

# CONCEPT AND IMPLEMENTATION OF THE GERMAN MARINE DATA INFRASTRUCTURE

Dr. Rainer Lehfeldt<sup>(1)</sup>, Johannes Melles<sup>(2)</sup>, Michael Bauer<sup>(1)</sup>

<sup>(1)</sup> Federal Waterways Engineering and Research Institute, Wedeler Landstr. 157, 22559 Hamburg, Germany, e-mail: {rainer.lehfeldt, michael.bauer}@baw.de

<sup>(2)</sup> German Maritime and Hydrographic Agency, Bernhard-Nocht-Straße 78, 20359 Hamburg, Germany, e-mail: johannes.melles@bsh.de

## ABSTRACT

The complexity of current questions like changes to marine ecosystems, global warming and the resulting requirements for coastal protection as well as reporting obligations of the European Union with respect to effective framework directives require interdisciplinary access to the related spatial data. Therefore a novel marine data infrastructure is being established in Germany. Coastal and marine data collected and made available by 11 Federal and State agencies are made available by OGC 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. In the following we describe the concept of this data infrastructure and the state of its implementation.

**Keywords:** *metadata, ISO19115, ISO19119, OGC Web services, marine data infrastructure, information system, European Framework Directives, EU reporting*

## 1 INTRODUCTION

Current questions related to changes to marine ecosystems, global warming and the resulting requirements for coastal protection and recent European framework directives concerning water, marine strategies, coastal zone management and the development of a common spatial data infrastructure have initiated considerable activities in documenting available information and providing access to distributed data resources in the German coastal zones of the North Sea and the Baltic Sea.

Since 2001, a metadata profile of the ISO19115 standard has been developed for the coastal zone in co-operation with Federal and State agencies, which are in charge of coastal protection and nature conservation in Germany. This profile extends the ISO recommended core metadata set with elements from the FGDC shoreline profile. It meets the requirements of national and international information systems such as the ICES monitoring network, the German Spatial Data Infrastructure, and the German Environmental Information Portal.

Spatial data predominantly from GIS sources and time series from environmental monitoring networks are common data types to be documented for quality assurance purposes in reporting obligations for the European Union as well as for search interfaces. Key features of the marine data infrastructure are

- a web geo-portal where spatial data can be visualised, downloaded and processed by the use of OGC Web services,
- a metadata authoring and maintenance tool with detailed discovery interfaces, where distinct information spaces can be combined for search operations and
- infrastructure nodes where the data will be provided by the originator as OGC services.

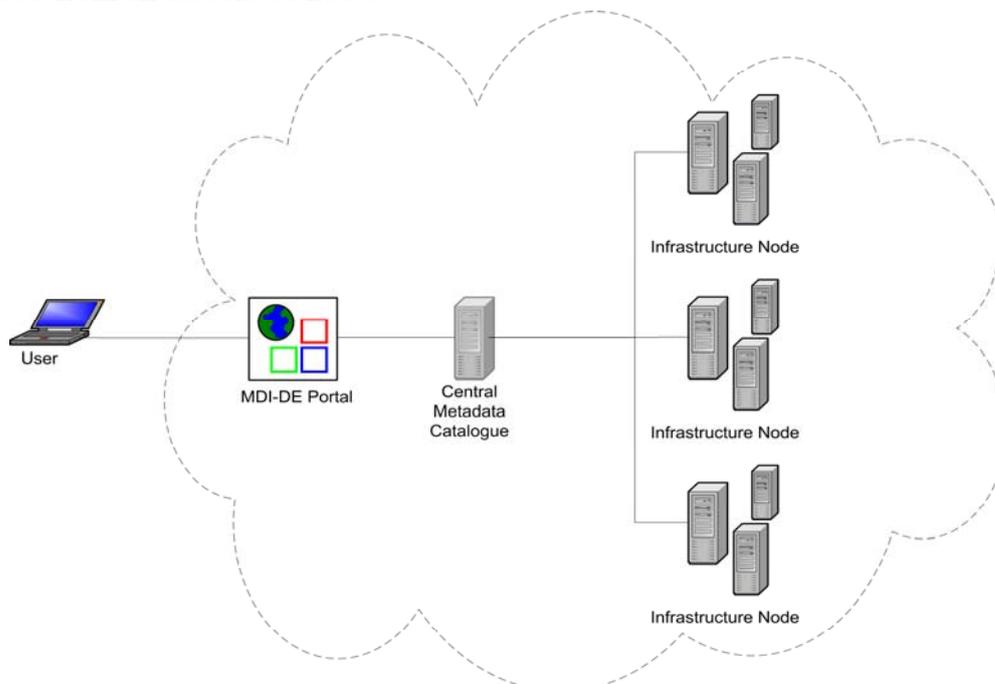
Since about 2005, OGC Web services have been implemented for various data types relating to hydrographical, oceanographic and meteorological parameters as well as for data concerning spatial planning. These data are continuously collected and permanently filed at the Federal Maritime Agency. They play a major role concerning information systems currently being established by the European Union, which require data access by Web mapping and Web feature services.

## 2 INFRASTRUCTURE ARCHITECTURE

Within the co-operative project "Marine data infrastructure MDI-DE" an integrated national marine and coastal information system will be set up by merging the already existing NOKIS (metadata from Federal and State agencies) and GDI-BSH (spatial data infrastructure at the BSH) information systems. Additionally each of the participating Federal and State Agencies is developing a infrastructure node to contribute their data to the network.

Each infrastructure node consists of a metadata catalogue for the creation, organization and provision of metadata as well as databases and mapservers for the provision of data and OGC compliant web services. Standardized data documentation is created by most nodes with a multilingual metadata editor, which is currently applied in several international research projects. The backbone for discovery services on the web portal are bounding boxes and bounding polygons as spatial selection criteria in addition to keyword-based search mechanisms. The necessary geometry entries can be extracted from map services embedded in the authoring tool. Included in the catalogue of each node is a Catalogue Service for the Web (CS-W) interface in order to provide interoperable access to the metadata.

One central instance of such catalogue will act as a harvester, collecting the metadata stored in all the sub-catalogues situated at the various nodes which are connected to the main catalogue through the network. A search on the central catalogue will find all relevant datasets from all associated nodes.



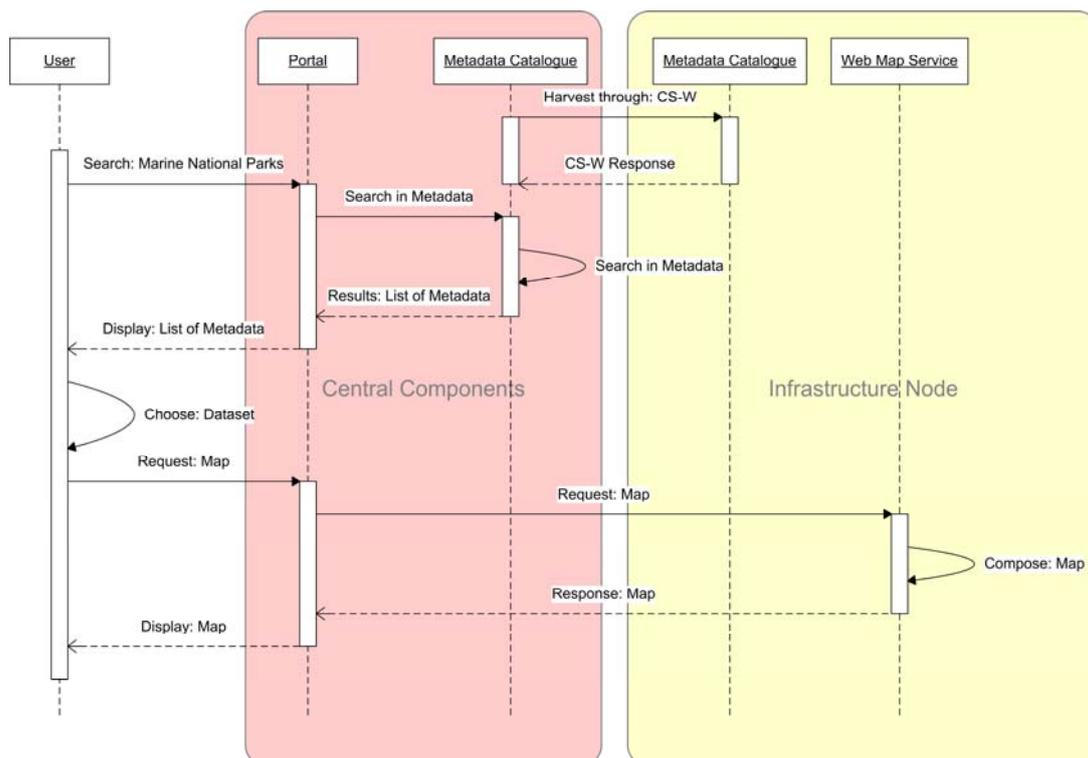
*Fig.1: Schematic view on the MDI-DE architecture*

Once identified through the describing metadata, the data itself can be viewed, downloaded or processed with Web Services following the specification of the Open Geospatial Consortium (OGC). Each infrastructure node will provide one or more OGC data provision Web Services like Web Map Services (WMS) to display thematic maps and Web Feature Services (WFS) to download data.

The central entry point for data and information from the German coastal zone and the adjacent marine waters will be a new web portal for marine and coastal data based on the described network for marine data. Connecting the local nodes, which are the major data sources of Federal and State agencies, it will provide a wide range of data coming different disciplines working in the marine environment.

In short, the MDI-DE will provide the following functionalities:

- Simple and expert search using a thesaurus for controlled vocabulary and a coastal gazetteer for geographic names in the marine environment,
- Intersectorally consistent data structures for interdisciplinary views on marine data,
- OGC Web Services for visualization and data access,
- Implementation of prototype services for data analysis and automatic report generation to meet the requirements from the EU framework directives.



*Fig. 2: Example data flow*

### 3 STATE OF THE IMPLEMENTATION

The new Web portal [www.mdi-de.org](http://www.mdi-de.org) will permanently maintained by the Federal Maritime Agency (BSH) in Hamburg. Its objective is to provide all available marine data and information through a joint portal from an interdisciplinary network and to establish a coordinated working environment based on metadata and services. This portal – reachable

under [www.mdi-de.org](http://www.mdi-de.org) – will be set up with the SDI Suite software from the German company con terra GmbH. It will be customized to fulfill all the needs of the participating institutions. The development of the portal is planned to be ongoing throughout the project duration. A first prototype of the portal will be accessible by the end of this year.

Harvesting functionalities of the central metadata catalogue are being implemented and should be operational by autumn. The individual infrastructure nodes are in a diverse state concerning the availability of metadata through a CS-W, they are all working towards covering their core business areas and providing the metadata by the end of the year in an interoperable way. That means if the prototype of the portal goes live, there will already be a vast repository of metadata to browse.

The diverse state of the infrastructure nodes holds true when it comes to providing Web Services for data access. Whereas some participating nodes already can share their data through various services, others are in the process of migrating their data from proprietary formats to interoperable services. All infrastructure nodes are positive to be able to provide substantial data when the prototype of the portal will be accessible, thus completing the paradigm of publish-find-bind.

Beyond the basic services like WMS and WFS other services will be incorporated into the the MDI-DE network like Web Processing Services (WPS) for data analysis or the Sensor Observation Services (SOS) for the provision of sensor data from the German marine environment. Furthermore an index of coastal projects has been compiled whose structure is in line with the coastal zone metadata profile. It provides additional context to data found by metadata. This approach has been extended by including an index for the German coastal journal.

The documentation of numerical simulation scenarios concerning the characteristics of CFD models together with the origin and pre-processing of input data used for the modeling is addressed in a profile under development that is compatible with the metadata standard ISO19115. The data will not only be available through WMS, WFS and SOS. Efforts are also made to migrate the modelling processes itself into a cloud and equip them with WPS interfaces. Results of this are expected to be seen in the latter stages of the project.

#### **4 CONCLUSION**

MDI-DE represents not only a state-of-the-art spatial data infrastructure, it also aspires to lose the ‘spatial-only’ attribute and include other related data into this distributed data source. This is especially important as the need for data analysis and automatic report generation for EU framework directives is one of the main objectives of the project.

The planned web based tools are to facilitate intersectoral views of resources by providing technological solutions for networking and distributed data management in a service oriented architecture, which relies on ISO metadata and uses OGC web services to access data repositories.

Furthermore the future Web services provided by the new Marine Data Infrastructure will support system analysis applications related to coastal engineering, spatial planning, nature conservation, science and ecology.

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