Transnational MSP Coordination Secretariat (as suggested in BaltSeaPlan Vision 2030).

The permanent group should hold presence meetings at least twice a year, and maintain working contact in order to solve ongoing problems. Its activities could be financed e.g. from the EU transnational cooperation funds e.g. INTERREG or BONUS.

The approach to private sector marine data users/providers is discussed below. Generally, the network is very open for cooperation with them, but conditions of data sharing can vary from those in the case of public authorities, and should be negotiated case-to-case. This also is one of the tasks of the **Expert Group**.

6.1.1. Resources

Baltic Sea states should grant adequate financial and organisational resources for securing the implementation and maintenance of a sustainable MSP data network and infrastructure..

National MSP (incl. data) contact points, the MSP Data Coordinating Point (as well as a potential secretariat), the expert group etc. should be given sufficient funds, skilled personnel etc. to conduct and maintain appointed tasks within the BSR MSP data network.

6.2. MSP Data Exchange Portal for the Baltic Sea Region

6.2.1. Data storage

There could be two possible approaches to building a MSP data infrastructure for making data available for MSP purposes. The first is to store the information in one place. This means all institutions should transfer their data to one central database. The second is to store all metadata information in a central database with online connection to the national databases with MSP relevant information.

Among maritime spatial planners there is consensus that a pan-Baltic information system for MSP should follow the second approach, i.e. be based on a network of existing databases, follow EU standards (INSPIRE directive), be regularly updated and flexible for further development of the MSP and licensing processes in different countries.

Having an informal agreement and guidance in form of the Recommendations, the **integrated Baltic Sea marine database** could be created, according to the model described in Chapter 6. To stress it once more, this database would not be a replacement, but merely an integration of relevant spatial data from the existing, networked data bases.

For practical and cost-effectiveness reasons, the data base should store only the metadata sets relevant for spatial planning. Raw data and back-ups of the data base can be stored on modern external data storage destinations like the world data centres or other cloud-like solutions.

Data exchange should be facilitated via a **Baltic Sea MSP data portal**, offering digital map and geo data services. These could be linked and/or integrated into individual applications.

All registered users of the network would be entitled to unrestricted searching, viewing, downloading and processing of the data.

In turn, they shall make available to their respective National/Regional MSP Data Contact Point the products the data has been used for and/or provide their data according to

1) The legal policy as described in 6.3,

2) formal requirements like data input format specified in the data specifications (Annex 7)

. National/Regional MSP Contact Points should provide for updated data sets in the data infrastructure in regular 6-month intervals – for issues facing dynamic development and rapid changes. Updating intervals for other issues should be fixed as necessary.

6.3. Legal Policy

In terms of legal agreements on transnational data exchange and storage for MSP purposes, **BaltSeaPlan Recommendations** will provide an important tool for cooperation between state agencies, other public stakeholders such as scientific institutes and various other data users/providers.

As described in Chapter 4, **restrictions** on data use are one of the biggest problems currently faced by marine spatial planners. Although implementation of the transparent public data policy of the INSPIRE Directive in all BSR countries would certainly ease the problem, even this directive allows public authorities, in particular those that “have a duty to raise revenue“ to impose “reasonable“ charges on their data services. It also seems over-idealistic to expect that data flow can become freer in future. Probably the opposite will be the case, since increasingly the spatially vital information is produced during commercial projects and less by public agencies, which are frequently lacking funds for coherent marine research.

Unless a new, more restrictive EU law imposes hard regulations on private data owners, the data market will further decentralise and privatise, and spatial planners have to learn how to cope with this.

The pan-Baltic data infrastructure and network structure proposed here can provide at least a partial solution to this problem, by encouraging all its members whether public authorities, or non-profit institutions and organisations to follow an **internal no-cost, no-restrictions policy**. In this way at least the amount of data produced already used in MSP projects e.g. in the course of statutory activities of public institutions or EU founded projects can be tapped and made available to all registered data base users (planners). The BaltSeaPlan data base also has a solution for duly restricted/commercial data entrusted by its members: in this case only the associated metadata and products will be published.

The authors of this study are convinced that the application of the above proposed internal legal policy by a sufficiently large circle of BSR public stakeholders has the potential to persuade commercial data owners/marine entrepreneurs to voluntarily join the network and make part of their measurement results available at no or low cost in exchange for reliable, good quality spatial information. In the end, coherent data basis and transparent data sharing structures are in the interest of all, both public and private stakeholders.

Furthermore, BaltSeaPlan MSP pilot projects confirmed that there is still much research and surveying to be done in order to fill data gaps in offshore areas, especially on marine biodiversity. This information is urgently required for the application of an ecosystem-based approach to MSP. Considering the high costs of marine surveying, it should be the responsibility of the European Union to initiate the relevant research programmes. Research is also needed on the impact of different scenarios of sea exploitation and climate change. Such research agendas have to be set nationally, however they should be coordinated internationally, e.g. through the above mentioned coordination body.

Public authorities involved in the data exchange network proposed by BaltSeaPlan MSP can contribute to reducing knowledge-related gaps by creating a demand for information, integrating different sources and information providers, and regulating the flow and dissemination of information. National MSP Contact Points should be developed to ensure proper links with terrestrial spatial planning.

Considering the low level of awareness of MSP issues, the network proposed by BaltSeaPlan should also serve a capacity-building purpose. It should have learning functions allowing for the presentation of conceptual ideas and good practices, as well as the exchange of opinions based on concrete planning examples. This, in turn, would probably stimulate a serious debate among spatial planners, thus contributing to improvement of the MSP methodology (Zaucha, 2011).

The pan-Baltic data infrastructure should draw on unrestricted and free of charge data produced e.g. in course of statutory activities of public institutions, or publicly funded projects. Other data on spatially relevant activities and functions should be made available as far as possible. In case of duly restricted/commercial data, only the associated metadata and products will be made available via the network.

The proposed networking structure is similar to the cadastre model currently applied in the German terrestrial spatial planning system, where all relevant authorities and companies are obliged by law to provide certain data to a coordinating unit at regular intervals. The law also specifies the format and other parameters of required data. Once it is ready, the data are accessible to all registered users.

The idea behind an integrated pan-Baltic database for MSP purposes is that spatially relevant information should be stored in a central database in each country (National MSP Contact Point). All private and public data providers should be obliged to pass on spatial information with the best available resolution.

Using the proposed networking structure: national/regional contact points permanently collect data from decentralised private and public data providers, which in turn provide **6-monthly up-dates** to the database managed by the Coordinating Body. To facilitate data exchange, all inputs shall be accomplished according to unified input templates. For standard data, format input should be almost automatic (depending on the software implemented).

BSR authorities agreeing to such an exchange modus could be a large step towards simplification and cost-efficiency of MSP.

6.4. Content-related aspects - MSP Data Specifications

Before all kinds of data are collected and stored, it is worth remembering that MSP is about space. Although basic environmental parameters provide essential knowledge for planners, the main purpose of data collection is to assess current patterns of use, with additional focus on spatial needs and potential future spatial demands. Therefore, when we speak of MSP data, we mean those which provide information on space and spatial impacts.

One conclusion from the BaltSeaPlan pilot projects has been the necessity of arranging data in a hierarchy of importance at the very beginning of the process. Great emphasis should be placed on the issue ofwhich data are indispensable ("must have"), and which are of minor importance ("nice to have") for drawing up the plan. This has an essential impact on the whole planning process, inclusive of cost and time.

These problems can actually be solved if all relevant information is really given. For example, in the case of data on fishery activity, the problem is that one would need a lot of time/money to buy the data if wanting to start from the beginning with raw data. At the same time, the available compiled datasets were processed for purposes other than MSP, so that it was impossible to combine them into a homogenous, reliable dataset.

The MSP data infrastructure should be based on jointly accepted lay-out and specifications with regard to data issues, data scope, formats and technical requirements.

6.4.1. Scope of Data

The MSP data infrastructure should be based on agreed lay-out and specifications with regard to data issues, data scope, formats and technical requirements etc.. This must be in line with the INSPIRE Directive, which should be amended with regard to marine space and maritime features to cover MSP relevant aspects. The data sets of the MSP data infrastructure should cover all MSP relevant issues. A basic or minimum range of information for MSP purposes must be defined, which should be further developed and extended as required.

Here a proposal is made for the most important / minimum or "must have" data issue and information and further "helpful", "nice-to-have" data – of course to be amended with new information and data as available:

Basic information:

- boundaries, bathymetry
- administrative context sea: boundaries at sea,
- physical / biological context:. Relevant data with regard to ecology incl. habitats / geology / oceanography / climate data, indices (vulnerability, biodiversity etc.)
- human activities (present / planned / relevant former activities/functions)
- designated areas and regulations (MSP/national, IMO, EU/EC, etc.)
- designated areas for nature conservation (national/EU/HELCOM/UNESCO etc.)

6.4.2. Integration of ecological and other environmental data

Due to the integrated nature of MSP and its affinity to the ecosystem approach (underlined i.e. . in the EU Water Framework Directive, Habitats Directive and the EU Marine Strategy Framework Directive) good quality environmental data are necessary as a basic information layer for all further planning and management assumptions. A proper characterisation of the marine environment should encompass the seafloor, the water column and the coast/adjacent terrestrial areas.

Whereas the coordinates of **marine protected areas** such as those NATURA 2000 or HELCOM MPAs are relatively easy to identify, there is only little and scattered information on the types of marine habitats, both outside and frequently also within the protected areas. Even the HELCOM database is not a reliable source of environmental information, for instance there is no data for Zostera meadows along the Southern Baltic coast. Zostera mapping in Polish coastal waters should have been made in 2011, but has been postponed due to shortage of qualified staff. Low prioritisation of environmental monitoring tasks is a trend also visible in other countries.

All coastal member states are obliged to undertake a **systematic monitoring** of the ecological status of marine waters according to the Framework Water Directive. For chosen parameters/species a great volume of data is thus produced systematically, however these raw data are difficult to apply for spatial planning purposes.

In order to make spatial planning assumptions, it is necessary to translate the complexity of the environmental information into **parameters (indices)**, which can be used in assessment for planning purposes.

Integrating ecological data with spatial data from other sources presents serious challenges. First, spatial data from different sources exist at different spatial resolutions and require careful treatment in relation to their scope of application, comparability and validity. Secondly, adopting ecosystem modelling for decision support processes and resource management requires good data organisation and visualisation concepts. Existing GIS tools and techniques can overcome these challenges and allow different types of data to be combined at their original resolution with the benefit of not adding or removing information, thus avoiding over-interpretation of spatial patterns and linkages between different parameters. In summary, compiling and integrating a large variety of multi-disciplinary data from different sources (including modelling) through GIS tools and techniques is a useful way of providing target-orientated, multi -functional maps to support spatial planners and scientists.

6.5. Technical requirements

6.5.1. Scales

The scale of spatial data depends largely on the subject of the planning and planning area, on necessary standards and the effort possible / necessary to put into planning. Marine surveying, mapping and modelling are costly and time-consuming endeavours and naturally require a compromise between available resources and desired spatial resolution. Therefore a carefully conceived sampling and modelling strategy which determines the minimum sufficient resolution is the key to success.

Different countries in the Baltic Sea Region now apply different scales in their statutory or pilot spatial planning initiatives. These vary from 1:15.000.000 (the whole Baltic Sea), through 1:1.000.000 (regional waters) to 1:50.000 for local MSP and even larger scale for particular projects like offshore wind parks. Each country, depending largely on the size of their marine territory, has different ideas as for “the” suitable MSP scale. A comparison of those different planning scale recommendations with the resolutions achieved by the popular surveying and modelling techniques clearly illustrates the mismatch between required management scales and available scales from survey and modelling efforts. In order to allow for the integrated database and data compatibility in international spatial plans, BaltSeaPlan should therefore propose scale recommendations for data providers.

What is meant are not fixed scales (GIS maps are flexible and can be zoomed according to needs and even size of print-out!), but **minimum resolutions** set for each of the planning steps. Zooming-out is always possible, but zooming in can be a problem, as poor resolution of some data simply does not allow for it. The general conclusion is that regional MSPs should provide an overview without much in the way of spare detail, whilst local plans must show much more specific detail. This will result in a cascade of plans – large-scale activities such as shipping routes may be looked at on a small scale, but certain areas might be looked at on a much bigger scale, e.g. harbour areas, areas of conflict with habitats, other activities (offshore installations etc.).

BaltSeaPlan’s recommendation, which could also be included in the Memorandum of Understanding, is therefore to introduce an approach inspired by nautical charts such as ECDIS, IHO or MyOcean. In this model, there are several scale levels, which allow for planning on different MSP ranges. These scales **imply the minimum resolution of data** on each level, and one can only get to the larger level by zooming into the map (different information is visualised at different levels).

The authors of this study recommend the following 6 scale levels:

1 min 1: 15,000.000 for the whole Baltic Sea MSP

2 min 1: 2,000.000 for larger regional area (e.g. Pomeranian Bight) MSP

3 min 1: 1,000.000 for medium regional area (e.g. Polish EEZ) MSP

4 min 1: 500,000 for small national or regional MSP (e.g. Latvian EEZ) MSP

5 min 1: 250,000 for local MSP (e.g. Gdansk Bay)

6 1: 10,000 and larger for project level planning (e.g. offshore wind parks)

For visualisation purposes, e.g. during the consultation process, it is important that the MSP in question fits on a handy (max. A1) sheet of paper, while still containing all the relevant information. Also for this purpose one of the above levels should be chosen (depending on the size of the area).

In case of missing data of higher resolution, a current approach in GIS analysis and cartography is to resample raster datasets with low resolution to fit better to the scale or resolution of the map or other datasets. This leads to a nominally higher resolution without gaining additional information. This was done for example within the BaltSeaPlan project in a study on offshore wind power site selection in the Pomeranian Bight (section IV, chapter 4) to make the resolution of the average wind speed (9 nm) comparable to the working scale (1 km) in order to avoid artefacts which would be caused by the low resolution. Since simple interpolation was applied and not a model , the wind shading effects of the coastline were neglected and the gradient close to the coast was expected to be too small. In other cases the technical resolution can be misleading. For Danish waters an older dataset with a resolution of 25 m is available and if you just skim through the description you might assume even higher input resolution, but the dataset shows less detail in large parts than the up-to -date dataset with 50 m resolution. Therefore, a proper description of original sources and methods in the metadata is essential (BALTSEAPLAN 2011, 37).

6.5.2. Metadata input formats

Concerning the multitude of existing templates and schemes for metadata input which are currently used within the Baltic Sea Region (e.g. with regard to exchange of data, visualisation, reliability, correctness, actualisation etc.), it is one of the most important prerequisites of the integrated database that all stakeholders agree on one meta data format.

INSPIRE Directive and ISO 19115Core/19119 requirements should be taken into consideration, and also the best practices from existing databases should be used, as opposed to inventing something completely new.

Below is the proposal of metadata input template discussed by BaltSeaPlan partners:

INSPIRE Part			Example
B 1	Identification		
B 1.1	Resource Title	Title	Image2000 Product 1 (n2l) Multispectral
B 1.2	Resource	Description	IMAGE2000 product 1 individual orthorectified scenes. IMAGE2000 was produced from ETM+ Landsat 7 satellite data
B 1.3	Resource Type		Dataset
B 1.4	Resource Locator	Location of the Data	http://image2000.jrc.it
B 1.5.	Resource Unique Identifier		
	Code		image2000_1_nl2_multi
	CodeSpace	URL	http://image2000.jrc.it
B 1.7	Resource language*	Language abbreviation, code list* (i.e.: Danish - dan, English - eng, Estonian - est, Finnish - fin, German - ger, Latvian - lav, Lithuania - lit, Polish - pol, Swedish - swe)	eng
B 2	Classification of data and services		
B 2.1	Topic Category*	choose from GEMET Thesaurus	imageryBaseMapsEarthCover
B 3	Keyword		
B 3.1	Keyword Value	choose from GEMET Thesaurus	Land cover
B 3.2	Originating Controlled Vocabulary		
	title*	GEMET Thesaurus, INSPIRE themes	GEMET Thesaurus version 1.0
	reference date*		
	date		2001-01-01
	date type		publication

B 4	Geographic Location		
B 4.1	Bounding Box	define a rectangle containing the area covered by data	
	West	westBoundLongitude	+3,93
	East	eastBoundLongitude	+7,57
	North	northBoundLatitude	+52,1
	South	southBoundLatitude	+54,1
B 5	Temporal Reference		
B 5.1	Temporal extent		(for example: From 77-03-10T11:45:30 to 2005-01-15T09:10:00)
B 5.2	Date of publication		2000-01-01
B 6	Quality and validity		
B 6.1	Lineage	General explanation of the data producer's knowledge about the lineage/quality aspects of the dataset	Product 1 scenes correspond to the path/row of the Sandsat orbit. All Image2000 product 1 scenes are ortho-corrected
B 6.2	Spatial Resolution		25.0
B 7			
B 7.1	Specification		
	title		INSPIRE Implementing rules laying down technical arrangements for the interoperability and harmonisation of orthoimagery
	publication date		2011-05-15
B 7.2	Degree	Information about the degree of conformity with the implementation rules provided in Art. 7-1. ISO 19115	true
B 8	Constraints related to access and use		
B 8.1	Conditions applying to access and use	description of terms and conditions, including where applicable, the corresponding fees (i.e. link)	no conditions apply
B 8.2	Limitation on public access		no limitations
B 9	Responsible Organisation		
B 9.1.	Responsible party		
	organisation		Joint Research Centre
	e-mail		image2000@jrc.it
B 9.2	Responsible party role		custodian
B 10	Metadata		
B 10.1	Metadata point of contact		
	organisation		Joint Research Centre
	e-mail		image2000@jrc.it
B 10.2	Metadata date format		2005-04-18
B 10.3	Metadata language	see B 1.5	English

Tab. 7: Proposal of metadata input template

To meet INSPIRE requirements as well as ISO 19115Core:

*B 1.7: dataset language should be defined, even if the resource does not include any textual information

*B 2.1:TopicCategory according to definitions in B 5.27 of ISO 19115

*B 3.2/B 5.2: the date of publication, revision or creation of the resource shall be given, while INSPIRE Temporal Reference may also be expressed through Temporal Extent (B 5.1)

* the dataset character set should be according to ISO 10646-1 or else should be defined in ISO 19115

6.5.3. GIS systems and libraries

Use of modern Geographic Information Systems (GIS) offers a variety of applications, which make it challenging for planners to select those technical options best suited to a particular planning task.

The data model proposed in this document is intended to be compatible with GIS tools developed both by commercial companies and independent communities as freeware, open source and public domain applications. For further information on the most popular and widely available systems, libraries and GIS tools are discussed in Appendix 3.

Factors such as price and available time and skills of staff play the biggest role in the choice of a suitable GIS software. As a rule, open source solutions are only apparently cheaper, as they require a lot of time-consuming customising and fine-tuning work. All this should be carefully calculated.

> The authors of this study would not like to recommend one GIS system clearly over another. It is also no longer necessary that all institutions taking part in a transnational MSP data exchange process apply the same software – all providers, both commercial and the open-source strive to make their products as compatible as possible. A shapefile as a digital vector storage format for storing geometric location and associated attribute information was introduced by Esri ArcView GIS in the beginning of the 1990s. Nowadays it is possible to read and write shapefiles using a variety of other commercial and free programs.

7. BaltSeaPlan data infrastructure set-up and database model

This section describes conceptual and logical data models for an integrated panBaltic system for Maritime Spatial Planning purposes. Both models are designed on the basis of functional requirements gathered during process analysis.

7.1. Requirements towards the model

The database envisaged as a possible outcome of this study is not intended for general use, in contrast to to some other current geodata initiatives. It is strictly targeted at potential users of the database, i.e. national authorities and institutions dealing with maritime spatial planning, international organisations as well as spatial planners and the related academic or scientific institutes. In some cases (Germany, Poland) these will already be BaltSeaPlan project partners and associated organisations, but the network is eventually intended to cover all institutions responsible for MSP in the whole Baltic Sea basin.

User requirements for the data model and general functionality which have a strong influence on the conceptual and logical data model have been discussed during direct consultations with users/stakeholders of the BaltSeaPlan.

The main requirements towards an integrated MSP database as identified throughout the BaltSeaPlan project are:

- Applying jointly agreed quality criteria and contents
- Following INSPIRE regulations
- Complete, consistent transboundary datasets
- Generic and universal (for future developments)
- Convenient tools for data search/browsing
- Solution for raw data storage
- Full metadata description, hyperlinks to text
- Open for all data providers, continuously updated
- Providing data and methods for Strategic Environmental Assessment and other kinds of assessments.

The long term goals for the pan-Baltic MSP data infrastructure are that it should:

- Generate increased benefits for society through the use of data based on cooperation across organisational boundaries at the lowest possible price.
- Link information resources in a network and make them available via homogenous services and uniform descriptions of the information.
- Serve all stakeholders of the MSP process and satisfy demands at local, regional, national, and transnational level.

7.2. Conceptual model

The concept of a System for MSP is based on data related to MSP (oceanography, geology, climate, maritime uses, maritime features, ecology, administrative data and regulations), collected and provided by Institutions involved in exploration of the sea. Following INSPIRE regulations such data should be maintained as near as possible to the source of origination. Such constraints force a model of a distributed data management system with a central index of data collected and available for MSP purposes and a committee (BSR MSP Committee) responsible for the development of data standards, and policy, and assuring the high quality of information system content. In Fig. 6.1 the spatial distribution of the MSP Data System shows the locations of the proposed structure of National Contact Points for MSP (MSP NCP.xx) and the association with the Pan-Baltic Coordinating Point (BSR MSP Committee) aggregating Advisory Group and Knowledge Base for MSP.

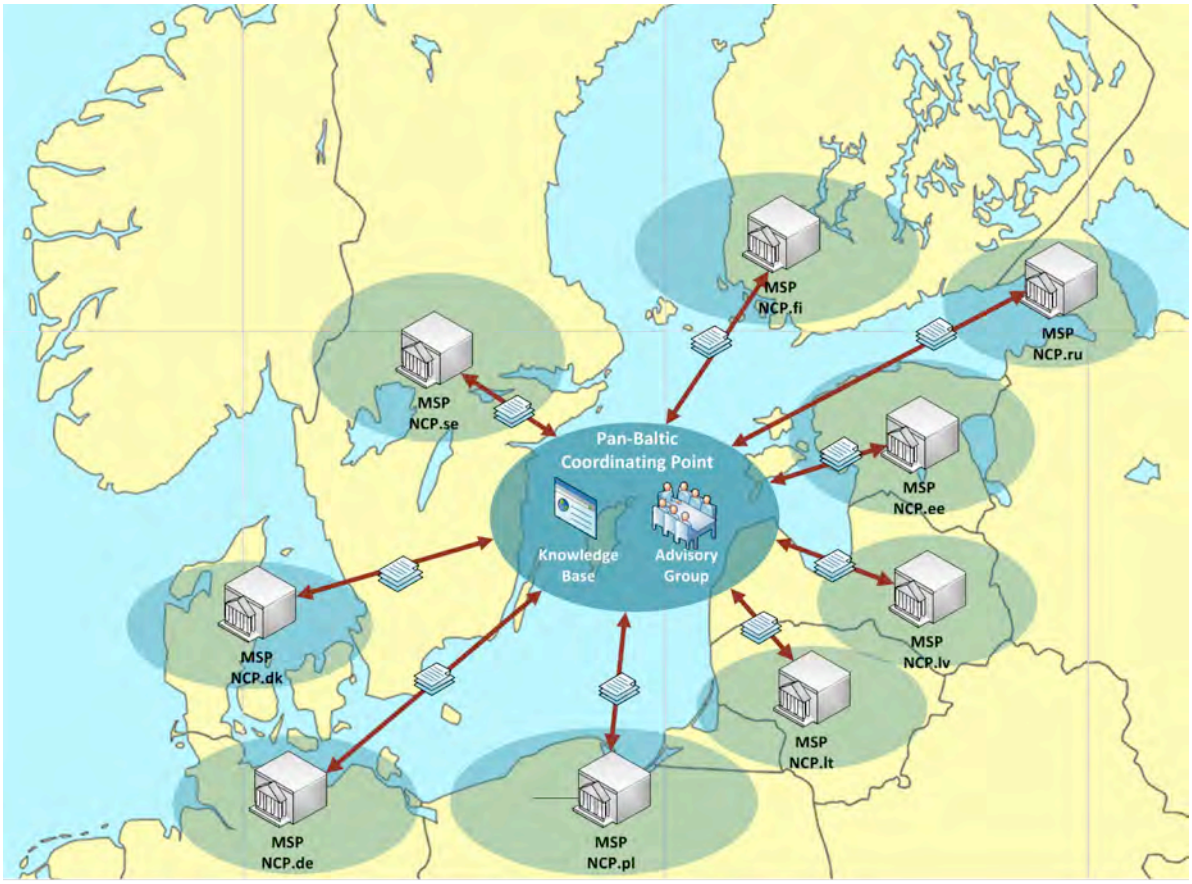

Fig 7.1: Spatial distribution of MSP Data System

In the Baltic Sea Region other data sources are available. Also very important, but not shown on the diagram are the following sources of data and information : ICES Data Centre (fishery, biological parameters, VMS/AIS , hydrology), BOOS (Baltic Operational Oceanographic System) data repositories, HELCOM Map and Data Service (indices, other availability and resolution of other parameters have to be verified in the future) and a network of data services developed within the EMODNET initiative. Availability of data within BOOS member organisations is presented in Table 8.

Organisation	Data on:
BSH/ Germany	currents, models, water level, waves
CMR / Lithuania	sea level
DAMSA / Denmark	hydrology
DMI / Denmark	hydrology
FMI / Finland	water level, waves, temperature
IMWM / Poland	water_level
IOPAS / Poland	hydrology
IOW / Germany	hydrology
LHMA / Latvia	hydrology
MIG / Poland	models
MSI / Estonia	hydrology
NWAHEM /Russia	water level
SMHI / Sweden	forecasts, observations
SYKE / Finland	biology
UL / Latvia	hydroecology

Tab. 8: Availability of data within the BOOS Data System

Network members should be able to deploy mechanisms to provide data in standard formats, thereby enabling data and information exchange processes inside the proposed system in the longer time frame. These mechanisms are also able to ensure the level of data quality required for planning procedures . Data originating from third party sources have to be processed to flag quality assurance of the data sets, to convert data sets to a format appropriate for planning purposes and to ensure data availability for further processing (e.g.

validation of the spatial plan, coherence of the plans developed for the same geographical extent, reference for plan documentation) in the long time perspective. Prospective functions of the Baltic MSP Knowledgebase include: quality assurance, electronic data transform and load functions, a replication system for data originating from third party sources, management of the index of data availability, supported with search engines allowing data search using thematic, spatial and time criteria and information management for the Baltic MSP. To control the system and keep it operable (in the meaning of legal identity, development of the data policy and internal agreements) it is necessary to establish a committee for BSR MSP.

The general model of data flow within the BSR MSP System has been presented in Fig. 6.2. The principle of the model is propagation of data objects requested, as acquired from a variety of sources and integrated both by MSP Partners and third party systems into the BSR MSP collection if the required level of quality is preserved. Data could be processed and used to generate a variety of products suitable for MSP processes.

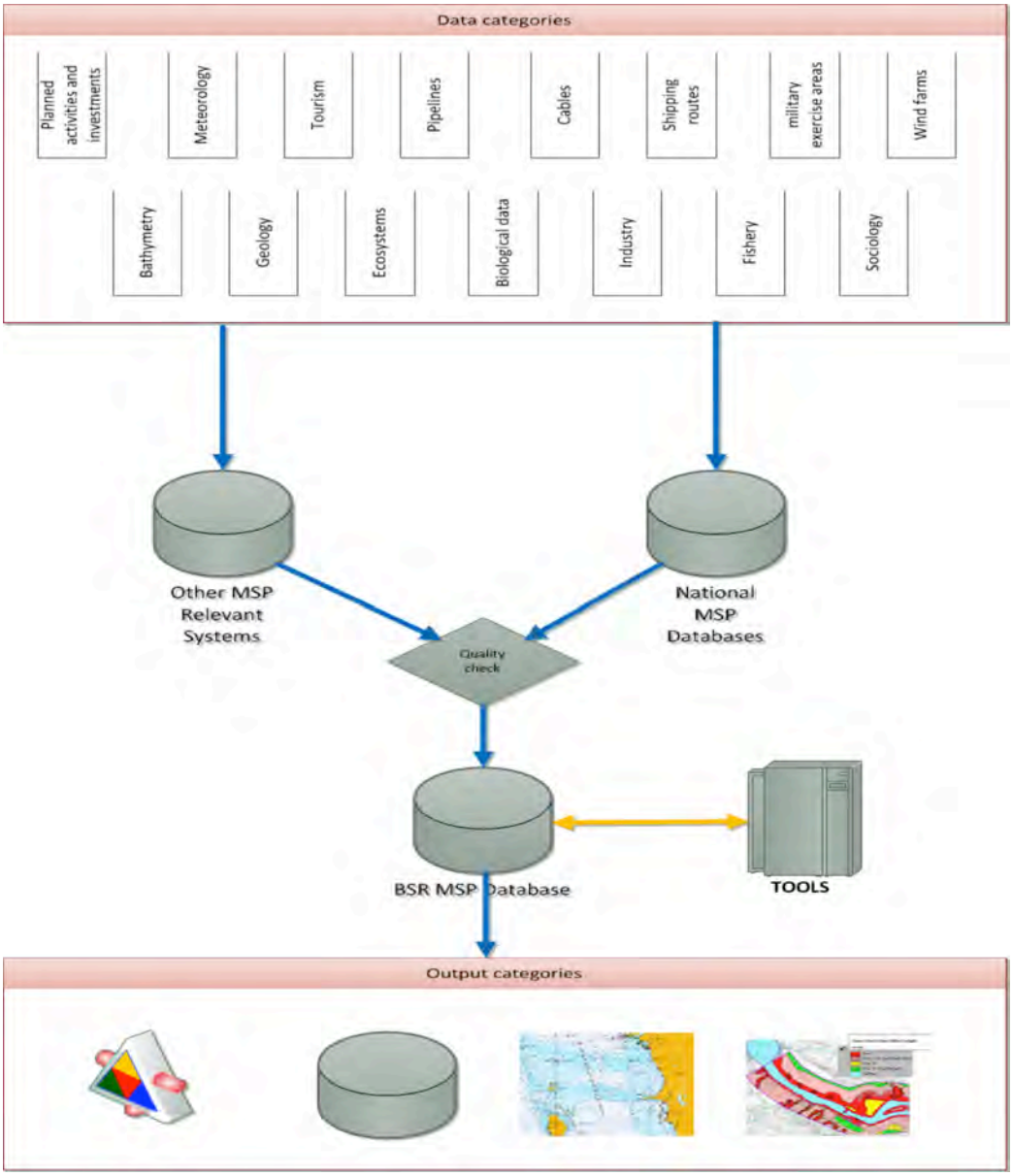

Fig. 6.2: General model of data flow

Data processed during MSP could be divided into the categories presented in figure 6.2. These categories are as follows:

- Offshore wind farms: All wind farms planned, approved or constructed in the pilot area
- Shipping routes: Maritime regulations (IMO, TSS, other categories); Shipping intensity – frequency of use – present situation, predicted development, number of ships, type of ship (bulk carrier, tanker, container carrier, ferry), regular connections / routes (ferries), fishing traffic, leisure traffic, ports / areas,

roadsteads, anchorages, obstacles (wrecks etc.), closed areas / access restrictions, danger areas (ammunition etc.), accidents / strandings / collisions, oil spills, pollution (air / water)

- Cables: All submarine cables, existing cables, planned cables
- Pipelines: All submarine pipelines, existing pipelines, planned pipelines
- Industry: Platforms (existing platforms, planned platforms), sand and gravel extraction (existing areas, planned areas), gas / oil extraction (existing areas, planned areas), other mining, related information (CCS, brine etc.) (existing areas, planned areas), dredging (existing areas, planned areas), dumping (existing areas, planned areas)
- Tourism: Submarine heritage, submerged historic settlement areas & sites, wrecks, important tourist areas (land/sea), tourism infrastructure, leisure traffic
- Military Exercise Areas: Existing areas, planned areas
- Fishery: Fishing effort, target species, fishing gear, fishing seasons
- Ecosystem and Biology: Habitats, bird migrating routes, bird numbers, fish spawning areas, fish nursing areas, Nature conservation, Designated areas, Planned areas for designation, Other valuable habitats
- Meteorology: meteorological information, wind conditions (speed etc.), extreme weather conditions etc.
- Geology, Bathymetry, Oceanographic information: Currents, Salinity, Hypoxia / anoxia, Temperature, Stratification, Ice conditions, Water levels / highest floods, historic water levels, hazardous substances / particles, eutrophication (nitrate etc.), geology / geomorphology, Bathymetry, Seabed / morphology, geology / sediment characteristics, development of seabed (dependent on changing water level),
- Administration, Sociology, Planning Context: Boundaries, Base line, Territorial sea, EEZ, development on land, demography, economic situation, planning objectives, MSP, Existing regulations
- Planned Activities, Investments: Current plans, MSP, planning objectives, Planned areas for designation.

Analysis of a possible data model for the knowledgebase and distributed data management system based on the “Guidelines for Data Submission in the Framework of BaltSeaPlan”, standards of data and metadata structures developed by standardisation organisations, presented in section 3.1.4 and descriptive language of geographical features (GML) provided by OGC and development status (functionality and availability) of systems supporting MSP processes.

7.3. Model of geographical, time and textual attributes

Geographical Information Systems generally, and for MSP purposes in particular, have to be enabled to exchange information with other systems operating in the GIS domain. The way to assure such functionality is to deploy Geographical Markup Language schemas into the data model of MSP system.

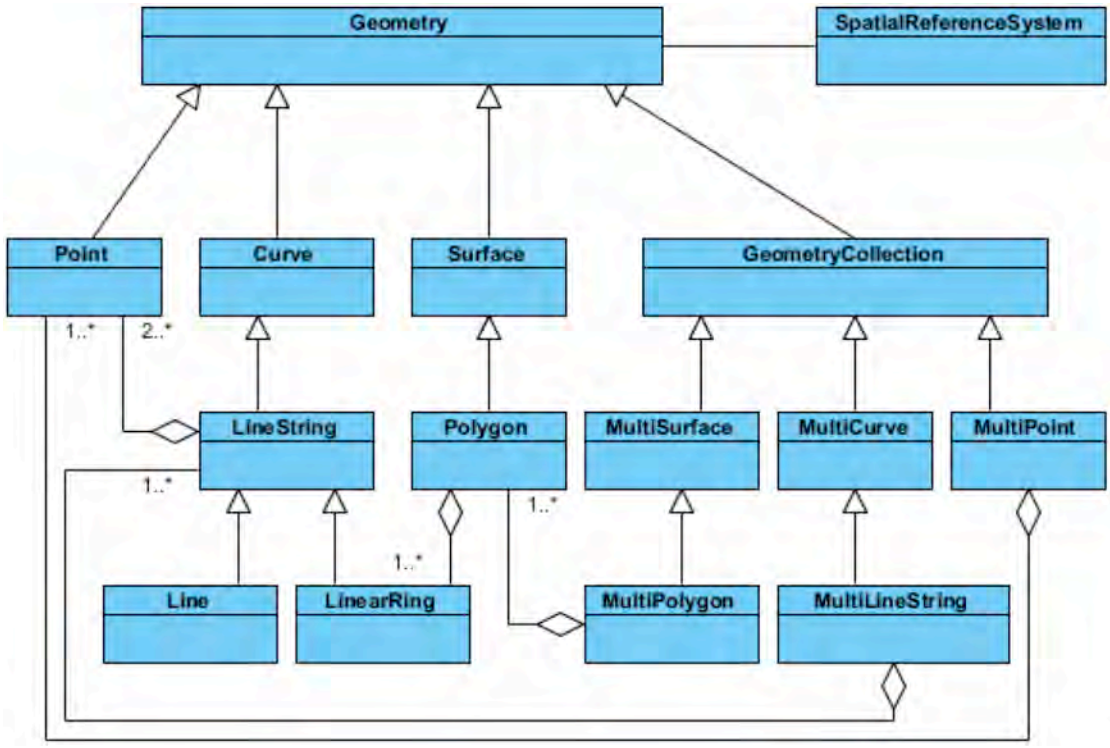

Fig 6.3: GML class structure

The class diagram presented in Fig. 6.3 shows the dependencies of the simple Geometry features defined in the OGC GML. This model in reality has two major simplifications: geographical features are assumed to have either simple types of attributes (booleans, integers, reals, strings) or complex types of geometric properties; geometries are assumed to be defined in two-dimensional spatial reference systems and to use linear interpolation between coordinates. Using this model system will preserve conformity to other GIS systems, however the third spatial dimension (depth) and time dimension have to be introduced to fulfil MSP purpose requirements. This schema does not implement strict attributes of the geometry objects and will be used as an interface for a class diagram of the conceptual model.

Attributes can have the following simple types of representation: boolean (having one of two possible values), numerical discreet values (represented by integer, word, longint types depending on the system platform), numerically continuous values (represented by real, float, double types), alphanumeric (represented by string, varchar types), categorical (having one value from an exhaustive set of values – categories). Attributes can also be associated with constraints to some representation types to restrict the set of possible values or ranges of values allowed for a given attribute.

Attributes classified by classes derived from Geometry have an implementation dependant on database management system construction. Most DBMS are enhanced with spatial extensions compatible with the OGC GML model. Additionally, values of these attributes can usually be easily exchanged between different systems using libraries and tools described in Appendix 6.

1.22 Model of feature classes

The class of the feature does not determine the class of the geometry associated with it. For example, localisation of the WindFarm feature could have a location attribute classified by Point, in the sense of the geographical location of the WindFarm, but could have an extent attribute classified by Polygon geometry in the sense of the physical extent of the wind farm object in space.

The Working paper Guidelines for Data Submission in the Framework of BaltSeaPlan contain definitions of the following features:

1. Point features
    a. Platforms
    b. Wind turbines
    c. Traffic stations
2. Curve features
    a. Administrative boundaries
    b. Submarine cables
    c. Pipelines
    d. Shipping routes
3. Surface features
    a. Subregions
    b. Offshore windfarms
    c. Sediment extraction
    d. Maritime features
    e. Areas of nature conservation

These features form the core of the data storage system. Additional information containers, which have to be implemented, provide for the organisation of data collection (data sets), repository of developed maritime spatial plans, parameter vocabularies and categories sets and metadata inventory.

8. Glossary

AIS - Automatic Identification System

Balance - Baltic Sea Region Programme

BalEco - Ecosystem model BalEco

BaltCoast - Integrated Coastal Zone Development in the Baltic Sea

BSH - Bundesamt für Seeschifffahrt und Hydrographie (Federal Maritime and Hydrographic Agency)

BSHcmod - regional 3D ocean model for the North Sea - Baltic,

BONUS - EU program: Science for a better future of the Baltic Seas region

BOOS - Baltic Operational Oceanographic System

BSP - BaltSeaPlan

BSR MSP - Baltic Sea Region Marine Spatial Plan

BSPA - Baltic Sea Protected Areas

CADSES - Central European Adriatic Danubian South-Eastern European Space

CCS - Carbon capture and storage

CEFAS - Centre for Environment, Fisheries and Aquaculture Science

CGI - Common Gateway Interface (also Computer Generated Imagery)

CHEMSEA - (CHemical Munitions SEarch & Assessment)

Coastman - Coastal Zone Management in the Baltic Sea region

COEXIST Project - Interaction in coastal waters

COHERENS - Coupled Hydrodynamical-Ecological Model for Regional and Shelf Seas

COMBINE - Comprehensive Modelling of the Earth System for Better Climate Prediction and Projection

CONTIS - Continental Shelf Information System

DBMS - Database Management System

DODS/OpENDAP - Distributed Oceanographic Data Systems / Open-source Project for a Network Data Access Protocol

ECDIS - Electronic Chart Display and Information System

ECOPATH - free ecological/ecosystem modelling software suite

ECOSMO - ECOSystem MOdel

EEZ - exclusive economic zone

EMPAS - Environmentally Sound Fisheries Management in Marine Protected Areas

EIA - Environmental Impact Assessment

ERGOM - The Baltic Sea Research Institutes Ecosystem Model

ESaTDOR - European Seas and Territorial Development

ESPON - European Observation Network for Territorial Development and Cohesion

ESRI - Environmental Systems Research Institute

EU/EC - European Union / European Community

EMODNET - European Marine Observation and Data Network

EUROSION - European initiative for sustainable coastal erosion management

FCGI - Finnish Council for Geographic Information

8. Glossary

GDAL - Geospatial Data Abstraction Library

GEMET - GEneral Multilingual Environmental Thesaurus

GETM- General Estuarine Transport Model

GIS - Geographic information systems

GML - Geography Markup Language

GMES - Global Monitoring for Environment and Security

GRASS - Geographic Resources Analysis Support System

HAMSOM - HAMburg Shelf-Ocean-Model

HELCOM - Helsinki Commission

HIROMB - High Resolution Operational Model for the. Baltic

HSI - Habitat suitability index

IBA - Important Bird Areas

ICES - International Council for the Exploration of the Sea

ICES-WKCMSP - Workshop on the Science for area-based management: Coastal and Marine Spatial Planning

IHO - International Hydrographic Organisation

IMAGE2000 - - covering all activities related to satellite image acquisition, orthorectification and production of European and National Mosaics

IMO - International Maritime Organisation

INSPIRE - Infrastructure for Spatial Information in the European Community

ICZM - Integrated Coastal Zone Management

INTERREG Innovation & Environment Regions of Europe Sharing Solutions

IOC - Intergovernmental Oceanographic Commission

ISO - International Organisation for Standardisation

MarineMap - Marine Life Protection Act Initiative Overview

MARXAN - MARine SPatially EXplicit ANnealing - freely available conservation planning software

MASPNOSE - an EU project on ecosystem-based Maritime Spatial Planning in the North Sea

MDI-DE - Marine Data Infrastructure Germany

MESMA - Monitoring and Evaluation of Spatially Managed Areas

MIG - Maritime Institute Gdańsk

MIKE – Series of numerical modelling software developed by DHI Group

MMC - Multipurpose Marine Cadastre

MMO - Marine Management Organisation

MO - Maritime Office

MOM - Modular Ocean Model

MOS - Ministry of the Environment (Poland)

MSFD - Marine Strategy Framework Directive

NASA - National Aeronautics and Space Administration

NATURA2000 - An ecological network of protected areas in the territory of the European Union

NERI - National Environmental Research Institute (Denmark)

NSDI - National Spatial Data Information

ODEMM - Options for Delivering Ecosystem-Based Marine Management

OGC - Open Geospatial Consortium

PlanCoast - Project with the aim of developing the tools and capacities for an effective integrated planning in coastal zones and maritime areas in the Baltic, Adriatic and Black Sea regions

SeaDataNet - Pan-European Infrastructure for Ocean & Marine Data Management

ECOPATH - Free ecosystem modelling software suite

RCAO - Regional Coupled Atmosphere-Ocean Model

RDBMS - Relational Database Management System

SAC - Special Area for Conservation

SEA - Strategic Environmental Assessment

SEIS - Shared Environmental Information System

SFS - Finnish Standard Association

SHYFEM - Shallow HYdrodynamic Finite Element Model

SIS - Swedish Standards Institute

SMA - Software Maintenance Agreement

SPA - Sea Protected Areas

SEA - Strategic Environmental Assessments

TIA - Territorial Impact Assessment

ToR - Terms of References

TSS - Traffic Separation Scheme

UNESCO - United Nations Educational, Scientific and Cultural Organisation

USA-CERL - United States Army Construction Engineering Research Laboratory

VASAB - Vision and Strategy around the Baltic Sea

VMS - Vessel Monitoring System

VTS - Vessel Traffic Service

XML - Extensible Markup Language

WAM - Wave Amplitude Model

WISE - Water Information System for Europe

WODC - World Oceanographic Data Centre

WWF - World Wildlife Fund (now World Wide Fund for Nature)

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- DEVELOPMENT OF BROAD-SCALE MARINE SPATIAL PLANNING PRINCIPLES IN THE BALTIC SEA AREA, HELCOM Recommendation 28E/9
- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy
- Directive 2003/4/EC the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EEC for metadata and data access;
- Directive 2003/98/EC of the European Parliament and of the Council of 17 November 2003 on the re-use of public sector information for metadata and data use;
- DIRECTIVE 2008/56/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)
- EC Regulation no 268/2010 of 29 March 2010, on implementing Directive 2007/2/EC as regards the access to spatial data sets and services of the Member States by Community institutions and bodies under harmonised conditions;
- ESPON 2011: ESaTDOR European Seas and Territorial Development Opportunities and Risks, Interim Report, Version 01/09/2011 with Appendices;
- EuroGOOS 2000: Policy and practice for EuroGOOS for the exchange of oceanographic and related data and products including guidelines on relationships in commercial oceanographic activities (EG99.37)
- Gee, K. et al 2011: VISION 2030. Towards sustainable planning of the Baltic Sea space, online under www.baltseaplan.eu;
- Harrald, M. & Davies, I.: Further Scottish Leasing Round Scoping Study, March 2010;
- HELCOM 2007: Baltic Sea Action Plan
- HELCOM-VASAB MSP WG 2/2011, Document 2/1/Rev1
- ICES Data Policy 2006 Agreement, C.M. 2004/Del04/05/03
- IHO Transfer Standard for Digital Hydrographic Data, Edition 3.1 – November 2000, Special Publication No. 57. International Hydrographic Bureau, Monaco.
- INSPIRE: Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community, with regulation EC 1205/2008 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata, for metadata and information discovery
- INSPIRE and Marine Spatial Planning, INSPIRE Conference 2011, Edinburgh – Marine Workshop 28 June, Mike Osborne, OceanWise Ltd.;
- IOC 2003: Oceanographic Data Exchange Policy (www.iode.org/)
- PLANCOAST 2008: Handbook on Integrated Maritime Spatial Planning. Results of the INTERREG III B CADSES project PlanCoast, online under www.plancoast.eu

- Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing a Programme to support the further development of an Integrated Maritime Policy, Brussels, 29.9.2010 COM(2010) 494 final
- SEANERGY 2011, Deliverable 2.3 Comparative analysis of Maritime Spatial Planning (MSP) regimes, barriers and obstacles, good practices and national policy recommendations
- Strategic Advice on Designing and Implementing Coastal and Marine Spatial Plans, A Report from the NOAA Science Advisory Board
- Support for EEA Coastal Assessment 2012 and Climate Change Impacts Assessment 2012, Use of coastal and maritime space (MS1)
- Territorial Agenda of the European Union 2020, Towards an Inclusive, Smart and Sustainable
- Europe of Diverse Regions agreed at the Informal Ministerial Meeting of Ministers responsible for Spatial Planning and Territorial Development on 19th May 2011 Gödöllő, Hungary
- White et al. 2012: Ecosystem service tradeoff analysis reveals the value of marine spatial planning for multiple ocean uses. Article in PNAS, online under www.pnas.org/
- Zaucha, J. 2011: Off-shore spatial information – Maritime Spatial Planning in Poland, Regional Studies 2012

Links:

BOOS (Baltic Operational Oceanographic System): www.boos.org

EUROGEOINFO: www.eurogeoinfo.eu

EBM Tools Network: www.ebmtools.org

IODE (International Oceanographic Data and Information Exchange Programme): www.iode.org/

VASAB (Vision and Strategies around the Baltic Sea 2010) www.vasab.org

MyOcean www.myocean.org, www.myocean.eu,

10. APPENDIXES

10.1. Appendix 1: Recommendations

BaltSeaPlan Recommendations

for the development and implementation

of a data exchange network and infrastructure

for Maritime Spatial Planning and Management purposes

in the Baltic Sea Region

Maritime Spatial Planning (MSP) has become a widely acknowledged tool for co-ordinating spatial use of the sea in the Baltic Sea Region. MSP is understood as a cooperative practice that involves several spatial and administrative levels. With regard to MSP purposes, stronger cooperation than has existed so far among data providers and the national authorities responsible for data collection is necessary in order to ensure that spatial information is easily accessible for (cross-border) planning purposes.

The INSPIRE Directive and EC regulation No 268/2010 on Data and Service Sharing provide a very good basis for such cooperation – although , many features of INSPIRE have not yet been implemented and marine space and maritime features are not so far adequately represented by INSPIRE data specifications. Numerous database initiatives such as EMODnet, WISE Marine, European Atlas of the Seas, MyOcean and BOOS, EuroGOOS, ICES and IOC data exchange policies have followed ever since. At the same time, there is as yet no overall operative cooperation structure in the Baltic Sea Region to meet the specific needs of MSP.

The HELCOM/VASAB Working Group on Maritime Spatial Planning, which published Baltic Sea broad-scale MSP principles for achieving better coherence in the development of Maritime Spatial Planning systems in the Baltic Sea Region, emphasises the importance of a high quality data and information basis. Principle 6 states that Maritime Spatial Planning should be based on the best available, highest quality and up-to-date comprehensive information that should be shared by all to the largest extent possible. This calls for close cooperation from the relevant GIS and geo-spatial databases, including the HELCOM GIS, monitoring and research in order to facilitate a trans-boundary data exchange process that could lead to a harmonised pan-Baltic data and information base for planning. This base should cover historical baselines, present status as well as projects and future scenarios of both environmental aspects and human activities. It should be as comprehensive, openly accessible and constantly updated as possible and compatibility with European and Global initiatives should be ensured.

Taking all of the above into consideration, the BaltSeaPlan project partners recommend that a process be agreed on, with the minimum requirements and performance criteria necessary to ensure technical interoperability, up-to-date and complete MSP data sets, as well as the sustainability and financial efficiency of the proposed data exchange structure.

Recommendation 1. MSP Data Infrastructure

A pan-Baltic data MSP infrastructure for up-to date, transferable, interoperable MSP relevant data and metadata shall be created in line with the INSPIRE Directive. This directive should be amended with regard to marine space and maritime features to cover MSP relevant aspects.

Recommendation 2. MSP Data Specifications

The MSP data infrastructure should be based on the proposed lay-out and specifications with regard to data issues, data scope, formats and technical requirements etc. (as outlined in Annex ...). The data sets should cover all MSP relevant issues. These issues included in the model and listed in Annex ... can be regarded as a proposal for a basic or minimum range of information for MSP purposes, which should be further developed and extended as needed.

Recommendation 3. MSP Data Exchange Network

The transnational network for MSP data exchange shall consist of the following functional levels:

1) A pan-Baltic MSP Data Coordinating group - managing the Baltic MSP Infrastructure, making available pan-Baltic MSP relevant data sets, creating harmonised Pan Baltic MSP relevant data sets from national data etc.
2) National MSP Data Contact Points – making national MSP relevant data available to MSP Infrastructure
3) for larger countries or federal states) Regional MSP Data Points – making regional MSP relevant data available to MSP infrastructure in cooperation with National Data Contact Points
4) MSP Data Providers, offering their data to the regional / national MSP Data Contact Points according to the rules set.

Recommendation 4. Data exchange process

Data exchange should be facilitated via a Baltic Sea MSP data portal, offering digital map and geo data services. These could be linked and/or integrated into individual applications.

All registered users of the network would be entitled to unrestricted searching, viewing, downloading and processing of the data.

In turn, they should make available any product the data has been used for and/or provide their data according to

1) The legal policy as described in Recommendation 6, and
2) formal requirements like data input format specified in the data specifications (Annex ...)

to their respective National/Regional MSP Data Contact Point. National/Regional MSP Contact Points should provide for updated data sets in the data infrastructure at regular 6-month intervals – for issues facing dynamic development and rapid changes. Updating intervals for other issues need to be fixed as necessary.

Recommendation 5. Expert / Advisory Group

The Pan-Baltic MSP Data Coordinating Group consists of representatives from the National MSP Data Contact Points. A permanent MSP Data Expert Group in an advisory capacity to the Pan-Baltic Data Coordinating Group should be created consisting of spatial planners and GIS experts from all BSR countries with further experts on relevant issues to be appointed and/or consulted as necessary. Among its tasks should be:

1) monitoring and proposal of improvements to the content of pan-Baltic data sets and the data exchange system,
2) providing methodology for MSP in relation to data needs and management, and advice on gaps to be filled,
3) ensuring the link to other data networks as mentioned above,
4) ensuring the link to the Transnational MSP Coordination Secretariat (as suggested in BaltSeaPlan Vision 2030).

Recommendation 6. Legal policy

The pan-Baltic data infrastructure should draw on unrestricted and free of charge data produced e.g. in course of statutory activities of public institutions, or publicly funded projects. Other data on spatially relevant activities and functions should be made available as far as possible. In the case of duly restricted/commercial data, only the associated metadata and products will be made available via the network.

Recommendation 7. Resources

Baltic Sea states should grant adequate financial and organisational resources for securing the implementation and maintenance of a sustainable MSP data network and infrastructure. Existing networks such as the HELCOM/VASAB WG on MSP should be considered for building up the data exchange network.

Definitions

“MSP“ is understood in the context of these Recommendations as Maritime Spatial Planning and Management;

“Data“ is understood as spatial data relevant for Maritime Spatial Planning purposes;

“Metadata“ is understood as "data about data" describing the content, quality, condition, and other characteristics of data;

“Commercial“ is understood as conducted for profit, cost-recovery or re-sale;

“Product“ is understood as a value-added enhancement of data applied to a particular application;

“Restricted” is understood as only accessible to users who have been given permission, for reasons of (national) security and others, and e.g. marked “confidential”

“Unrestricted“ is understood as non-discriminatory and non-confidential, thus generally accessible;

“Free of charge“ is understood as no more than the cost of reproduction and delivery, without charge for the data and products themselves.

10.2. Appendix 2: Case study

For visualisation and presentation of the requirements and capabilities of a BSP-Database, a case study should demonstrate how the database should work and which data should be stored for MSP purposes. A hypothetical example should show where sand and gravel extraction, as a human activity with severe impact on environment, could be permitted and what the procedure could be for choosing the most convenient solution.

This case study is based on Marion Harrald, Ian Davies: Further Scottish Leasing Round Scoping Study, March 2010, a Scottish Government study for choosing the best location for a tidal or wave plant. The logical way taken by the Scottish space planner to find the right location can also be followed in this case.

Therefore, the initial step in preparing for further activity has been to identify a set of proposed areas. The selection took account of a number of characteristics, namely that potential areas of interest should:

1) Have the necessary natural resources of sand and/or gravel;
2) Avoid sensitive areas;
3) Have limited impacts on existing marine uses.
4) Have regard to the requirements of national security;
5) Be within easy reach of a harbour for transportation of sand and gravel

All the above points should be weighted in according with their importance. This should be the task for a marine spatial planner.

i. For estimating natural resources of sand and gravel geological data are needed. Analysis of sediments charts will determine areas where extraction can be economically viable. The second important factor is the depth of deposits.
ii. Sensitive areas are of environmental and conservation interest. There are Natura 2000 sites, nature reserves and archeological sites.
iii. Marine uses are shipping routes, wind farms, cables and pipelines and recreational areas, which includes recreational and professional fishing grounds, sailing and cruising routes, marinas, bathing beaches etc.
iv. I Not only marine harbours are important for national security but also areas of military exercises, but also electricity cables, gas and oil pipelines and deposits of fossil fuels. (Harrald and Davies, 2010)
v. Interesting deposits of sand and gravel should be not too far from harbours. Loading facilities and transport links are important.

The identification of potentially suitable areas was seen as an exercise in the application of marine spatial planning tools. In particular, the exercise required the accumulation of a large amount of spatial information relating to the availability of sand and gravel deposits, and on current activities or uses (such as the locations of Natura 2000 areas, shipping routes and fishing activity) that may interact with the exploitation of the resource. The volume of data for the expertise is large. It is clear that data processing using Geographical Information System (GIS) software should be the most effective and efficient approach for the task.

There are several possibilities for approaching the final solution.

a. Exclusion – Sensitive areas should be identified and excluded from the areas potentially available for extraction
b. Restriction – Locations of other commercial activities or environmental sensitivities should be mapped and used as constraints to reduce the suitability of areas for development. These were subsequently combined in a series of restriction models.
c. Weighting - The process of weighting combines the exclusion with the restriction process. It also rescales scores to make the ranges consistent between all processes and thereby facilitates weighting between sectors. Estimating these weight points is not the task of this data study, as thesedepend generally on national regulations.

For the final analysis, all approaches should be taken into account.

TABLE 9.

The data layers used in the case study and treated as either exclusions or restrictions to development.

Category number	Sector	Exclusion layers	Restriction layers	Buffer (m)
1	Environment	Special Areas of Conservation		
		Natura 2000		
		World Heritage Sites		
		Nature Reserve Areas		
			Seabirds	
			Underwater meadows	
2	Shipping	International Maritime Organisation (IMO) routes		
			All shipping routes	
			Harbour administration areas	10
3	Fish spawning and nursery grounds		Fish spawning and nursery	
4	Commercial fishing		Fishing grounds and landings	
5	Cultural heritage	Protected wrecks		100
		Other wrecks		
		Schedule of Ancient Monuments (SAMS)		500
6	Commercial	Fish or shellfish farms pending		250
		Current fish or shellfish farms		250
		Disposal sites		250
		Wind farms		500
		Oil and gas licenses		500
		Active pipelines		500
		Active cable		250
		Cables under construction		250
		Wind farm cables		250
7	Recreation		Marinas & sailing clubs	100
			Sailing areas	
			Racing routes	
			Cruising routes	100
			Bathing beaches	500
			Recreational fishing areas	
8	National security	Military exercise areas		
		Testing areas		
		Munitions disposal areas		500

Buffers shown in Table 9 are examples only. They depend on international, national and regional regulations. Some of these buffers could not be distinguished on the general scale, but should be taken into consideration in detailed charts used in the final decisions for real projects. Another example for relativity of restrictions is the 500 m buffer from wind farms for industry, but sailing between wind mills is allowed for pleasure boats.

For illustrating this case study information was chosen from the HELCOM Geoportal. An additional advantage was to show a lack of important data for MSP in the HELCOM database. For this reason maps shown in this study are incomplete and not for use for a real case scenario. The source of real data will also be shown, as in an ideal data model. These data should be stored in a central database for MSP purposes. Data for MSP should be stored as real data. Storage of metadata is insufficient only in this case i due to the possibility of changing the stored data or the art of storage in the source database. It should be possible to use these data in the same form for additional proof by experts. It is not recommended that the HELCOM Geoportal be used as a data source for MSP purposes. According to the INSPIRE principle, data should be taken for MSP analysis and for a MSP database “as close to the data owner as possible”. It sounds like “wishful thinking”, but an obligation for commercial companies to deliver data for MSP purposes would be very helpful for marine spatial planning in Baltic Sea.

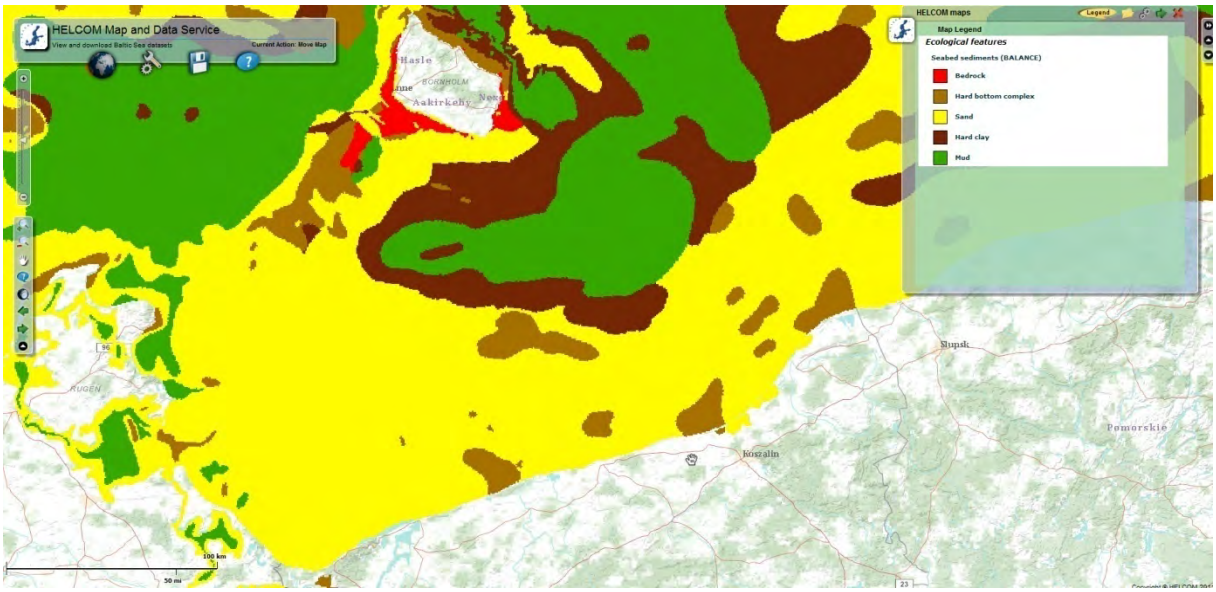


Fig. A2.1 Sediments in the Southern Baltic Sea

Fig A2.1 shows sand occur (yellow) in the Southern Baltic Sea along the Polish coast. In proceeding with the analysis, all exclusions and restrictions zones should be identified.

Data source: Real data should come from geological surveys from each Baltic country. For MSP purposes these data do not always have sufficient spatial resolution and for the end decision additional measurements should often be made.

For the proposed Data Model, data, in the form of shapefiles, should come from the central database. Since the geology is not very dynamic, an update of this data set should be carried out as new data become available (new measurements, new classification system, better resolution etc.)

Exclusions

There are several type of exclusions areas listed in Table 9:

- environment
- shipping
- cultural heritage
- commercial
- national security

All these areas are particularly sensitive and should be considered unavailable for commercial using.

Restrictions

The data layers treated as giving graduated degrees of constraint on development according to the nature and intensity of the activity, are listed in Table 9. The layers were categorised into a series of 5 sectors containing restriction layers (Table 9) and a separate restriction model should be developed for each:

- environment,
- recreation,
- shipping,
- commercial fishing,
- fish spawning and nursery areas.

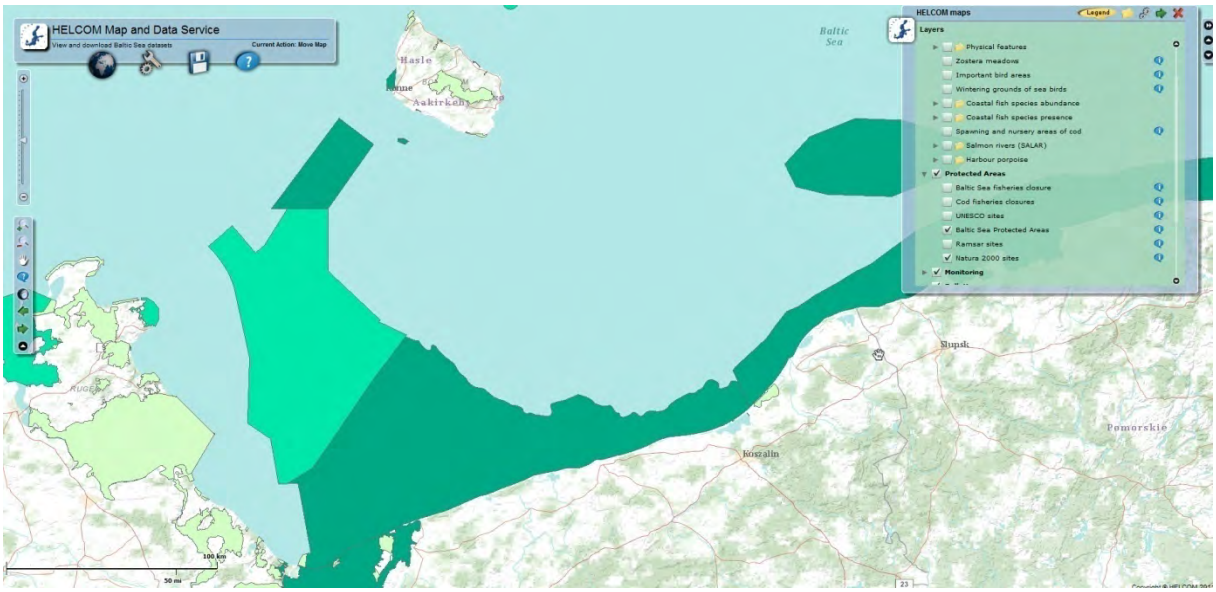


Fig. A2.2: Baltic Sea Protected Areas and Natura-2000 Areas

Data source: Positions of Nature Parks and Natura 2000 and other protected areas should be available from the Environment Ministries of each Baltic country. These data in the form of shapefiles should be stored centrally and updated in the case of changes.

Baltic Sea Protected Areas and Natura-2000 Areas should be excluded from areas of interests.

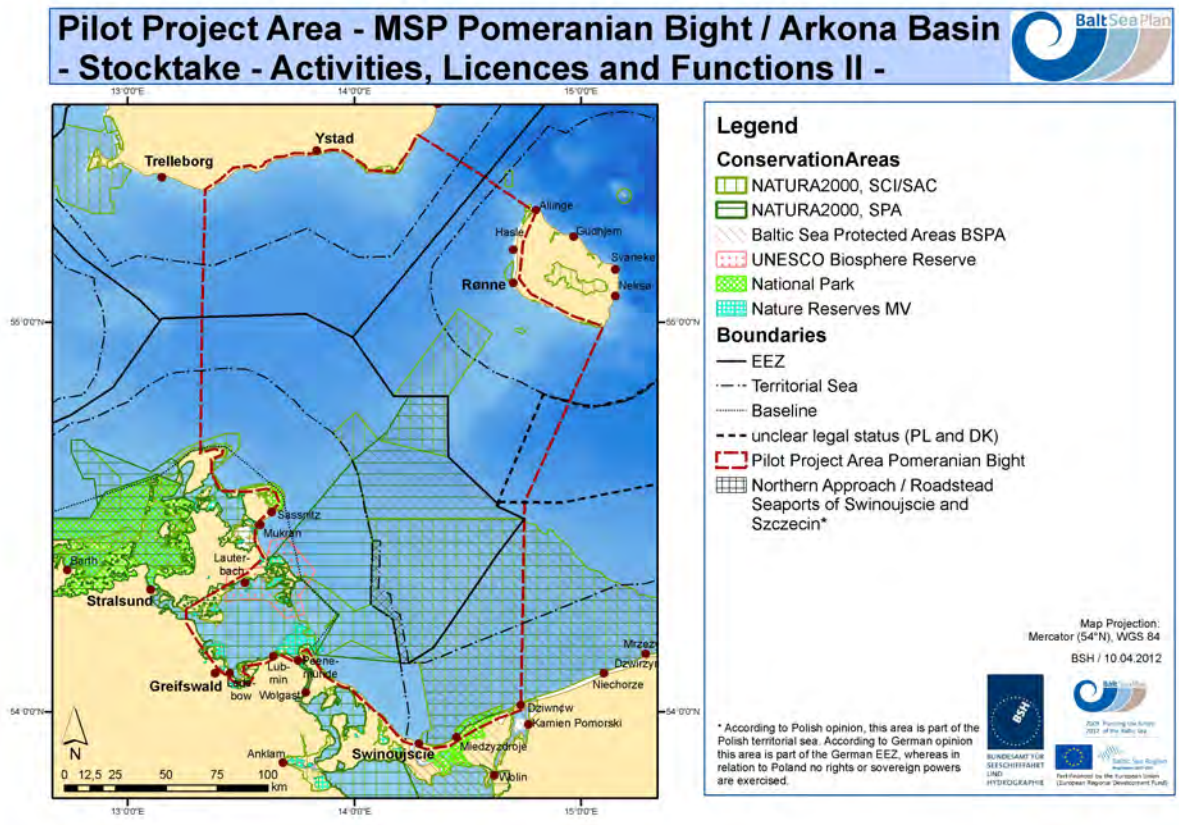


Fig. A2.3: Nature Conservation Areas in Pomeranian Bight and Arkona Basin. (BSP Pilot Project Pomeranian Bight)

Fig. A2.3 shows an another example of how boundaries of protected nature areas could be shown on a map with greater scale. Here more details could be distinguished and this scale is good for an overview of the area concerned. . For the end planning and the final decision, it should be possible to plot maps in ever greater scale for some smaller spots for narrow selection, i.e. MSP data should be of sufficient quality for “zooming”. Tools for visualising MSP data should have several levels for map plotting, like navigation maps, from sea overview to harbour plans, as in IHO standard S57/3, for example.

Fig. A2.4: Ships routes, coastal traffic (striped) and harbours

Important ships routes and coastal traffic should be excluded from areas of interests. The additionally marked harbours show where the exploitation of sand and gravel could be cost-effective because of long transportation distances. The information shown in Fig A2.4 is not up to date. For instance new Traffic Separations Zones are not shown in this area.

Not shown on Fig. A2.4are shipping not IMO routes used more or less frequently and which could be tracked with the help of AIS logs. The accuracy of this data, based on logging frequency, could be better than 500 m. These are not official IMO routes but those with serious restrictions for spatial planner and have been taken into account.

Data source: Databases from institutions responsible for nautical charts in each of the Baltic countries. Updates of relevant information (changes to Traffic Separation Zones, new harbour facilities etc.) should be made as data become available. AIS information is collected and shared by numerous sites ,HELCOM being only one of these The AIS database should also be a part of MSP database.

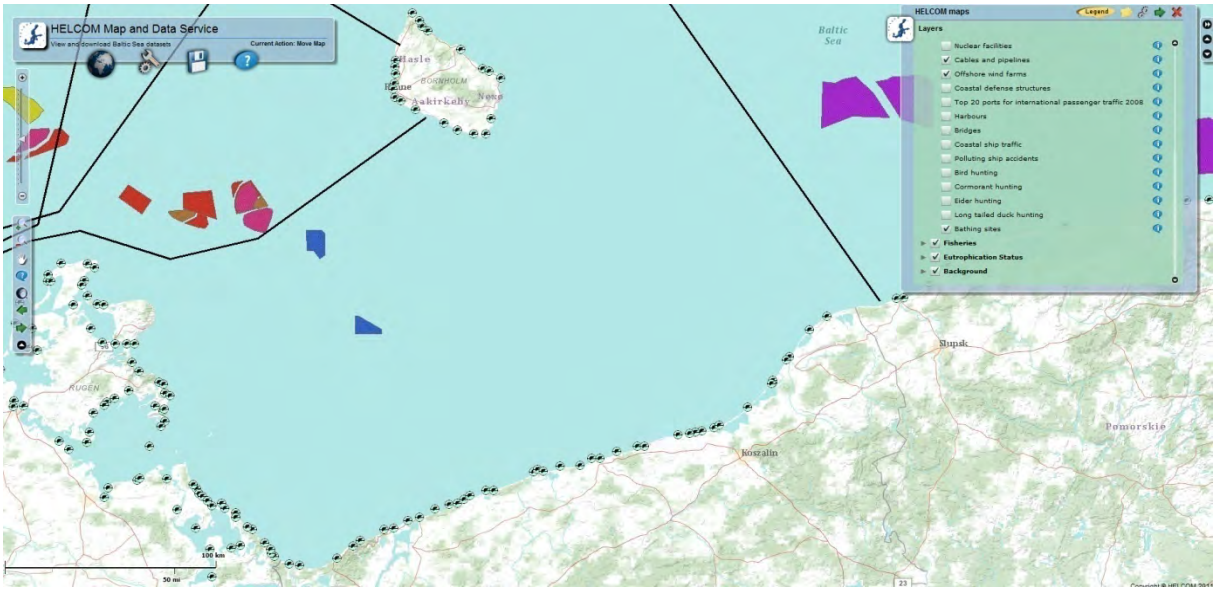


Fig. A2.5: Cables, pipelines, wind farms (existing and planning) and bathing areas

Because of a lack of data in the HELCOM database, not all cables and pipelines are shown in this map. All bathing areas are in nature protection areas and are excluded. Areas reserved or used for a wind farm do not adversely affect the possibility of offshore exploration of sand and gravel on the eastern part of the Polish coast shown.

Data source: Databases from institutions responsible for nautical charts in each of the Baltic countries for existing pipelines, cables and wind farms. All planned projects. should be also stored. Bathing areas on the coast are not important for the purposes of offshore gravel and sand extraction from the sea bottom.

Shapefiles stored in the central database (i.e. World Oceanographic Data Centre - WODC) should be updated as new information becomes available (new pipelines, new planning or completed wind farms etc.)

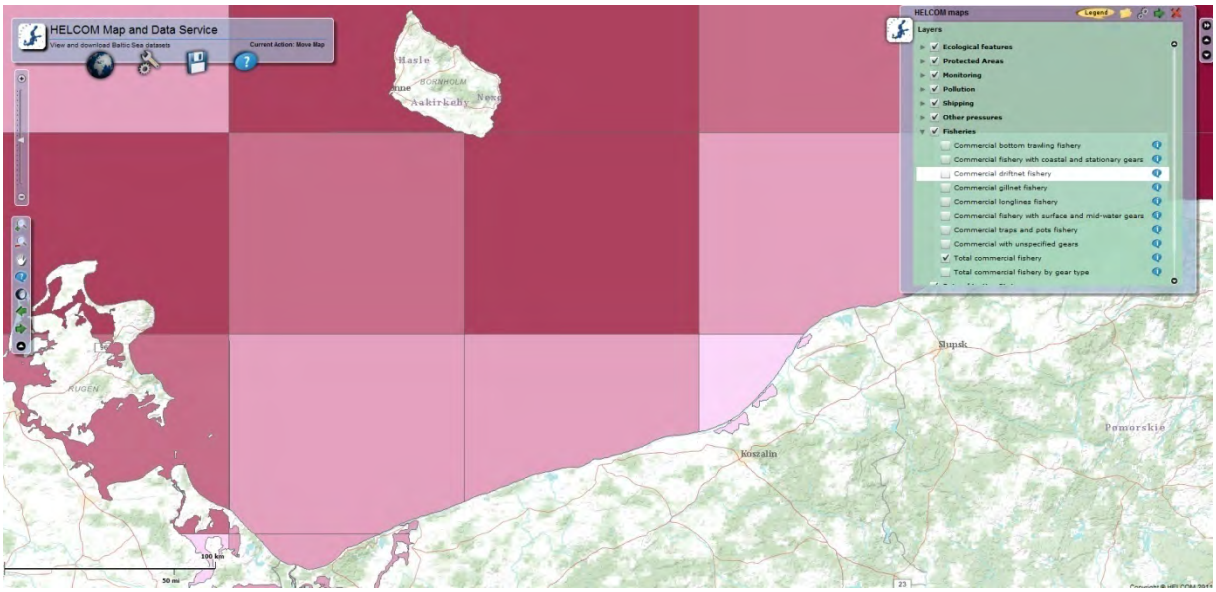


Fig. A2.6: Total commercial fishery

From the sparse fishery data set it can be concluded that fishery is not very intensive near the Polish coast. Thus, the rather limited area for sand and gravel exploitation cannot significantly disturb the interests of fishermen. On the other side, the data set presented has insufficient spatial resolution for MSP purposes.

Data source: Data from fishery monitoring should be available from national contact points every six months. The best data are delivered as VMS (Vessel Monitoring System). Although these data are under restriction because of commercially sensitive information, they should be available for MSP purposes. It is necessary to check how these data could be accessed in connection to fishery grounds with geographic coordinates and with the best possible accuracy.

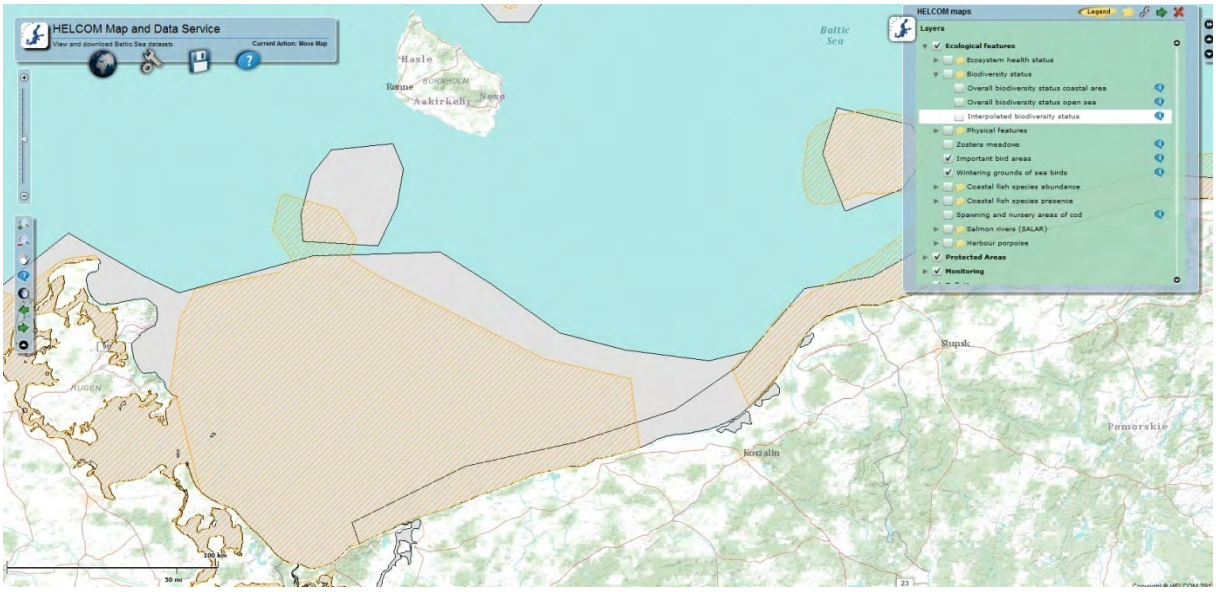


Fig. A2.7: Important areas and wintering grounds for sea birds

Important areas for sea birds (striped) and wintering grounds are, roughly, over the Pomeranian Bay and in a narrow strip along the coastline to the east.

Data source: Data should be collected according to the Birds Directive (Directive 2009/147/EC). These data should have geographic coordinates to make it possible to format them in GIS compatible formats. For MSP purposes, the best format would be shapefile. Updates should be done according to monitoring frequencies in the Bird Directive. For this and the following example, it would be very useful to attach the results of strictly scientific investigations of the MSP database. This requires broad cooperation with the scientific community. Also an obligation to share data should be anchored in the financial grants of scientific projects.

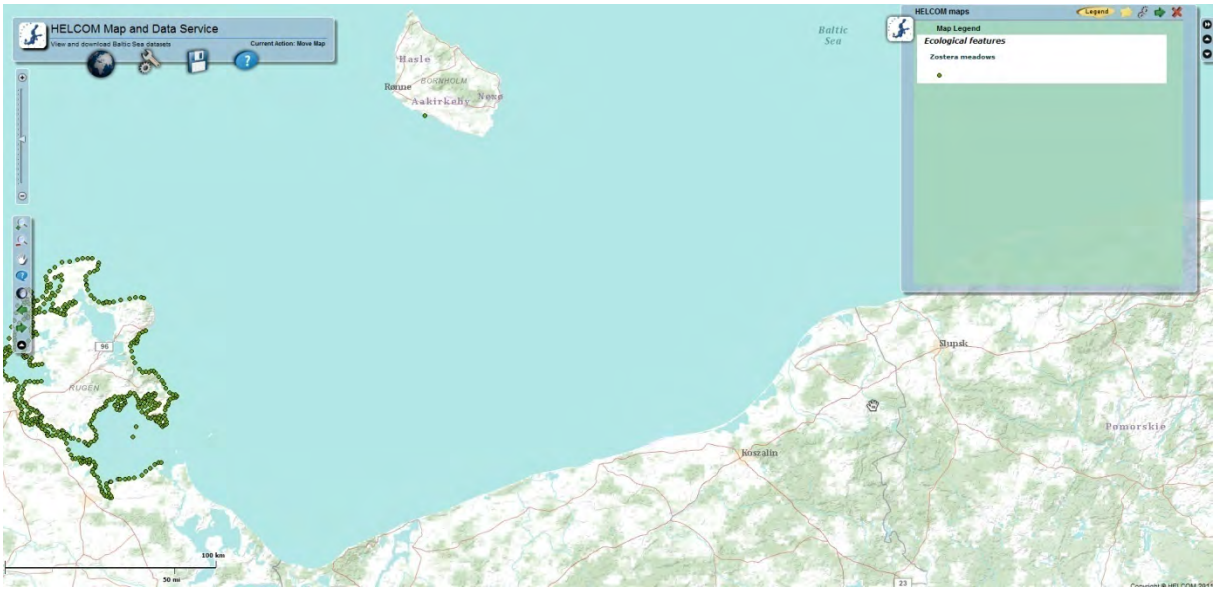


Fig. A2.8: Zostera meadows (green points)

Zostera meadows are shown along the German coast only. The assumption is that there is no data available for the Polish coast. In fact, Poland has no monitoring program for underwater meadows and all information comes exclusively from scientific sources and is not included in the HELCOM data set. In the real case, an additional investigation needs to be undertaken.

Data source: Data should come from the database as a result of monitoring data according to implementation of the Framework Water Directive (Directive 2000/60/EC). The standards for geographical data positioning have already been implemented in monitoring procedures as well as the monitoring frequencies. Data should be exchanged as shapefiles or/and detailed data (including all species) in GIS conform format.

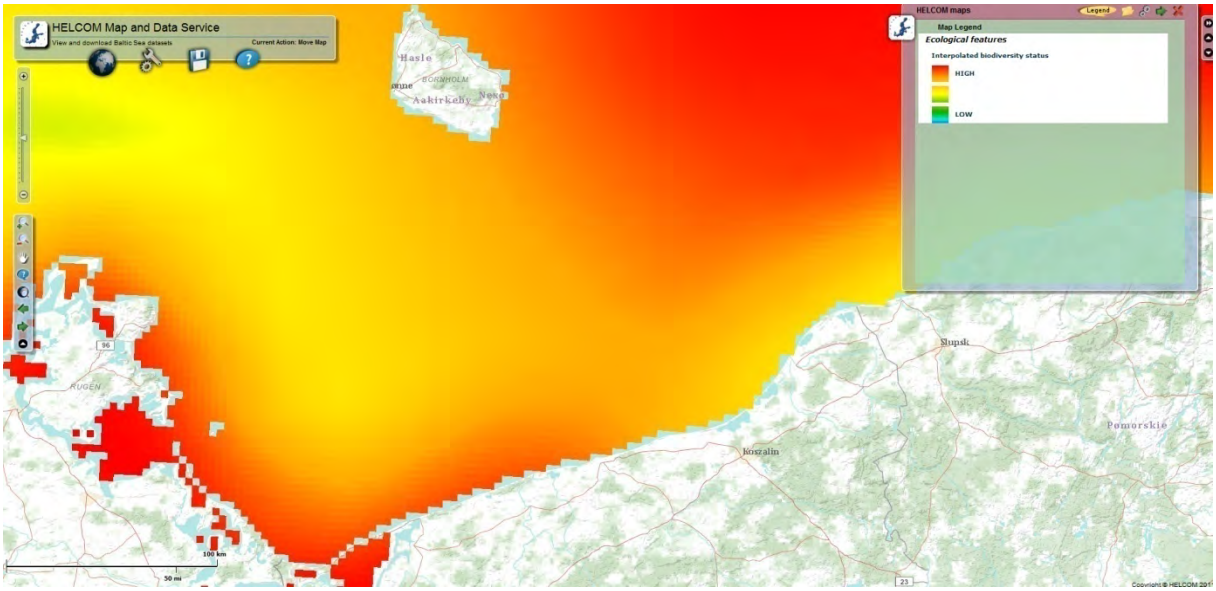


Fig.: A2.9: Biodiversity in the Southern Baltic Sea

Biodiversity is rather sparse off the coast between Koszalin and Słupsk and the limited area of exploitation should not disturb the existing nature excessively. Although these data are compiled from various monitoring measurements, its statement should carefully analyzed.

Data sources: Data should come from processed monitoring data from each of the Baltic countries and stored in WODC in shapefile format.

Within each sectoral restriction model, data layers were weighted according to subjective judgments of the relative importance of each layer in relation to other layers within the sector. For example, the environment restriction model was comprised of datasets of underwater meadows and seabirds at sea. It was decided that the seabirds should receive a higher weighting (100) than meadows (90) because many birds in European waters are listed as European Protected Species under the EC Birds Directive (2009/147/EC, the codified version of Directive 79/409/EEC as amended) and are thus protected throughout their environment. However, most seabirds only receive protection at their breeding site in those areas that have received designation as “Special Areas of Conservation” or “Nature Reserve Areas” and have already been excluded.

Because the subjective judgment of weighting for each layer can be criticised, it is important to create an objective criteria and procedures for layer importance.

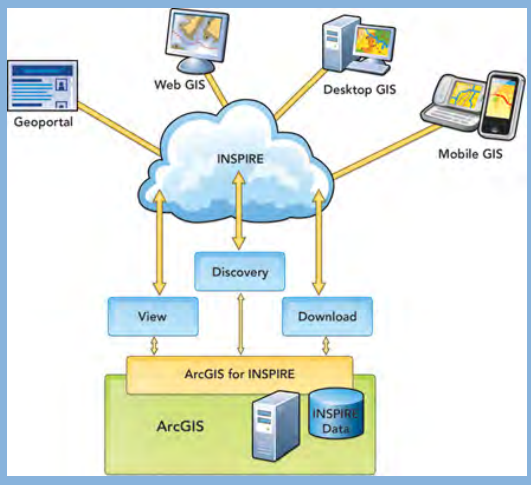
In each data layer, the intensity of the activity in each map cell (e.g. numbers of sightings of seabirds per cell, or number of ships per day per cell) should be expressed numerically and visualised. This intensity should be shown as an interval for each layer and each cell.

The combination of charts with information about excluded areas, geological and bathymetry charts and all restricted areas can be used as a basis for experts in choosing the best areas for sand and gravel extraction.

In this case there is not enough information for the final decision about sand and gravel extraction in the area of interest off the coast between Koszalin and Słupsk. In this area, large scale maps are needed.

For a real case, higher resolution maps should be drawn up for the selected area. The data sources are the same as for the maps presented. The position accuracies of all data are important for choosing the best area for offshore sand and gravel extraction. These maps cannot be presented, because no such database currently exists.

10.3. Appendix 3: Comparison of GIS systems

ESRI ArcGIS	
Type	**Commercial**
Description and application	Arc GIS is currently the most popular system for tools and services providing complete support for all domains of GIS technologies. Due to wide range of users and a long history of development, Arc GIS has become the standard GIS processing software and dominates the market in mapping tools and services. ArcGIS provides a powerful and comprehensive SDI solution that now includes capabilities to ensure INSPIRE compliance supporting data, services, and metadata, which are delivered in the "ArcGIS for INSPIRE". "ArcGIS for INSPIRE" could help to meet INSPIRE compliance in a timely manner by extending the ArcGIS software already existing in organisations. This package consists of INSPIRE View Service, INSPIRE Download Service, INSPIRE Annex I data models and INSPIRE Discovery Service. Cooperation of the package is presented in Fig. A2.1.  Fig. A2.1: Diagram of cooperation of "ArcGIS for INSPIRE" Part of the Package is the ESRI Geoportal Server, a free, open source product that enables discovery and use of geospatial resources including datasets, rasters, and Web services. It helps organisations manage and publish metadata for their geospatial resources to let users discover and connect to those resources. The Geoportal Server supports standards-based clearinghouse and metadata discovery applications. With the ESRI Geoportal Server it is possible to maintain data integrity by allowing organisations to easily share the authoritative version of data among users. It is also possible to search and discover existing geospatial data and services by allowing users to create and manage descriptions of their geospatial resources and supporting easy-to-use, sophisticated data discovery technologies. The ESRI Geoportal Server was released under the Apache 2.0 license, which allows developers to freely customise and redistribute the software.
Conclusion, suitability for MSP	Plus: the large number of users make data sets produced with ArcGIS products easily transferable, shapefiles are compatible with most open source software. ArcGIE has an own database and a number of internet courses. Minus: high license price, software needs specialist knowledge, expensive online tutorials.

GDAL	
Type	Open source developed by the Open Source Geospatial Foundation
Description and application	GDAL is a translator library for raster geospatial data formats t released under an X/MIT style Open Source license. As a library, it presents a single abstract data model for the calling application in all supported formats. It also comes with a variety of useful command line utilities for data translation and processing. The GDAL library supports more than one hundred formats of georeferenced files. The most valuable are ARC INFO Grids, NetCDF, DODS/OpENDAP, GRASS, geotiff and OGC services formats. A full list of supported formats is available at GDAL documentation www.gdal.org/formats_list.html. The GDAL data model covers storage structure and semantics of data. The basic unit is the data model I dataset. A dataset (represented by the GDALDataset class) is an assembly of related raster bands and some information common to them all. In particular the dataset has a concept of the raster size (in pixels and lines) that applies to all the bands. The dataset is also responsible for the georeferencing transform and coordinate system definition of all bands. The dataset itself can also have associated metadata, a list of name/value pairs in string form. The GDAL dataset, and raster band data model is loosely based on the OpenGIS Grid Coverages specification. Dataset coordinate systems are represented as OpenGIS Well Known Text strings. These can contain: > Overall coordinate system name > Geographic coordinate system name > Datum identifier > Ellipsoid name, semi-major axis, and inverse flattening > Prime meridian name and offset from Greenwich > Projection method type (I.e. Transverse Mercator) > List of projection parameters (I.e. Central_meridian) > Unit name, and conversion factor to metres or radians > Names and ordering for the axes > Codes for most of the above in terms of predefined coordinate systems from authorities such as EPSG. GDAL metadata consists of auxiliary format and application specific textual data kept as a list of name/value pairs. The names are required to be well behaved tokens (no spaces, or odd characters). The values can be of any length, and contain nothing but an embedded null (ASCII zero). The metadata handling system is not well tuned to handling very large bodies of metadata. Handling of more than 100K of metadata for a dataset is likely to lead to performance degradation. Some formats will support generic (user defined) metadata, while other format drivers will map specific format fields to metadata names. The GDAL library provides possibilities to implement drivers for native systems and must be considered during the implementation process. Binaries are available for Perl, python, Ruby, Java and C#/.Net
Conclusion, suitability for MSP	Plus: Open Source Software -> no license costs Minus: Software not intuitive, needs special skills, time-consuming, prone to errors. GDAL is not a GIS software but a library used in most GIS programs.

Grass	
Type	Open source developed by the Open Source Geospatial Foundation
Description and application	GRASS GIS is used for geospatial data management and analysis, image processing, graphics/map production, spatial modelling, and visualisation. GRASS is currently used in academic and commercial settings around the world, as well as by many governmental agencies and environmental consulting companies.
Conclusion, suitability for MSP	Plus: no license costs, GRASS is the most popular GIS Software among Open Source programs, and enjoys good support through an Internet community. Supports most free ware databases. Continuously developed. Minus: Software not intuitive, needs specialist knowledge.

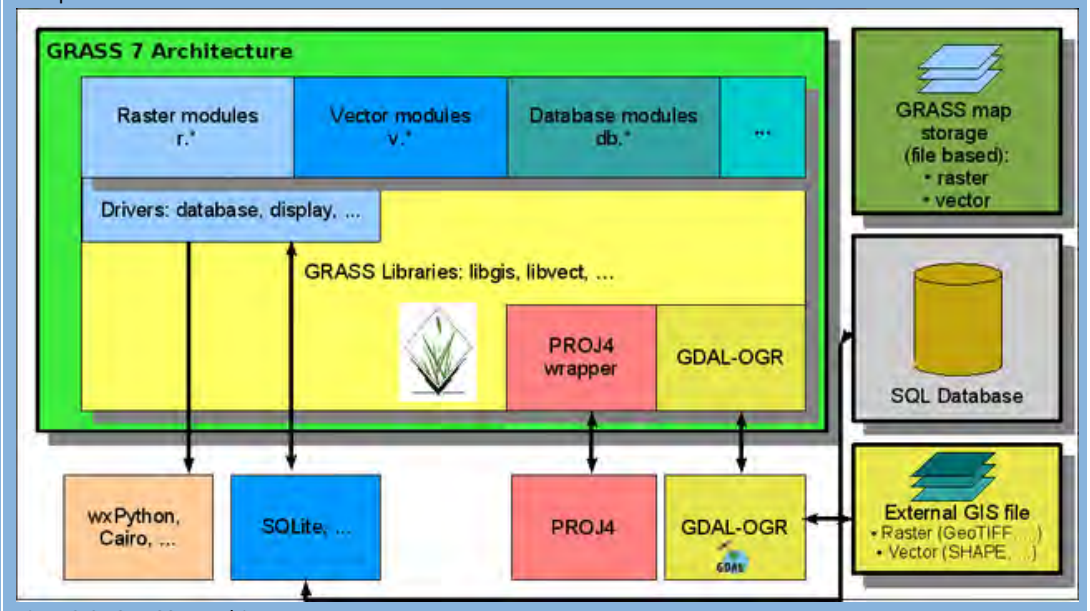


Fig. A2.2: GRASS 7 architecture

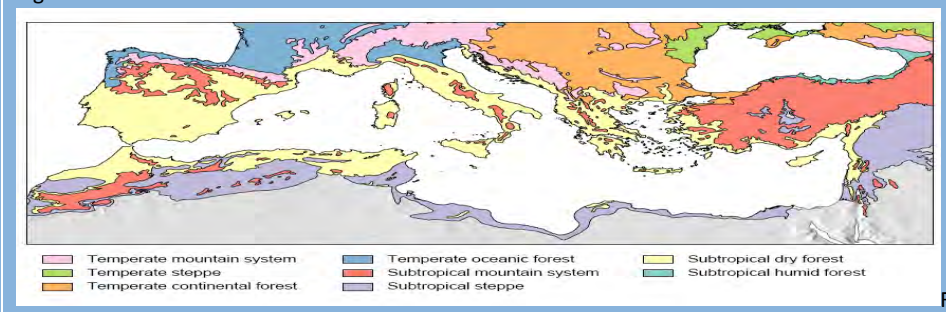


Fig. A2.3: Ecological zones of the Mediterranean produced by GRASS

GRASS was developed by the USA-CERL to meet the needs of the United States military for software for land management and environmental planning. GRASS could be easily adopted as a tool for marine spatial planning purposes, however compatibility of data types has to be preserved. GRASS supports DBF files, SQLite embedded database, PostgreSQL RDBMS, MySQL RDBMS, MySQL embedded database and UnixODBC. (PostgreSQL, Oracle, etc.)

Manifold	
Type	Commercial
Description and application	**Manifold is** an integrated product system that provides three major classes of GIS functionality in a single package: as a desktop application, as an objects library for programmers and as an Internet Map Server for web applications. Manifold provides a set of Surface Tools to aid users with: > Arbitrary Computations on Multiple Surfaces - The Transform dialogue allows arbitrary transformation of surfaces, including computations that involve multiple surfaces such as subtracting one surface from another. A very rich collection of operators, over two dozen of which are CUDA-enabled for supercomputer performance in NVIDIA CUDA systems, allowing many different types of tasks to be accomplished. > Watershed Computations - The Watersheds dialogue works with a surface and optionally a drawing to find watersheds in the surface (regions sharing a common drainage) as well as streams in the surface or upstream areas in the surface from points in a specified drawing. > Profiles and Elevations - The Surface Tools extension adds the ability to work with new Profiles and Elevations components that show cross-sectional cuts through a given path over a surface. > Visibility Analysis - A "viewshed" dialogue that shows areas which are visible from given points. The height of viewing points may be automatically adjusted from a height field. This same dialogue also enables the computation of visibility of cell phone towers or other structures from different locations on the ground. > Extended Interpolation Options - New options in surface generation allow the creation of surfaces from drawings and tables using Gravity interpolation, Median-polish Kriging and triangulation. > Expanded Model Choices for Kriging Interpolation - Added options include Linear, Power, Rational and automatic model choices. > Interpolation Toolbar Operators - New transform toolbar operators are added for interpolation of missing pixels, Interpolate, Interpolate (Parameter) and Interpolate Row. Manifold fully supports 32bit and 64bit platforms as well being potentially crucial crucial for planning of future use and scalability of the MSP supporting system. Manifold also supports computations on NVIDIA CUDA architecture.
Conclusion, suitability for MSP	Plus: Relatively low licence cost, user community and related internet sites. Minus: For MS Windows operating system only.

UMN MapServer	
Type	Open source developed by the University of Minnesota (www.mapserver.org)
Description and application	**UMN MapServer** is a development environment for building spatially enabled internet applications. It can run as a CGI program or via MapScript which supports several programming languages. The original idea comes from 1991 and thereafter MapServer was developed with support from NASA, which needed a way to make its satellite imagery available to the public. Version 1.0 of UMN MapServer was published in 1997 and now UMN MapServer 6.x has been released. It is supported by a diverse group of organisations that fund enhancements and maintenance, and administered within OSGeo (Open Source Geospatial Foundation) by the MapServer Project Steering Committee made up of developers and other contributors. > Advanced cartographic output: o Scale dependent feature drawing and application execution o Feature labelling including label collision mediation o Fully customizable, template driven output o TrueType fonts o Map element automation (scalebar, reference map, and legend) o Thematic mapping using logical or regular expression-based classes > Support for popular scripting and development environments: o PHP, Python, Perl, Ruby, Java, and .NET > Cross-platform support: o Linux, Windows, Mac OS X, Solaris, and more > Support of numerous Open Geospatial Consortium (OGC) standards: o WMS (client/server), non-transactional WFS (client/server), WMC, WCS, Filter Encoding, SLD, GML, SOS, OM > A multitude of raster and vector data formats: o TIFF/GeoTIFF, EPPL7, and many others via GDAL o ESRI shapefiles, PostGIS, ESRI ArcSDE, Oracle Spatial, MySQL and many others via OGR > Map projection support: o On-the-fly map projection with 1000s of projections through the Proj.4 library
Conclusion, suitability for MSP	UMN MapServer is not a full-featured GIS system, nor does it aspire to be. It is, however, a good software for Internet presentations .

GeoServer	
Type	Open source software server written in Java (www.geoserver.org)
Description and application	**GeoServer** allows users to share and edit geospatial data. Designed for interoperability, it publishes data from any major spatial data source using open standards. GeoServer is developed under GNU General Public License. It is also possible to get professional support for installation, training and consultation. One can pay only for the service required , instead of investing in expensive support packages. As a community-driven project, GeoServer is developed, tested, and supported by a diverse group of individuals and organisations from around the world. GeoServer is the reference implementation of the Open Geospatial Consortium (OGC) Web Feature Service (WFS) and Web Coverage Service (WCS) standards, as well as a high performance certified compliant Web Map Service (WMS). GeoServer forms a core component of the Geospatial Web. Active Community modules, for developers to experiment with plug-ins before they are ready for core distribution, including modules for REST Configuration API, as well as using REST for User role management and SLD management. Plus CSV and Excel and HTML Image Map
Conclusion, suitability for MSP	> True open source development style, built by a strong community, which one can join and tailor GeoServer for their needs. > Documentation that details everything in easy to understand language. > Featured in books like GIS for Web Developers. > Active email lists for quick support. > Commercial grade installation, support, customisation and improvements available from an eco-system of companies, non-profits, and consulting individuals.

Tab. 10: Comparison of GIS Systems

In this context it is worth mentioning the Open Geospatial Consortium. OGC is an international industry consortium of 436 companies, government agencies and universities participating in a consensus process to develop publicly available interface standards. OGC® Standards support interoperable solutions that "geo-enable" the Web, wireless and location-based services and mainstream IT. The standards empower technology developers to make complex spatial information and services accessible and useful with all kinds of applications.

OGC is, in fact, a kind of standardisation organisation and all geoprocessing and location service procurement and technology development programs should demand OGC standards. OGC activity is divided into several domains where Government and spatial data infrastructure is most relevant.

10.4. Appendix 4: Transnational projects with MSP relevance

BaltSeaPlan (2009 – 2011)

The Baltic Sea Region Programme 2007-2013 project BaltSeaPlan is the contractor of this study, and is therefore described in detail in the introductory chapter.

MyOcean (2010-2013)

MyOcean is a large EU-funded project responsible for the development of the pre-operational global marine monitoring service (GMES), in the framework of the EU Marine Knowledge 2020 initiative – described in Chapter 3.1.5.

Based on the combination of space and in situ observations and on data assimilation, MyOcean will provide information on the ocean for the large scale (worldwide coverage) and regional scales (main European basins and seas) on such parameters as temperature, salinity, currents, ice extent, sea level, primary ecosystems.

The areas it is aimed at are: Maritime Security, Oil Spill Prevention, Marine Resources Management, Climate Change, Seasonal Forecasting, Coastal Activities, and Monitoring Ice Sheet surveys, Water Quality and Pollution.

MyOcean also proposes a first model of governance for a Marine Service organisation while also preparing a long-term roadmap. By including major European centres involved in operational ocean monitoring & forecasting, by involving users from day one and by fostering scientific excellence, MyOcean coordinates the effort to avoid duplication through an integrated pan-European capacity for ocean monitoring and forecasting.

MyOcean's objective is to set up (definition, design, development and validation) an integrated pan-European capability for ocean monitoring and forecasting, using nationally-available skills and resources.

At the moment, each member state has developed its own capacities in oceanography, at global or regional scale, but the organisations, procedures and operational levels vary widely from one state to another. In the United Kingdom, operational oceanography is managed by a specific department of the Met Office, with strong commitment and strict procedures, whereas in Italy the centre of operational oceanography is part of the research institute for geophysics (INGV). For the Baltic Sea, several bodies have redundant capacities, whereas in France they are shared and grouped together within the same GIP (Mercator Ocean).

The challenges which MyOcean will have to accept will be to:

- avoid resource duplication.
- ensure that all European subsystems are interoperable.
- define the same procedures (quality standards) for development and operational qualification in every (sub)system and ensure they are applied.
- define an architecture which integrates all these capacities (skills and resources) into an operational organisation.
- prove that this organisation is reliable, robust, sustainable and meets the service quality requirements imposed by Europe.

ESaTDOR (2010 - 2013)

ESaTDOR - European Seas and Territorial Development, Opportunities and Risks is a transnational project of ESPON (European Observation Network for Territorial Development and Cohesion) Programme.

Among the main objectives of ESaTDOR are to investigate the current uses of Europe's seas through mapping current sea use patterns, typologies, dynamics and inter-linkages, and analysis of relationships between terrestrial and maritime planning in the search for optimal practices of maritime governance. The data collected should reinforce the ESPON database (compare Chapter 3.5)

The project has so far produced an interim report, which already includes some very interesting findings connected to i.a. marine mapping (Appendix 4) and maritime governance (Appendix 5)

PLAN BOTHNIA (2010 – 2012)

The PLAN BOTHNIA project, coordinated by the HELCOM Secretariat, will test Maritime Spatial Planning in the Bothnian Sea area as a transboundary case between Sweden and Finland. It is an EU Integrated Maritime Policy preparatory action funded by EU Commission DG MARE.

The project will maintain close contact with the joint HELCOM-VASAB Baltic Sea MSP group established in 2010 as well as with i.a. the other EU DG MARE preparatory action MASPNOSE running parallel in the North Sea.

MASPNOSE (2010 – 2012)

MASPNOSE is an EU project on ecosystem based Maritime Spatial Planning in the North Sea, focusing on two cross-border pilot areas: Thornton Bank, 40 km west of Belgium, and Dogger Bank, a large sandbank in a shallow area of the North Sea about 100 km off the east coast of England. MASPNOSE will examine in detail the development of MSP in these countries waters, while focusing heavily on cross-border issues and opportunities in areas shared by them. The project will gather information and analyse the current conditions, including ecological and biological features and human use and its impact.

The objectives of this preparatory action are to:

1. Encourage and facilitate concrete, cross- border cooperation among European countries on ecosystem based MSP through:

- exploration of the possibilities of cooperation among North Sea Countries and the possible nature of an international strategy for the Southern North Sea;
- establishing elements for a common agenda for cooperation of countries around the Southern North Sea;

2. Test the applicability in practice of the 10 key principles for MSP, identified by the Roadmap on MSP, focusing on the cross-border context and identify possible gaps or lessons to be learned, notably through the development of MSP in sea areas shared by several Member States and by drafting maritime spatial plans for selected areas;

3. Identify potential barriers to the implementation of national and cross-border MSP and work out additional recommendations with a view to further development of a common approach towards the application of MSP.

ODEMM (2010 – 2014)

ODEMM (Options for Delivering Ecosystem-Based Marine Management) is a 7th Framework Program project led by University of Liverpool, aimed at developing a set of ecosystem management options that would deliver the objectives of the Marine Strategy Framework Directive, the Habitats Directive, the European Commission Blue Book and the Guidelines for the Integrated Approach to Maritime Policy. The key objective is to produce scientifically-based operational procedures that allow for a step by step transition from the current fragmented system to fully integrated management. Among the planned outputs of this large-scale research project are a web-based model of cost-benefit appraisal across the four study regions, as well as an accessible web-based guide to the toolkit for marine management scenario evaluations. So far there have been no recommendations produced by this project that could contribute to creating the Baltic Sea integrated MSP database.

MESMA (2009 – 2013)

MESMA is a 7th Framework Programme project on monitoring and evaluation of spatially managed marine areas. MESMA will produce guidance and tools to support the implementation of marine spatial planning in Europe's seas. One of the deliverables of this project is the concept of a data model for MSP. Outcomes from this initiative have to be reviewed when they are openly available. These will include advice, tools and information on human uses, biotope classifications/distributions (including examples of geospatial data systems), governance processes and different approaches to conflict management.

COEXIST (2010 - 2013)

COEXIST is a broad, multidisciplinary project which will evaluate competing activities and interactions in European coastal areas. The ultimate goal of the COEXIST project is to provide a roadmap to better integration, sustainability and synergies across the diverse activities taking place in the European coastal zone.

Six case studies from a number of different regions will be taken into consideration. These case studies, representing the specific conditions and combinations of activities of European coastal areas of particular importance for aquaculture and coastal fisheries, will provide data for further analysis and evaluation. Case study results will be compiled in order to identify benefits and bottlenecks for concomitant development. Under consideration are Hardangerfjord (Norway), Atlantic Sea Coast (waters between Ireland and England and Brittany), Algarve Coast (Spain), Adriatic Sea Coast (Italy), Coastal North Sea (Netherland) and Baltic Sea (Aaland Islands).

COEXIST will publish a roadmap for integration of aquaculture and fisheries with other activities in the coastal zone. Other main project outcomes will include characterisation of relevant European coastal marine ecosystems, their current utilisation and spatial management, as well as evaluation of spatial management tools for combining coastal fisheries, aquaculture and other uses, both now and in the future.

KnowSeas (2009 – 2013)

The Knowledge-based Sustainable Management for Europe's Seas (KnowSeas) project is supported by the European Commission under the Environment (including climate change) Theme of the 7th Framework Programme for Research and Technological Development. The 4 -year project has 32 partners from 15 countries and is coordinated by the Scottish Association for Marine Science.

The overall objective of the project is to provide a comprehensive scientific knowledge base and practical guidance for the application of the Ecosystem Approach to the sustainable development of Europe's regional seas. This will increase the evidence base available for decision makers and facilitate the practical implementation of the Ecosystem Approach, currently seen by some stakeholders as confusing and nebulous. It will be delivered through a series of specific sub-objectives that lead to a scientifically based suite of tools to assist policy makers and regulators with the practical application of the Ecosystem Approach. It is also expected to deliver high quality scientific outputs that advance understanding of coupled social and ecological systems.

GAP2 (2011 – 2014)

The EU 7FP Project "Bridging the gap between science, stakeholders and policy makers: phase 2 - Integration of evidence-based knowledge and its application to science and management of fisheries and the marine environment (GAP2)" has 37 partners from 12 countries and is coordinated by CEFAS (UK). The aim of the GAP2 project is to promote and enable processes for open and effective participation of stakeholders in research and management, and to demonstrate through specific examples and critical evaluation, the role and value of stakeholder driven science in the governance of fisheries and the marine environment. The outcomes from GAP2 will provide a concrete realisation of specific Science in Society objectives for engaging the public in research, enabling effective two-way communication between scientists and other stakeholders, and helping to make policy based on scientific evidence and research knowledge.

The GAP2 Baltic Sea Case Study: "Mapping the Baltic Sea fisheries in support of Maritime Spatial Planning"

Objectives of the Baltic Sea Case Study are:

1) to develop a user -friendly "BaltFishPlan" interactive web application to be used for Maritime Spatial Planning related Mutual Learning events,

2) to use the PlayDecide, ConceptMaps and the Bayesian Belief Network methodologies to support the Mutual Learning events,

3) to deliver a series of Mutual Learning events with the aim of developing credible, relevant and sound arguments to be used in balancing environmental, economic and social interests in a process of the Maritime Spatial Planning and in support of the sound governance of the Baltic Sea marine space.

It is expected that the knowledge base collaboratively developed in the course of Mutual Learning events: 1) will encourage communication and/or learning among different stakeholders and between scientists, stakeholders and politicians, 2) will promote co-learning, 3) will be readily translatable across socio-economic groups, and 4) will be suitable for use by members of the larger community. It is also expected that the products generated by tools used in Mutual Learning events will 1) be reasonably accurate and precise, 2) express understanding of uncertainty, and 3) provide results that are readily communicated to target groups, clear and appealing to policy/decision makers.

CHEMSEA (2011 – 2014)

The recently commenced Baltic Sea Region Programme CHEMSEA (CHemical Munitions SEarch & Assessment) project will tackle the problem of World War Two chemical warfare agents at the bottom of the Baltic Sea. It is an applied-science project and the cooperation of leading scientific institutes and maritime decision makers, established in order to assess and minimise risks related to sea-bottom activities near chemical munitions dumping sites. It consists of partners from Poland, Sweden, Finland, Lithuania and Germany.

Besides assessing the probability, range and ecological consequences of the release of sunken munitions, CHEMSEA will detect and map all contaminated areas on the Baltic Sea bed and propose guidelines for submarine operations within these areas. These data and rules of conduct will be of great importance for the future MSP database.

PlanCoast (2006 - 2008)

The INTERREG IIIB NP CADSES Project had 16 partners not only from the Baltic Sea, but also from the Adriatic and Black Sea basins. It was to date the only comparable international MSP project with such a broad geographic scope. PlanCoast was successful in the popularisation of modern GIS in countries that had not introduced such systems before due to high costs and lack of technical guidelines.

Due to the, with some exemptions, generally low level of GIS experience among the partners, no common datasets and only general level recommendations could be produced during this project. These became part of the PlanCoast Handbook on Integrated Maritime Spatial Planning:

Message 7:

Improve quality, comparability and accessibility of spatial data by implementing the EU INSPIRE Directive

Agree on systematic information exchange:

- Link coastal and marine data collection
- Bring together coastal and marine data collection and data management in one institution
- Formalise data flow: create a regularly updated coastal and maritime cadastre

Collect data according to needs:

- For monitoring of trends and sea uses collect relevant data regularly and continuously
- For case specific planning in limited sea areas, collect data according to most acute spatial problems (PLANCOAST 2008, 12).

BALANCE (2005 – 2007)

BALANCE was a project of the INTERREG IIIB Baltic Sea Region Programme, which aimed to develop tools and an agreed template for transnational marine spatial planning and decision-making. BALANCE work highlighted the significance of the "blue corridors" network between protected sites, adding spatial development dimensions to the implementation of the NATURA 2000 Directives and the EU Marine Strategy.

BALANCE project left a large database, which was incorporated into the HELCOM database after project's end. The BALANCE Maritime Spatial Planning Handbook also covers some examples of GIS tools which support decision making in the maritime spatial planning process: biophysical, socio-economical and governance indicators of the management performance. (BALANCE 2008, p. 68-72)

UNESCO IOC MSP Initiative (2006 – 2010)

The purpose of this initiative is to help countries operationalise ecosystem-based management by finding space for biodiversity conservation and sustainable economic development in marine environments. One way to do this is through marine spatial planning (MSP). The work focuses on moving MSP beyond the conceptual level by:

- Developing a step-by-step approach for implementing MSP;
- Documenting MSP initiatives around the world;
- Analysing good practices of MSP;
- Collecting references and literature on MSP;
- Enhancing understanding about MSP through publications;
- Developing capacity and training for MSP.

The UNESCO IOC MSP Initiative aspires to be a good information point about world-wide MSP development, however its website has not been updated since January 2010.

Appendix 5: Current national set-ups for MSP data

Germany

There is a variety of public administrations on both federal and state level which strive for mutual co-operation and assistance with regard to data exchange, but there is as yet no formalised procedure. The ongoing Marine Data Infrastructure Germany "MDI-DE" initiative could ease the situation in the future. Networks are also built during work on maritime spatial plans due to consultations, informal working groups etc.

In terms of data management, Germany is characterised by decentralised data storage and separate handling of EEZ and 12 smz data. Data on offshore activities, hydrographic and some ecological data are stored at the Federal Hydrographic Agency's (BSH) CONTIS database. Other federal ministries and agencies (environment, nature conservation, water and shipping directorates etc.) manage databases on marine ecology, hydrography, geology, nautical issues etc.

Coastal federal states (Länder) are responsible for spatial planning on the territorial sea and collaborate with the respective sectoral state agencies (environment, mining etc.)

Denmark

No established procedures on data provision and exchange - generally free access upon direct inquiry. Some data are available for direct download on the homepages of the institutions responsible. There are however restrictions for specific topics, e.g. security for bathymetry data (only limited resolutions available).

Environmental data are stored at the Ministry of Environment portal: http://www.miljoeportal.dk, including: surface water status, point sources - emission data, nature conservation and natural resources.

Scope: predominantly ecosystem orientated, e.g. eutrophication, habitat quality, noise impact on sea mammals, potential of offshore use (wind parks, sand & gravel extraction areas, large constructions) on water pathways and benthic habitats. NATURA 2000 areas, shipping routes.

Poland

Generally there is agreement to follow the INSPIRE Directive, however insufficient funds and efforts have been currently allocated to its implementation. Currently the largest activity is the creation of the Geoportal as a means of regulating the form of data sharing.

Several agencies share their responsibilities for keeping sector oriented data – like the National Geological Survey for marine geology (part of the OneGeology project), Institute for Meteorology and Water Management (exchanging barely any data from environmental/meteorological/hydrological monitoring), Hydrographic Office of the Polish Navy – working according to S57 standards (also now responsible for implementing INSPIRE regulations in the case of bathymetric data), Maritime Office collecting information from AIS and dangerous goods transport information.

The Ministry of Infrastructure has been appointed as main contact point for the INSPIRE Directive including marine data, however no real human and technical resources have been allocated there. The technical side will be carried out by the agencies and organisations mentioned above. No coordination/contact office established yet.

Sweden

Swedish Standards Institute (SIS) started a Geographic Information Standards Initiative (Stanli). Members of this initiative who work with maritime spatial data are the Swedish Maritime Administration and Swedish Meteorological and Hydrological Institute.

A National Geodata Strategy has been developed covering all strategic issues related to the handling of geodata in Sweden. This strategy is intended to provide guidance for all players in the GI field in Sweden. The strategy is based on well -defined goals and time frames.

The vision for the national geodata strategy, in a 10-year perspective, is that organisations that manage geodata should:

- Generate increased benefits for society through the use of geodata based on cooperation across organisational boundaries at the lowest possible price.
- Link information resources in a network and make them available via homogenous services and uniform descriptions of the information.
- Serve the public and private sectors and citizens and satisfy demands at local, regional, national, European and global levels.

The Geodata Strategy was first published in March 2007, and has been updated every year since then. Several goals in the strategy have already been fulfilled.

The architecture of the future co-operation model was presented in June 2009, while cost benefit analysis including client/supplier needs, agreement and licence models, financing and price models was also produced.

The first version of a Geodata Portal is now in use including WMS services and metadata published by a number of producers. A proposal for a Swedish profile for the metadata standard, SS-ISO 19115, has been decided on while an application which makes it possible for respective authorities to create metadata is available.

As far as the INSPIRE transposition is concerned, the government has proposed that it should be implemented in Swedish legislation through an Act of Parliament and an ordinance.

Lithuania

Lithuania has not yet adopted a concise marine data policy . Relevant data can be collected from various (sectorial basis) data sources:

- • Sea charts with existing obstacles, navigation corridors, anchorages and roadsteads, dumping sites, closed military and restricted areas, offshore installations are officially published by Safety Navigation Administration;
- • Nature protection sites are being designated and mapped by National Agency for Nature Protection (within Ministry of Environment);

Planned activities (such as underwater cables and pipelines, offshore wind parks, extraction sites etc.) and environmental data (habitats, modelling, water depths, sea floor morphology and lithology, birds and fishery, etc) are being collected/developed by Coastal Research and Planning Institute of the University of Klaipeda (CORPI) from various sources such as national and international projects and other initiatives). Marine Research Department within National EPA (part of Ministry of Environment) is performing the National environmental monitoring of the Lithuanian EEZ.

Latvia

Latvia is also characterised by decentralised marine data storage:

- Hydrographic Service of the Maritime Administration of Latvia: information on sea uses (maritime safety information), including data on shipping routes, harbour areas, anchorage areas, dumping grounds, ship wrecks, pipelines, cables, marine protected areas, dumping sites/areas of military chemical waste and ammunition, military practice areas
- Ministry of Economy: areas for exploration and production of hydrocarbons, and investigation areas for offshore wind farm development
- Ministry of Environment and Regional Development: protected areas (protection categories, purpose of designation, data on protected species and habitats)
- Institute of Food Safety, Animal Health and Environment (BIOR): areas important for fisheries and fish reproduction, fishery statistics, catch per each commercial species, data on locations of fishing activity.
- Institute of Aquatic Ecology: modelling and field survey data on habitat distribution
- Marine and Inland Waters Administration of State Environmental Service: data on dredging activities (dumping areas and amount of material dredged)
- Latvian Coast Guard Service: data on ship traffic surveillance (restricted availability, only through specific procedures)

Most of the data are available on official request. Usually a fee is charged for preparation of specific data layers.

Estonia

Environment related data are free for distribution for public purposes. The Estonian Land Board and (www.maaamet.ee) the Estonian Maritime Administration (www.vta.ee/atp) are the central contact point for maritime data. The Estonian Environment Information Centre (www.keskkonnainfo.ee) provides information on environmental parameters.

Finland

The Finnish Council for Geographic Information (FCGI) was established in 2001 to move forward National Spatial Data Information (NSDI). Spatial Data Information are collated in accordance with the Finnish Standard Association (SFS). Since 2001 several acts have been issued which implement the INSPIRE directive in Finnish spatial information. Paikkatietoikkuna (www.paikkatietoikkuna.fi) is the national geoportal in Finland, launched in 2009. This service is not limited to INSPIRE data themes but includes a variety of geodata. The website is updated weekly/monthly while the portal is still under development. Other sources for marine spatial data are several scientific projects and the Finnish maritime administration.

United Kingdom

The first stage of the new system of marine planning in the United Kingdom is the development of the Marine Policy Statement (MPS). The MPS will build upon high level marine objectives and will set out policies for the sustainable development of the UK marine area in one document. It will act as a guide to decision making for the Marine Management Organisation (MMO) and the development of Marine Plans.

The second stage of the new marine planning system is the preparation of a series of marine plans. These will translate the policies in the Marine Policy Statement at local level, applying them in more spatial detail to particular parts of the marine area. Both the Marine Policy Statement and marine plans will guide and direct decisions in the marine environment. Marine plans will be a source of information, which developers and other marine industries can use when considering where and how they might carry out activities.

All these activities are perfectly in accordance with European Marine Strategy Framework Directive (Directive 2008/56/EC), although the UK Government acted earlier. In 2004 the Department for Environment, Food and Rural Affairs (Defra) started a Marine Spatial Planning Pilot. Its final report was issued in February 2006.

In the United Kingdom no central database for marine spatial data exists. Information is scattered among several Internet sites i.e. UK Marine Renewable Energy Resources Atlas (www.renewables-atlas.info/) or GoGeo (www.gogeo.ac.uk/gogeo/). GoGeo is a database for storing metadata information according to ISO 19115 and INSPIRE, but it is slightly wider. Details are in the UK AGMAP 2.1 profile. This profile is extended to support the specialised needs of the academic community and ensure interoperability between other UK and EU spatial data portals. GoGeo has searching, storing and checking functions fully implemented.

Although the GoGeo portal seems to be fully operational and definitely includes more information than the INSPIRE Geoportal, it cannot be recommended for marine spatial planning for the same purposes. Data are stored by their owner and GoGeo has the meta information only.

The UK Marine Renewable Energy Resources Atlas has fewer functionalities. It includes only several thematic maps without any possibilities to extract the data for further use.

USA

The Multi-purpose Marine Cadastre Viewer and Data registry is an integrated marine information system which provides authoritative and regularly updated ocean information including offshore boundaries, infrastructure, human use, energy potential and other data sets. This data viewer provides the baseline information needed for coastal and marine spatial planning efforts, particularly those that involve finding the best location for renewable energy projects. The Multipurpose Marine Cadastre (MMC) is also a helpful tool in the permit review process. Users pick the ocean geography of their choice and quickly see the applicable jurisdictional boundaries, restricted areas, laws, critical habitat locations, and other important features. With the MMC, potential conflicts can be identified and avoided early in the planning process.

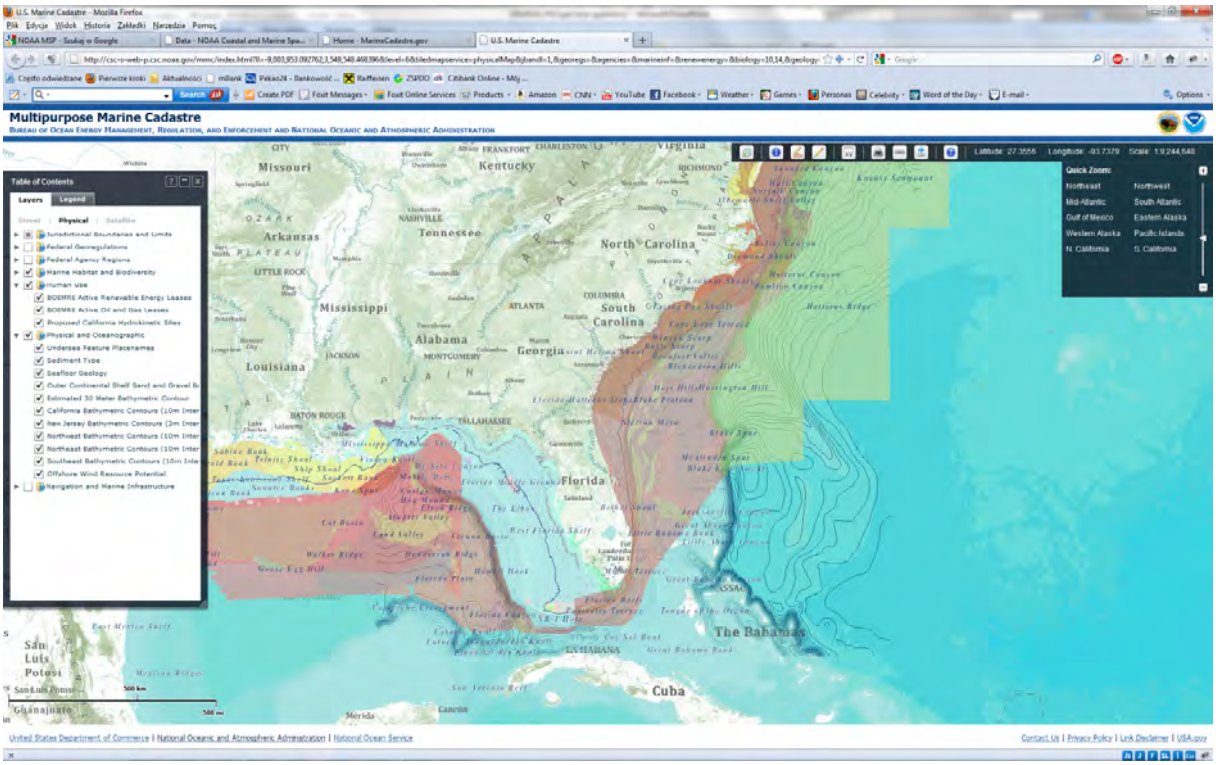


Fig. A4.1: USA Marine Cadastre

10.6. Appendix 6: Databases and geoportals with MSP relevance

EMODnet

Within the Marine Strategy Framework Directive, the Directorate-General for Maritime Affairs and Fisheries (DG MARE) of the European Commission has decided on the creation of pilot components of the **European Marine Observation and Data Network** (EMODnet). The overall objective is to create pilots to migrate fragmented and inaccessible marine data into interoperable, continuous and publicly available data streams for complete maritime basins. The results will help to define processes, most appropriate technology and approximate costs of a final operational European Marine Observation and Data Network.

EMODnet will provide data on scales defined by the regions and sub regions of the Marine Strategy Framework Directive. EMODnet, as an open data system, is also considered as a significant observation and monitoring data conduit for that section of the Water Information System for Europe (WISE) that will deal with marine information (WISE-Marine) and supporting the needs for the initial assessments required by member States in 2012 by the Marine Strategy Framework Directive. WISE and WISE-Marine are thematic branches of the envisaged Shared Environmental Information System (SEIS) based on INSPIRE principles. EMODnet data should be directly available for viewing through WISE-Marine. WISE-Marine is being developed along a timeline, which is in parallel to the EMODnet preparatory actions.

EMODnet (operational 2014)	WISE-Marine
Networking facility for maximising added value from potentially any marine observation and data, supporting the 'services' dimensions of maritime sectors and the knowledge base of the maritime policy.	European portal for marine environmental information, in line with SEIS; Streamlined official reporting channel, reference centre for thematic marine environmental information
Focus on becoming a 'data warehouse' for marine observations for all types of users.	Focus on becoming a 'common reporting and information sharing' facility for communities in the sphere of marine environmental policy.
Regionally coherent, streamlined, raw data sets accessible to all potential users. Discovery, viewing, retrieving. Extensive post-processing into information products not intended.	Prioritised entry levels in WISE-Marine are: 1. Indicators and thematic assessments 2. Access to underlying data 3. Interpretation in order to derive environmental meaning from data.

Tab. 11: Comparison EMODnet vs. WISE-Marine (EMODnet 2009, 41)

As preparatory actions, EMODnet has developed **five pilot portals**: EMODnet -hydrography, marine biology, marine chemistry, marine geology and marine habitats.

The main purpose of these portals is to allow the user download of data products for further analysis and to make it available for combination with data products from other portals. The portals also provide search options and access to data that are managed by a range of decentralised sources and organisations.

Future EMODnet actions will partly depend on the outcome of these preparatory actions. Should these prototypes prove to be successful, then efforts will be made to extend their geographic range in order to cover all of the waters of EU Member States for one set or parameters or more ..

The OneGeology–Europe portal is fully functional and has a full suite of map layers for onshore data, however the offshore layers are currently under development. Only the sea-bed sediment layer is available but other map layers will be added soon and updated throughout the duration of the EMODNET-Geology project.

GMES

Parallel to EMODnet, a prototype marine service portal called Global Monitoring for Environment and Security (GMES) was launched in spring 2009 as one of the preparatory actions of the EU Marine Knowledge 2020 initiative. It provides access to seamless layers of bathymetric (water depth), geological, physical, chemical, biological and habitat data for selected sea basins. It includes facilities for users to provide feedback so that the services offered can progressively meet the requirements of the target users – industry, public authorities and academia.

Today, GMES services address six main thematic areas, among them marine environment monitoring, currently provided through the EU-funded project MyOcean (see Appendix 4)

INSPIRE GeoPortal

INSPIRE is the name of a European directive developed for describing meta data for spatial applications. It addresses 34 spatial data terms needed for metadata description. Full implementation of the directive is expected in May 2019.

INSPIRE describes sea (marine) region as a defined area of sea with common physical or chemical characteristics. An Ocean Geographic Feature represents the (physical or chemical) properties of the Sea Region. A Sea Region may have other properties that are not an Ocean Feature, for example bathymetry (Elevation theme). A Sea Region will typically be represented as a vector dataset whereas an Ocean Geographic Feature will be a raster or coverage type". For data services related to marine spatial planning, Ocean Geographic Features, Bio-geographical regions, Habitats and biotopes, Species distribution, Energy Resources and Mineral Resources are the most relevant themes. A full list is included in Chapter 3.1.3

Another aspect of INSPIRE which affects the Data Model for MSP are protected sites. Within the INSPIRE context, Protected Sites may be located in terrestrial, aquatic and/or marine environments, and may be under either public or private ownership. They may include localities with protection targets defined by different sectors and based on different objectives. Objectives for protection may include: the conservation of nature; the protection and maintenance of biological diversity and natural resources and the protection of man-made objects including buildings, prehistoric and historic archaeological sites, other cultural objects, or sites with specific geological, hydrogeological or geomorphological value. Protected Sites may receive protection due to more than one type of objective, and may have a double or multifarious designation status.

Protected sites may differ greatly in their reasons for protection, their designation and their management. Examples of legislation under which Protected Sites included in this INSPIRE theme are designated, managed and regulated include:

- Habitats Directive (1992) (Directive 92/43/EC);
- Birds Directive (1979) (Directive 79/409/EC);
- Water Framework Directive (2000) (Directive 2000/60/EEC)
- World Heritage Convention (1975);
- Ramsar Convention (1971);
- Barcelona Convention (1976);
- Helsinki Convention (1974);
- OSPAR Convention (1992) and
- national laws of each European country and EU and international sector policies (for example, relating to forests or fisheries).

Metadata element	Multiplicity	Condition
1.1 Resource title	1	
1.2 Resource abstract	1	
1.3 Resource type	1	
1.4 Resource locator	0..*	Mandatory if a URL is available to obtain more information on the resource, and/or access related services.
1.5 Unique resource identifier	1..*	
1.7 Resource language	0..*	Mandatory if the resource includes textual information.
2.1 Topic category	1..*	
3 Keyword	1..*	
4.1 Geographic bounding box	1..*	
5 Temporal reference	1..*	
6.1 Lineage	1	
6.2 Spatial resolution	0..*	Mandatory for data sets and data set series if an equivalent scale or a resolution distance can be specified.
7 Conformity	1..*	
8.1 Conditions for access and use	1..*	

8.2 Limitations on public access	1..*	
9 Responsible organisation	1..*	
10.1 Metadata point of contact	1..*	
10.2 Metadata date	1	
10.3 Metadata language	1	

Tab. 12: Elements of Metadata

Legal documents and the implementation progress status of the INSPIRE directive are available from the dedicated website, where a prototype of a Geoportal for visualisation of stored meta data has also been implemented. For spatial data corresponding to Annex III, metadata will be available on the INSPIRE Geoportal at the end of 2013. This portal has several functions, which have to be considered in the preparation of a data model suitable for the marine spatial planning system.

The most attractive functionality of the portal is the possibility to search data with keywords (functions Discovery and Viewer), resource type or topic categories (spatial data terms). As result, apart from detailed metadata information, the spatial range of the requested data set can also be viewed. This feature is shown on Figure A5.1

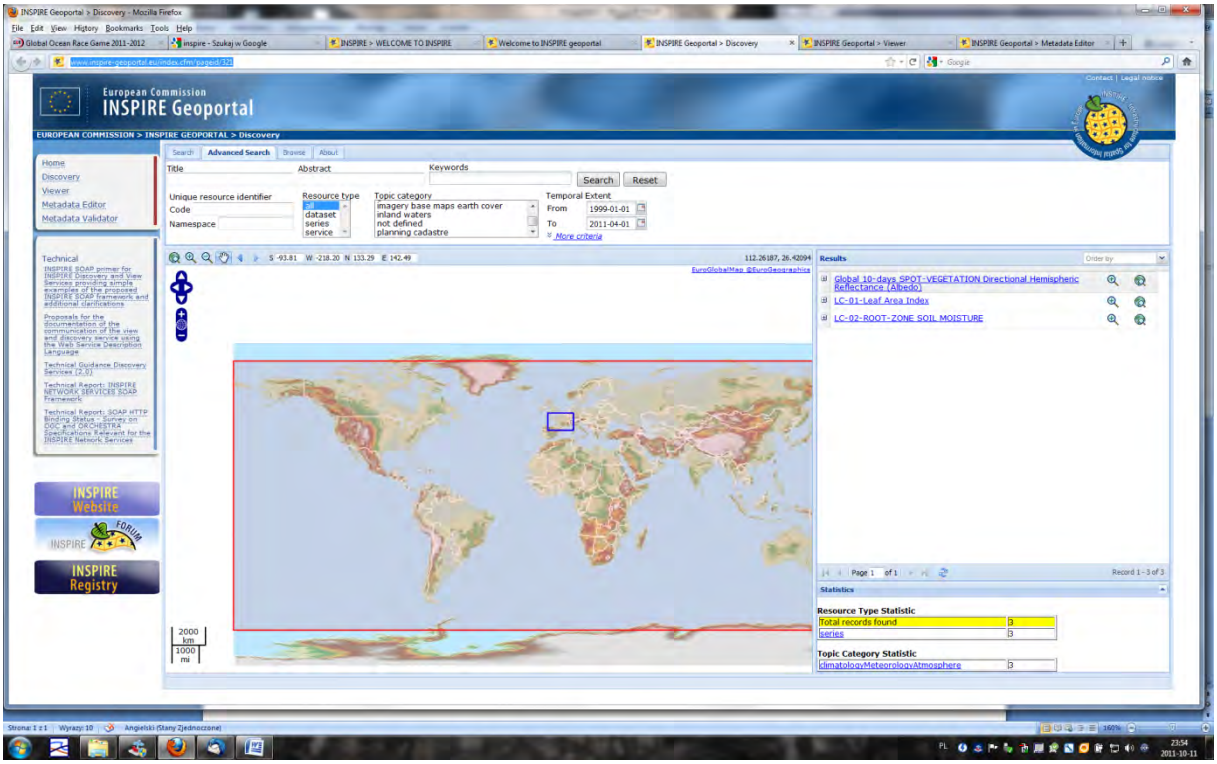


Figure A5.1: Searching in INSPIRE Geoportal with visualisation of spatial data range.

The next feature of INSPIRE Geoportal is its metadata editor, which helps to prepare a dataset description record following the rules defined within the INSPIRE directive. The fields are divided into Mandatory, Conditional and Optional. Conditional fields become Mandatory when certain conditions are met.

The metadata validator makes a complete check of meta data accordance with the INSPIRE directive based on EN ISO 19115 and EN ISO 19119. This check includes, beside contents, also a file format of metadata.

Table 12 Metadata for spatial datasets and spatial dataset series specified in Regulation 1205/2008/EC (implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata)

Data in the INSPIRE Geoportal are divided into metadata (MD) and Data Sets (DS), only metadata are provided but for free distribution. The overview of the technical architecture of INSPIRE Geoportal is shown in Fig. A5.2

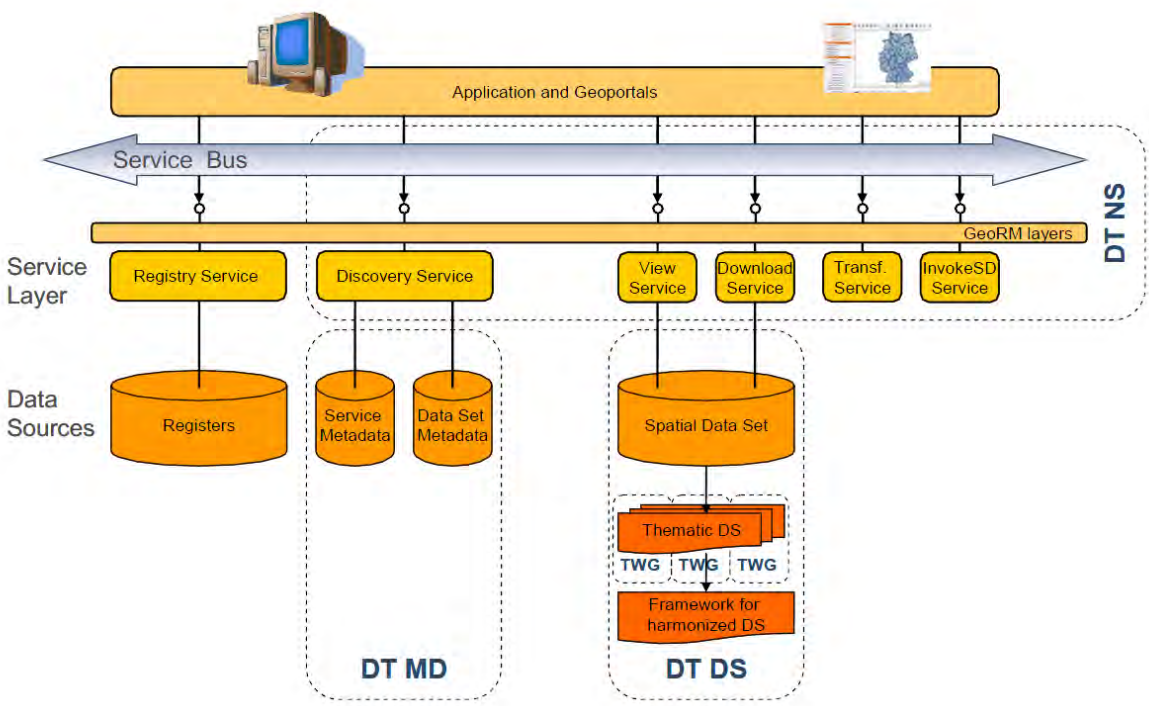


Fig. A5.2: INSPIRE technical architecture overview. (INSPIRE Technical Architecture – Overview, EU 2007)

The core resource in the diagram is the actual content, i.e. the spatial data in spatial data sets. All other resources shown in the diagram, e.g. data set metadata, are only needed to find, access, interpret or use the spatial objects in the spatial data sets that form part of the infrastructure. (INSPIRE Technical Architecture – Overview, EU 2007).

The data model of INSPIRE proposes the use of several registers of defined values for metadata and data attributes (**vocabularies**). According to the INSPIRE technical architecture overview these are as follows:

- **Data specifications:** Detailed description of one or more data sets that will enable it to be created supplied to and used by another party.
- **Feature catalogues:** Catalogues containing definitions and descriptions of the spatial object types, their attributes and associated components occurring in one or more data sets, together with any operations that may be applied. Part of a data specification.
- **Application schemas:** Conceptual schema for data required by one or more applications. Part of a data specification and specified in a formal conceptual schema language (UML in INSPIRE).
- **Code lists:** Dictionary describing the attribute value domains for selected property types in a feature catalogue/application schema. Unlike enumerations, the value domain is not fixed in the feature catalogue/application schema, but is managed separately. i.e. this establishes a controlled vocabulary outside of the application schema.
- **Coordinate reference systems and operations:** Dictionary of coordinate reference systems, datum, coordinate systems and coordinate operations used in data sets.
- **Units of measurements:** Dictionary of units of measurement used in data sets.
- **Spatial object identifier namespaces:** A mechanism is required to guarantee uniqueness of object identifiers across various content providers. One approach is to use existing “local” identifiers of the provider, but define namespaces to distinguish between different providers (and between different offerings of a provider). These namespaces required management..
- **Service types:** List of service types (service taxonomy).

The structure of the data specifications is based on the “ISO 19131 Geographic information – Data product specifications” standard. They include the technical documentation of the application schema, the spatial object types with their properties, and other specifics of the spatial data themes using natural language as well as a formal conceptual schema language11. A consolidated model repository, feature concept dictionary, and glossary are being maintained to support the consistent specification development and potential further reuse of specification elements. The consolidated model consists of harmonised models of the relevant standards from the ISO 19100 series, the INSPIRE Generic Conceptual Model and the application schemas developed by

each spatial data theme. The multilingual INSPIRE Feature Concept Dictionary contains the definition and description of the INSPIRE themes together with the definition of the spatial object types present in the specification. The INSPIRE Glossary defines all the terms (beyond the spatial object types) necessary for understanding the INSPIRE documentation, including the terminology of other components (metadata, network services, data sharing, and monitoring).

For providing a basis for the interoperability of spatial data in INSPIRE, the data specification development framework and the thematic data specifications can be reused in other environments at local, regional, national and global level, contributing to improvements in the coherence and interoperability of data in spatial data infrastructures.

The INSPIRE Geoportal could be a powerful tool for spatial planning, but it does not include the data itself. It could help to find, if not the desired data set, then the person or institution responsible for this data. On the other hand, data searching could be limited to a small area of interest.

The other current disadvantage of the INSPIRE Geoportal is the brevity of regional data. This is a problem for the content of this database only, because the storage of meta data information for small scale spatial data is essentially possible. In short, the features of the INSPIRE Geoportal are not currently fulfilling the needs of marine spatial planning. On the other hand, the final assessment of the INSPIRE Geoportal can only be made after December 2013, when the last component is implemented.

ICES GeoPortal

The International Council for the Exploration of the Sea (ICES) coordinates and promotes marine research on oceanography, the marine environment, the marine ecosystem, and on living marine resources in the North Atlantic. Members of the ICES community now include all coastal states bordering the North Atlantic and the Baltic Sea. ICES cooperates with organisations and institutes on an international scale and maintains some of the world's largest databases on marine fisheries, oceanography and the marine environment and its Data Centre is part of a global network of distributed data centres.

Data in ICES GeoPortal are divided into five thematic areas:

- Biological community,
- Contaminants and biological effects,
- Fish predation (stomach content),
- Fish trawl survey,
- Oceanographic.

Metadata are stored according to the ISO 19115 norm.

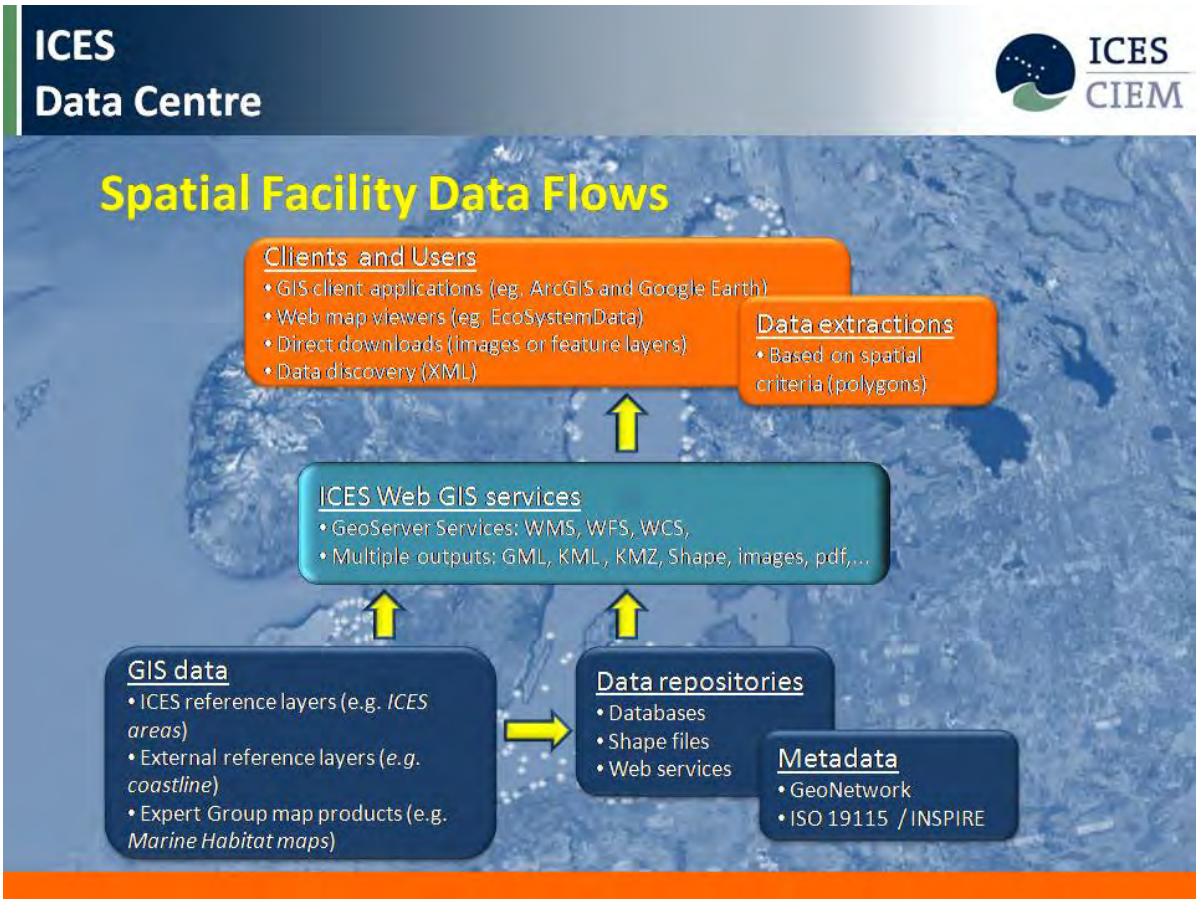


Fig. A5.3: Data flow in ICES GeoPortal (source: ICES)

Only the amount and positions of data can be shown on the map. It is possible to see and download meta data. It is difficult to work with this database for MSP purposes but it can be regarded as a good source for historical data for scientific purposes.

HELCOM database

One of the main roles of HELCOM is to act as a regional environmental focal point providing information about the state of, or trends in, the marine environment and the efficiency of measures to protect the Baltic Sea. In recent years, HELCOM has increasingly been using geographic information systems (GIS) for analysing data and to visualise complex scientific information on both static maps, as well as interactive internet-based maps.

According to the HELCOM data and information strategy, HELCOM data and information activities should make it possible to produce assessments of pollution loads and their effects on the Baltic Sea marine environment, facilitate decision making of the Contracting Parties in environmental management and make environmental information accessible for the general public.

The new HELCOM map and data service allows interested users to access a wide range of data on activities and pollution loads affecting the Baltic Sea marine environment, also including information about monitoring activities and regional preparedness for accident response. Users can view, create and save/print their own maps, download datasets, and create live links to the HELCOM GIS website via the new HELCOM map and data service.

The main objective of the HELCOM map and data service is to make environmental information accessible for interested users and the general public. The map and data service aim to be easy to use, intuitive and attractive, with a similar look and feel as Google Maps, Bing Maps, etc.

The new map and data service is based on ESRI's ArcGIS Server and Flex development platform. Through the HELCOM map and data service, users are able to:

- Visualise, analyse and search Baltic Sea environmental data.
- Draw and save or print their own maps

- Download ESRI shapefiles
- Access layers in OGC WMS standard protocol

Technically, the HELCOM database could be a good base for MSP purposes, but there are two inconveniences. The first is problems with zooming the GIS browsers down to the resolution needed for planning, e.g. in the case of positioning pipelines and undersea cables, where approximately 5 m accuracy is required. The second obstacle is the lack of comprehensive and up-to-date data on human activities.

EUROSION GIS Database

EUROSION is a European initiative for sustainable coastal erosion management. As part of its objectives, it has produced a GIS database at a scale of 1:100,000, meant to provide baseline information on the different factors influencing coastal erosion processes and the value of assets at risk. The full GIS database is part of the Geographical Information System of the European Commission. Most 90on o90 data layers are also freely accessible and may be downloaded from the European Environment Agency website.

The EUROSION GIS database covers the following thematic layers:

- Terrestrial Administrative Boundaries
- Maritime Boundaries
- Shoreline
- Bathymetry
- Elevation
- Geomorphology and geology
- Erosion trends and coastal defence works
- Hydrography
- Infrastructure
- Wave and wind climate
- Tidal regime
- Sea level rise
- Land cover and land cover changes since 1975
- Areas of high ecological value

European Atlas of the Seas

As one output of the EU Integrated Maritime Policy, a new webmap service, the European Atlas of the Seas has been created. It provides basic information (fact sheets) as well as very general spatial information for the major EU sea basins, among them the Baltic Sea. The available information, e.g. on marine protected areas, type of coastline, bathymetry, fish stocks etc. can only give an overview of the main issues but is by no means suitable for scientific nor spatial planning purposes, as the maximum resolution is 1: 2 000 000.

Marine Data Infrastructure Germany (MDI-DE)

MDI-DE is a section of the GDI-DE (Geodata Infrastructure for Germany) networking initiative, driven by the coastal Länder and the leading German marine science institutes, which started in 2010 and is expected to deliver all results by 2013.

The MDI-DE will achieve the networking of spatial data across administrative boundaries. Complex decision-making processes in industry and policy, e.g. on issues of environmental protection, safety or the location of off-shore investments can thus be effectively supported. The construction and operation of the MDI-DE is embedded in the EU legislative framework such as the INSPIRE Directive.

MDI-DE will develop prototype tools for aggregation and harmonisation of marine data in preparation, such as , for example, the presentation of time series, profiles and maps, to enable user-controlled access to the data. Transformation tools will be created for the adaptation of reference systems and map projections, for the conversion of physical and chemical units and fixed term for the grouping in classes of biological or earth sciences.

MDI-DE feeds data i.e. . to the GeoPortal.Bund. Since the release of the **GeoPortal.Bund** in October 2005, the geodata search engine GeoMIS.Bund (Ordinary Search, Extended Search), in operation on the internet since as early as 2003, has been integrated into a new technical platform, which allows visualisation of decentrally kept

data from different public institutions. This way, the user can view geodata found on interactive maps and combine them as desired (Baseviewer, Expertviewer). In the years to come, other functionalities will follow, among them further extension to a WebGIS (GIS = GeoInformationSystem), by means of which geodata will be visualised not only as a map image, but also processed and ordered by the user.

BSH CONTIS

The German Federal Hydrographic Agency (BSH) is a well-known source of navigation charts and maritime data for the German part of EEZ, territorial sea and adjacent sections of international waters. The GeoSeaPortal developed by the BSH is a tool allowing the search for scientific information using a meta-information system and a harmonised presentation of records found in the form of the interactive maps offered by (WebGIS).

GeoSeaPortal draws on the following databases:

- Continental Shelf Information System (CONTIS)
- Nautic-hydrographic information system (Nauthis)
- Water pollution (GVU)
- Marine Environmental Monitoring Network (MARNET)
- Remote Sensing
- Sea Surface Temperature (SST)
- Prediction Model
- Shelf Geo Explorer (SGE)
- Marine Environment Database (MUDAB)

The Continental Shelf Information System (CONTIS) was developed by the BSH to present the different maritime uses on the German continental shelf and exclusive economic zone. Digital maps can be downloaded which show i.e. the proportional area of each use, overlapping uses and areas free from use. CONTIS is thus intended to be used for maritime spatial planning purposes, its application, however, is currently limited due to its large scale and lack of possibility to view all the details on charts.

10.7. Appendix 7: BSP Data Model Structure

The BSP Data Model Structure is attached in electronic form.

The BaltSeaPlan project in general

Activities

BaltSeaPlan activities were designed to support all major aspects of maritime spatial planning within the Baltic Sea region:

> Improving the joint information base / stocktaking for maritime spatial planning:

A forum for dialogue bringing together spatial planners and scientists and identify sources of data / information. Compiling current uses, conflicts and natural values of the Baltic Sea. Filling data gaps, exchange of data, improve integration of ecological and socio-economic data sets, identify relevant modelling methods, clarify MSP data needs.

> Including Spatial Planning in National Maritime Strategies

Assessment of national frameworks, methodologies and sectoral strategies that influence the use of sea space (e.g. energy, fishery, transport, tourism, as well as nature conservation)

Developing recommendations on spatial issues within National Maritime Strategies.

Exploiting the visions to foster a national cross-sectoral debate, discussing goals & targets for dealing with space and filling gaps in national sectoral policies & strategies

> Develop a Vision for Maritime Spatial Planning in the Baltic Sea 2030

taking into account transnational interdependencies and cumulative impacts

initiate a Baltic Sea region wide campaign as to discuss the BaltSeaPlan Vision 2030

> Demonstrate MSP in 8 pilot areas

- Danish Straights / T-Route (DK)
- Pomeranian Bight (DE/DK/SE/PL)
- Western Gulf of Gdansk (PL)
- Middle Bank (SE/PL)
- Lithuanian Sea (LT)
- Latvian Sea (LV)
- Pärnu Bay (EE)
- Hiiumaa and Saaremaa Islands (EE)

> Lobbying and capacity building for MSP

- stakeholder involvement & participative planning methods
- BaltSeaPlan series of guidelines & policy recommendations
- workshops & conferences for decision-makers

Partners

Germany

- Federal Maritime and Hydrographic Agency (BSH), Lead Partner
- Ministry of Energy, Infrastructure and Regional Development of Mecklenburg-Vorpommern
- WWF Germany, Baltic Sea Unit

Poland

- Maritime Office in Szczecin
- Maritime Office in Gdynia
- Maritime Institute in Gdańsk

Denmark

- Department of Bioscience, Aarhus University (formerly National Environmental Research Institute – NERI)

Sweden

- Royal Institute of Technology (KTH)
- Swedish Environmental Protection Agency

Estonia

- Estonian Marine Institute of University of Tartu
- Baltic Environmental Forum Estonia

Lithuania

- Klaipėda University Coastal Research and Planning Institute (CORPI)
- Baltic Environmental Forum Lithuania

Latvia

- Baltic Environmental Forum Latvia

BaltSeaPlan Publications

- BaltSeaPlan Findings
- BaltSeaPlan Vision 2030 – Towards the sustainable planning of Baltic Sea space
- Become a Maritime Spatialist within 10 Minutes (EN, DE, LV, LT, PL, EE)
- BaltSeaPlan Bulletin #1
- BaltSeaPlan Bulletin #2
- BaltSeaPlan Project Flyer (EN, DE, LV, LT, PL, EE, SE)

BaltSeaPlan Reports

Impact Assessments

1 - Strategies with relevance for Estonian maritime space
2 - Strategies with relevance for German maritime space
3 - Strategies with relevance for Latvian maritime space
4 - Strategies with relevance for Lithuanian maritime space
5 - Strategies with relevance for Polish maritime space
6 - Strategies with relevance for Russian maritime space
7 - Strategies with relevance for Swedish maritime space
8 - Implications of the international and national policy context for Baltic Sea space and MSP

Pilot MSP reports

9 - Developing a Pilot MSP for the Pomeranian Bight and Arkona Basin
10 - Developing a Pilot MSP for the Middle Bank
11 - Developing a Pilot SEA for the Western Gulf of Gdansk
12 - Preparing for a MSP at the Danish Straits
13 - Towards a Pilot MSP for the Pärnu Bay
14 - Towards a Pilot MSP for the Saaremaa and Hiiumaa Islands
15 - Towards a Pilot MSP for the Lithuanian Sea
16 - Developing a Pilot MSP for the Western Coast of Latvia

MSPs and SEA

17 - Pilot MSP for the Western Coast of Latvia (LV)
18 - SEA for the Western Gulf of Gdansk (PL)

Technical reports

19 - Modelling for MSP – Tools, concepts, applications
20 - Data exchange structure for MSP
21 - Effects of underwater noise on harbour porpoises around major shipping lanes
22 - Remote sensing methods for detecting small fishing vessels and fishing gear
23 - Legal and planning options for integrating fisheries into Maritime Spatial Planning
24 - Stakeholder Involvement in MSP
25 - SEA in MSP: Recommendations from the German and Polish experience
26 - Fisheries in the MSP context
27 - Seabed and habitat mapping in the Hatter Barn area
28 - BaltSeaPlan Web-advanced tool in support of MSP
29 - Case Study: Systematic site selection for offshore windpower with Marxan in the pilot area Pomeranian Bight
30 - Case Study: Site selection of fisheries areas for MSP
31 - Recommendations for legislative action regarding the MSP in Europe

Maritime Spatial Planning (MSP) has become a widely acknowledged and necessary tool for co-ordinating spatial use and balancing of interests in the sea. In view of expanding activities such as offshore wind energy parks and growing shipping traffic and at the same time increasing needs to protect the marine environment a systematic, integrative and forward-looking planning is required in order to safeguard the sustainable development of the seas. Currently, however, this tool is far from being established practice.

The 3.7 million € INTERREG IVB project "BaltSeaPlan" (2009–2012) has been the largest project in recent years dealing with maritime spatial planning throughout the Baltic Sea Region. Under the lead of the German Federal Maritime and Hydrographic Agency (BSH) and covering partners from all Baltic Sea countries (except Finland) the project has not only developed pilots in 8 demonstration areas, but also advanced methods, instruments & tools as well as data exchange necessary for an effective maritime spatial planning.

The results of BaltSeaPlan are published in a series of reports all available for free download under www.baltseaplan.eu.

Good knowledge of the sea and the trends & pressures it faces is essential for MSP to be delivered successfully. For this data needs to be translated into spatially relevant information and cooperation has to be ensured among data networks so that information is easily accessible when needed. The BaltSeaPlan Report N° 20 - " Integrated Pan-Baltic Data Infrastructure for MSP – Framework Analysis and Recommendations for an MSP Data Model, Data Exchange and Good Governance" identifies content related and technical conditions as well as problems & gaps associated to data and information sources at the current stage. Further it describes the conceptual data model for MSP developed within the framework of BaltSeaPlan and provides recommendations on the steps which need to be gone, in order to reach the information basis necessary to undertake MSP at satisfactory level within the BSR.

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