Melles, Johannes; Lehfeldt, Rainer

Management of Marine Data in Germany

ICHE 2014, Hamburg - Lehfeldt & Kopmann (eds) - © 2014 Bundesanstalt für Wasserbau ISBN 978-3-939230-32-8

Management of Marine Data in Germany

J. Melles
Federal Maritime and Hydrographic Agency (BSH), Germany
R. Lehfeldt
Federal Waterways Engineering and Research Institute (BAW), Germany

ABSTRACT: Current questions related to changes to marine ecosystems, global warming and the resulting requirements for costal protection as well as reporting obligations of the European Union with respect to effective framework directives (INSPIRE, MSFD etc.) require interdisciplinary access to the related spatial data. Therefore an integrated national marine and coastal information system was set up within the co-operative project "Marine Data Infrastructure (MDI-DE)". Coastal and marine data collected by 11 Federal and State agencies are made available by OGC compliant Web services and documented with metadata according to the ISO standard. A new Web portal serves as central entry point for data and information from the German coastal zone and the adjacent marine waters. This facilitates intersectoral views of resources by providing technological solutions of networking and distributed data management. The benefit of hosting the data locally is that the data from different sources could be merged in almost any way, custom-made compositions of thematic data layers can be compiled without touching the data itself. The MDI-DE infrastructure is permanently maintained at BSH as a joint project of Federal and State ministries under the guidance of a steering group.

Keywords: Marine data infrastructure, Web services, Metadata, INSPIRE, MSFD

1 INTRODUCTION

Governmental agencies collecting environmental data are subject to many reporting commitments. Especially in Europe there is a multitude of reporting duties to comply to. For example, in 2007, the INSPIRE-Directive (European Parliament and Council 2007) entered into force to establish an infrastructure for spatial information in Europe with common implementing rules for a number of specific topics such as metadata, data specifications, network services, data and service sharing as well as monitoring and reporting. But also other directives and international conventions require data and metadata: The Marine Strategy Framework Directive MSFD (European Parliament and Council 2008), OSPAR and HELCOM (Regional Conventions to protect the environment of the North East Atlantic, 1992, and the Baltic Sea, 2000) are only the most prominent. The federal structure of Germany leads to 11 different agencies or institutes which are thematically or geographically responsible for the marine environment, marine conservation and coastal engineering.

2 ELEMENTS OF DATA INFRASTRUCTURES

During the development of the “Marine Data Infrastructure in Germany (MDI-DE) one of the goals was to use INSPIRE regulations, guidelines and specifications wherever possible (Lehfeldt and Melles 2011). In this way, the distributed data concerning both the German coastal and the German exclusive economic zone are processed according to the requirements for data provision by EU member states. A large number of marine monitoring and surveying data has to be provided according to technical interoperability, i.e. data access via OGC web services WMS, WFS and WPS (Open Geospatial Consortium 2011), data

documentation via ISO metadata (ISO 19115:data and ISO 19119:services) (International Standard Organization 2003) as well as the paradigm of seamless data, i.e. data harmonization.

During the work on MDI-DE between 2010 and 2013, well established German coastal metadata systems and marine information systems were merged into a novel spatial data infrastructure for marine data composed of the following infrastructure elements:

- a multidisciplinary network for integrating the major coastal data sources,
- an open number of distributed Web servers located at Federal and State public authorities and research centers,
- a new Web portal for Ocean and Coast, MDI-DE,
- a comprehensive national Ocean and Coastal Information System as catalog services CS-W
- providing data mining web services for data visualization and for data download,
- a coastal thesaurus for controlled vocabulary making use of semantic technologies,
- a coastal gazetteer for documenting geographic names of features which can change shape, location and names over time, and
- a coordinated working environment relying on metadata and Web services.

The obvious benefits of this joint effort, i.e.:

- comprehensive provision of distributed marine data,
- improvement of workflows with data from heterogeneous coastal sources to produce data products to support political and economic decisions as well as for reporting and presentation in different target systems

have been recognized and as of 2014, MDI-DE is in operational mode with joint financing from Federal and State agencies.

2.1 *Technical Infrastructure*

Data and metadata of the MDI-DE partners are maintained in distributed infrastructure nodes. This denotes the hardware and software of a local server architecture, which is used to manage and deploy spatial data and metadata via standardized services. According to the Publish-Find-Bind-principle the individual components interact with each other by services compliant with Open Geospatial Consortium (OGC 2011) standards.

Binder (2012) gives a comprehensive description of infrastructure nodes which can be set up differently. There is no demand, which Software or Hardware has to be used. The only thing which is mandatory is that all the services provided by the infrastructure nodes are OGC-compliant and that the metadata is produced according to a specific marine profile. As an example the infrastructure node from the Federal State of Lower Saxony is shown in Fig. 1.

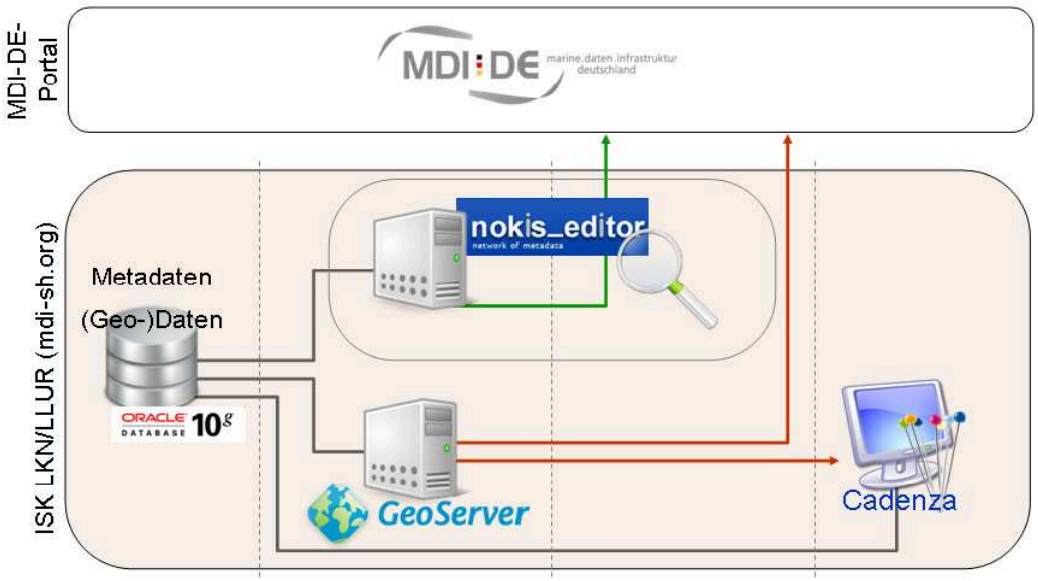

Figure 1. Elements of the MDI-DE infrastructure node in the Federal State of Lower Saxony. Red arrows denote WMS and WFS, the green arrow indicates the flow of metadata via CS-W and harvesting by the MDI-DE Web portal.

Any information flow is directed towards the MDI-DE Web portal, which is the central node of the MDI-DE network. Being implemented by standardized OGC Web services for viewing WMS, downloading WFS and searching CS-W, the information hosted at distributed infrastructure nodes can thus be used in another context, which also relies on these standards. In the case of Lower Saxony shown in Fig. 1 all spatial data and metadata are stored in an Oracle database which is supplemented by the GeoServer for publishing the WMS and WFS. The second component for maintaining metadata is in this case a metadata editor developed for information concerning the German coastal zone (Lehfeldt et al. 2008). The standardized services provided by these two servers of the local cyber infrastructure are utilized in the central Web portal of the MDI-DE as well as in the local portal based on the Cadenza software.

In order to speed up response times in the Web portal, the distributed metadata is harvested at the central MDI-DE node using the CS-W interfaces. The services provided are currently available free of charge and there are no plans to introduce a billing system.

2.2 *Metadata and spatial data from the German coastal zone*

The European Water Framework Directive (WFD) adopted by the European Parliament and Council (2000) calls for novel information management in the member states and for automated workflows to meet reporting requirements. Lehfeldt and Reimers (2004) point out the importance of standardized metadata for these obligations, which help to discover and share relevant and timely information from distributed data sources. The Water Information System for Europe WISE maintains a Web portal, water.europa.eu, presenting the current status and activities within this thematic network.

Cross-boundary information exchange becomes an important issue when considering catchment areas, for example. Apart from producing seamless geographic data, there may be diverse vertical reference systems in place, and different units or measurement methods may be applied. To be able to harmonize available data with transformation algorithms for an integrated view and analysis these must be documented.

Already in 2003, the NOKIS group (Lehfeldt and Heidmann 2003) agreed on a metadata profile for the coastal zone, which addresses these issues in a more detail. The selected metadata elements put equal emphasis on horizontal information flow between the actors involved in collecting data and creating data products for public information and vertical information flow between either hierarchical or cascading information systems.

The agreed Coastal Zone Metadata Profile meets all requirements of existing German information systems (German Environmental Information Portal, www.portalu.de, Federal Spatial Data Portal, www.geoportal.de). Therefore, once an information resource like a dataset, a map, an image, etc. has been documented with this profile it can be discovered by these national portals and by the MDI-DE portal, in par-

ticular. Without further editing its metadata are valid in multiple environments and, most importantly, they comply with the European INSPIRE directive.

2.3 *Web services for Metadata*

Preparation, maintenance and use of metadata in the MDI-DE are described in a Metadata Guide by Wosniok und Räder (2013). The INSPIRE directive requires metadata for both the spatial-datasets and the Web-services related to these data.

For INSPIRE the German metadata is made available through the national spatial data infrastructure GDI-DE (Geodateninfrastruktur Deutschland 2008) which has been designed to provide metadata for this purpose. To provide the metadata for the marine areas the local infrastructure nodes of the MDI-DE partners are harvested by GDI-DE. To make sure that all the national metadata complies with the INSPIRE requirements GDI-DE provides a test suite for checking the data which is also used by MDI-DE.

Efficient search clients implemented in Web portals rely on consistent metadata for spatial datasets and Web-services. An index is used in the portals of GDI-DE and MDI-DE to first register all existing metadata records within the network and then associate data and services in a second step. This mechanism allows result lists on the portals to display the records found together with related services for their visualization and download.

3 SUSTAINABLE APPLICATION

The participating agencies or institutes are thematically or geographically responsible for the marine environment, marine conservation and coastal engineering. Their spatial data are made available by OGC compliant Web services and documented with metadata according to the ISO standard thus fulfilling the INSPIRE interoperability requirement. The Web portal www.mdi-de.org serves as central entry point for data and information from the German coastal zone and the adjacent marine waters. This facilitates intersectoral views of resources by providing technological solutions of networking and distributed data management.

Figure 2. Web portal Marin Data infrastructure Germany – MDI-DE

To achieve a seamless integration, each node within the network needs to be equipped with a few basic components (see Fig. 1):

- services for data provision like view-services and download services,
- metadata to facilitate the discovery of relevant information provided as a catalog-service
- a database as a storage from which the services can be produced and published.

For the provision of spatial data, the Open Geospatial Consortium (OGC) has developed a number of open and international standards. The most appropriate in this context are the Web Map Service (WMS) to generate and visualize digital maps in the Web and the Web Feature Service (WFS) to download the data in an interoperable form such as GML. For both several software packages in the Open Source and commercial sector are available which can easily be used. The underlying database needs to support these services. This can be achieved by either installing a spatial database dedicated for this purpose or adding a data view to an existing database to adapt existing structures to the needs of the services. After thus ensuring the data distribution, the last piece of the puzzle is the corresponding metadata that again is available through a specialized database or a data view and provided in the Web by any metadata management tool that offers a standardized Catalogue Service for the Web (CS-W) interface.

Our guideline on "Linking an additional infrastructure node to the MDI-DE network" (Binder 2012) in combination with our guideline on "Metadata" (Wosniok und Räder 2013) outlines the technological principles we follow and presents the individual implementations at our partner institutions.

The MDI-DE Web portal provides both a keyword search for geospatial data mining and several theme based entry points with data and information on particular subjects.

3.1 *Data harmonization*

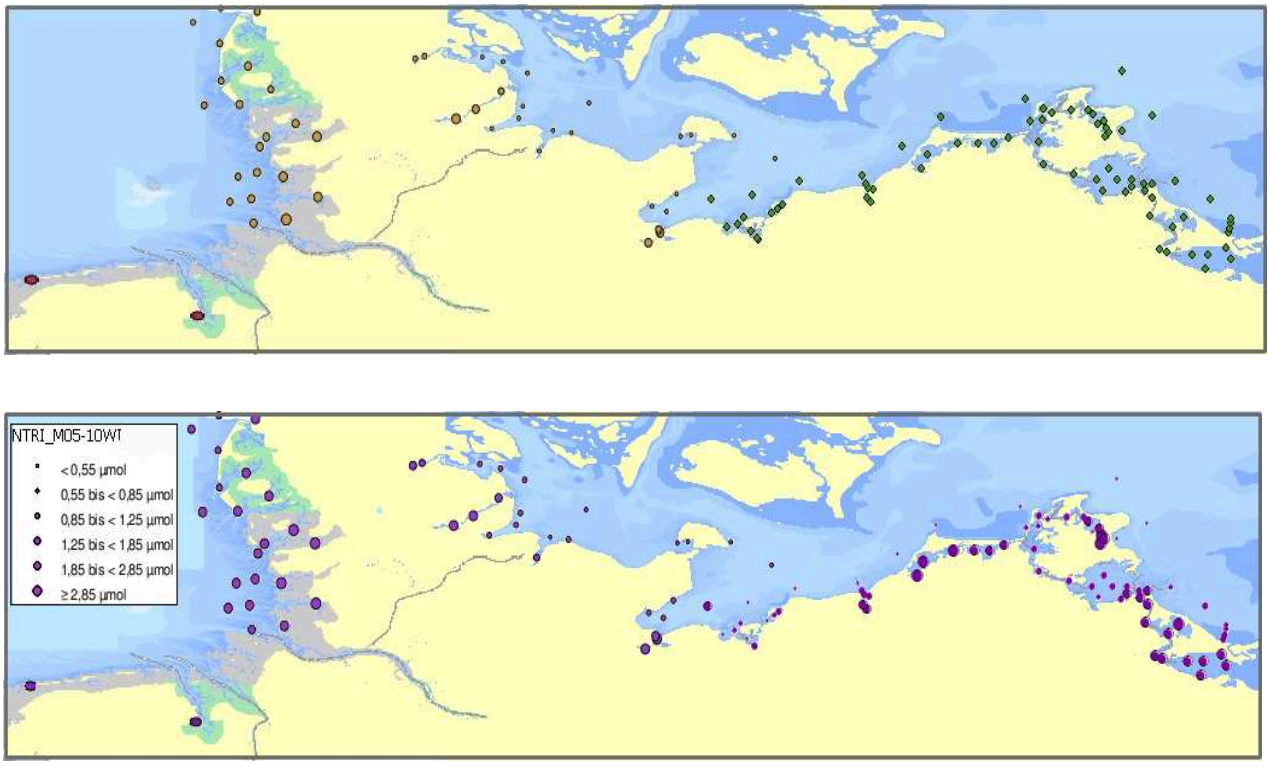

Figure 3. Harmonization of Data from MV and SH

In order to present the data from different sources and topics in a homogenous manner it has to be merged and arrangements must be made on the structure and content to harmonize it. These agreements are strictly based on European guidelines and international standards. Not only names and formats have to be defined, also code lists, units and reference systems. For a unified visualization of the different datasets, signatures and class boundaries must be defined and applied to the distributed data.

While interoperability of data essentially is a technical issue, harmonization of data is a much more complex and time-consuming process that, when carried out carefully, results in widely recognized guidelines for presenting data. This labor-intensive procedure is necessary for every parameter to be provided by a Web portal which is based on distributed sources. In particular, the qualitative descriptors for determining good environmental status specified in Annex 1 of the Marine Strategy Framework Directive (European Parliament and Council (2008) pose a great challenge nationally and internationally.

ACKNOWLEDGEMENTS

The co-operative research and development project MDI-DE was funded by the German Federal Ministry of Education and Research BMBF through the project management of Projektträger Jülich PTJ under grant numbers 03KIS089, 3KIS090, 03KIS091 and 03KIS092. The authors gratefully acknowledge this support as well as the many contributions from students, co-workers and other partners of these research projects.

REFERENCES

Binder, K. (Hg.) (2012). Leitfaden zur Anbindung eines Infrastrukturknotens an die MDI-DE. 37S. http://projekt.mdi-de.org/images/mdi-de/Publikationen/plugin-mdi-de_leitfaden_isk_2_0_publish.pdf. Last visited June 19, 2014.

European Parliament and Council (2008). Directive 2008/56/EC establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). Official Journal of the European Union L 164, pp. 19-40.

European Parliament and Council (2007). Directive 2007/2/EC establishing an Infrastructure for Spatial Information in the European Community (INSPIRE). Official Journal of the European Union L108, pp. 1-14.

European Parliament and Council (2000). Directive 2000/60/EC of the establishing a frame-work for the Community action in the field of water policy (EU Water Framework Directive). Official Journal of the European Communities L 327, pp. 1-72.

Geodateninfrastruktur Deutschland (2008). Auftrag GDI-DE. 2008. http://www.geoportal.de/DE/GDI-DE/Organisation/Aufgaben/aufgaben.html. Last visited June 19, 2014.

International Standard Organization (2003). Geographic information: ISO 19115 - Metadata; ISO 19119 - Services. http:// www.iso.ch /iso/. Last visited May 24, 2006.

Lehfeldt, R. and Melles, J. (2011). Die Marine Dateninfrastruktur Deutschland MDI-DE. K.-P. Traub, J. Kohlus und Lüllwitz, T. (Hg.): Geoinformationen für die Küstenzone. Norden Halmstad: Points Verlag (3), pp. 107–116.

Lehfeldt, R.; Reimers, H.-C.; Kohlus, J. and Sellerhoff, F. (2008). A Network of Metadata and Web Services for Integrated Coastal Zone Management. COPEDEC VII, Dubai, UAE, Cyber-proceedings, paper 207.

Lehfeldt, R. and Reimers, H.-C (2004). The WFD Reporting Process - A German Approach to Information Management in the Coastal Zone. D. Garcia de Jalón, P. Viz-Caino, (eds) 5th International Symposium on Ecohydraulics. Aquatic Habitats: Analysis & Restoration, September 12-17. IAHR, Madrid, Spain, pp. 175-181.

Lehfeldt, R. and Heidmann, C. (2003). Information Infrastructure for Integrated Coastal Zone Management. J. Ganoulis and P. Prinos. (eds). XXX IAHR Congress Proceedings. Theme A. Coastal Environment: Processes and Integrated Management, pp. 465-472.

OGC - Open Geospatial Consortium (ed.) (2011). Implementierungsspezifikationen für Geodatendienste. http://www.opengeospatial.org/. Last visited June 19, 2014.

Wosniok, C.und Räder, M. (Hg.) (2013). Leitfaden zur Pflege und Erstellung von Metadaten in der MDI-DE und Mappingtabelle. 86p. http://projekt.mdi-de.org/images/mdi-de/Dokumente/MDI-DE_Leitfaden_Metadaten_v1.0.1.pdf. Last visited June 19, 2014.