Marine environmental data, availability and harmonisation
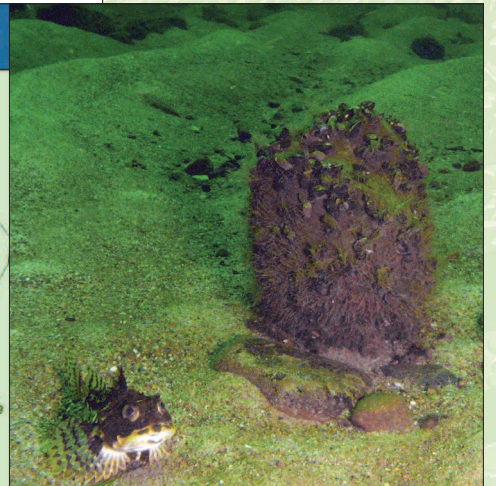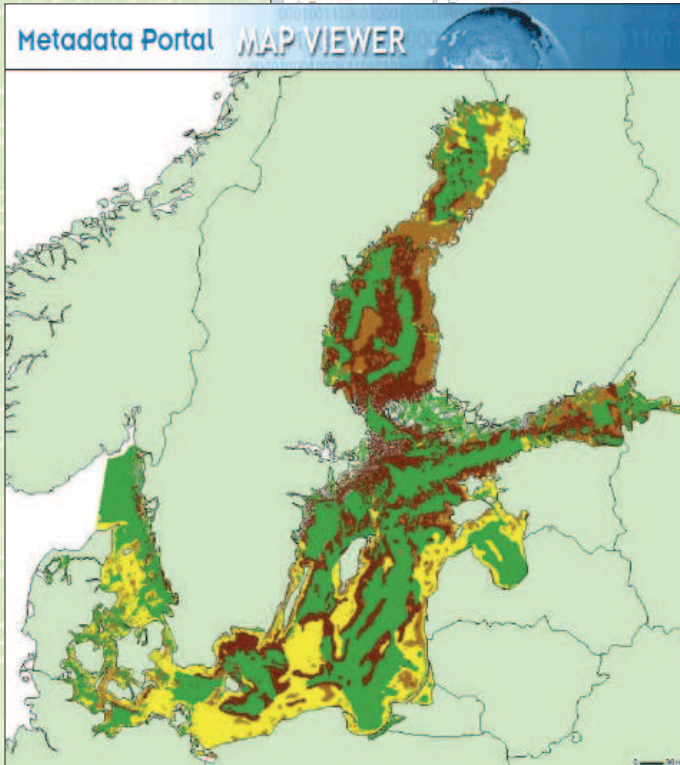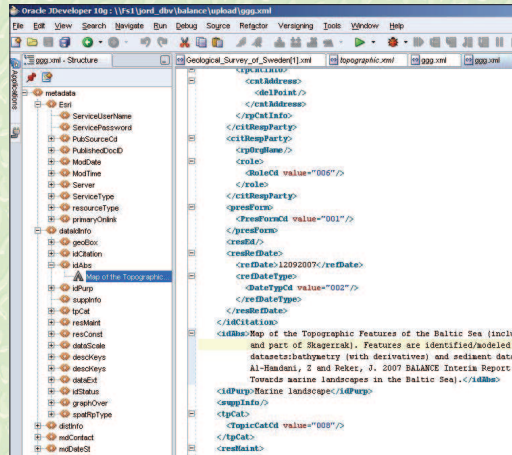
BALANCE WP1 report

Marine environmental data, availability and harmonisation

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0   PREFACE

The BALANCE-project is a cross-sectoral and transnational co-operation aiming at improving strategic and spatial planning of the Baltic Sea Region*, which merges data on e.g. marine landscapes, habitat distribution, economic values and conservation status.

A good-quality approach to strategic and spatial planning requires a large amount of data, which makes collation of metadata and data very important. Metadata are 'data about data' and are extremely valuable when searching for information as well as when trying to make judgements about its usefulness and quality.

Existing data of different environment variables in the Baltic Sea region, both national and international, is numerous, but very diverse. National categories need to be harmonised to classification schemes and international standards are advantageous for the data that are used as well as for data collation and management. Thus, guidelines on data harmonisation, protocols for intercalibration of cross-sectoral and transnational data are essential. Moreover, easy access and overviews of information on the existing data are beneficial.

In addition, for a consistent future approach to mapping programmes and facilitation, the uses of internationally agreed Protocols and Standards are crucial for different survey methodologies and sectors.

The results and products presented in this report are part financed by the European development fund BSR INTERREG IIIB Neighbourhood Programme and partly by the involved partners.

More information on the BALANCE project is available at: www.balance-eu.org and on the BSR INTERREG IIIB Neighbourhood Programme at: www.bsrinterreg.net.

The dataportal described in this report is available at: http://maps.sgu.se/Portal.

*The Baltic Sea Region is defined by the BSR INTERREG IIIB Neighborhood Programme to include the Baltic Sea, Kattegat and Skagerrak.

1 INTRODUCTION

The main objectives of the BALANCE Work Package 1 are to create a platform for the data on which the subsequent derivation of marine landscape and classification and mapping are based and to harmonise the data available, i.e. ensuring that different types of data from different sources and countries can be used together.

This report describes the platform, a portal for marine metadata relating to the Baltic Sea aimed for communicating data between Balance partners and end users. In addition, spatial referencing and data exchange formats are outlined as well as categories for the data that are valuable for spatial planning of the marine environment and used for the development of e.g. marine landscape and habitat maps. An overview is presented of existing datasets for each category as well as guidelines and links to standards and protocols for data collection, collation and management.

Moreover, the datasets published in the dataportal within the BALANCE project are presented.

2 DESCRIPTION OF THE DATA PORTAL

2.1 What is a GIS Portal?

The BALANCE project involves a large number of organizations from countries surrounding the Baltic Sea. Many of them contribute to the project with existing resources of spatial information (e.g. datasets, reports, map services, documents) from their geographic and thematic areas of interest, or produce new datasets within the BALANCE project. Others perform analyses on these basic datasets for the production of harmonized information in the entire project area and/or develop management guidelines using information produced by the BALANCE project.

Given the complexity of the information flow in a project like BALANCE, a single point of access to spatial information was identified as an important part of the BALANCE project. This is realized through a GIS Portal. GIS Portals are built on top of underlying World Wide Web technology and provide the framework for collaborative geospatial user communities and facilitate the discovery, sharing, and delivery of GIS content and services, see Fig. 1. GIS portals organize content and services such as directories, search tools, community information, support resources, data and applications. They provide capabilities to query metadata records for relevant data and services and link directly to the online sites hosting content services. The content can be visualized as maps and used in geographic queries and analyses.
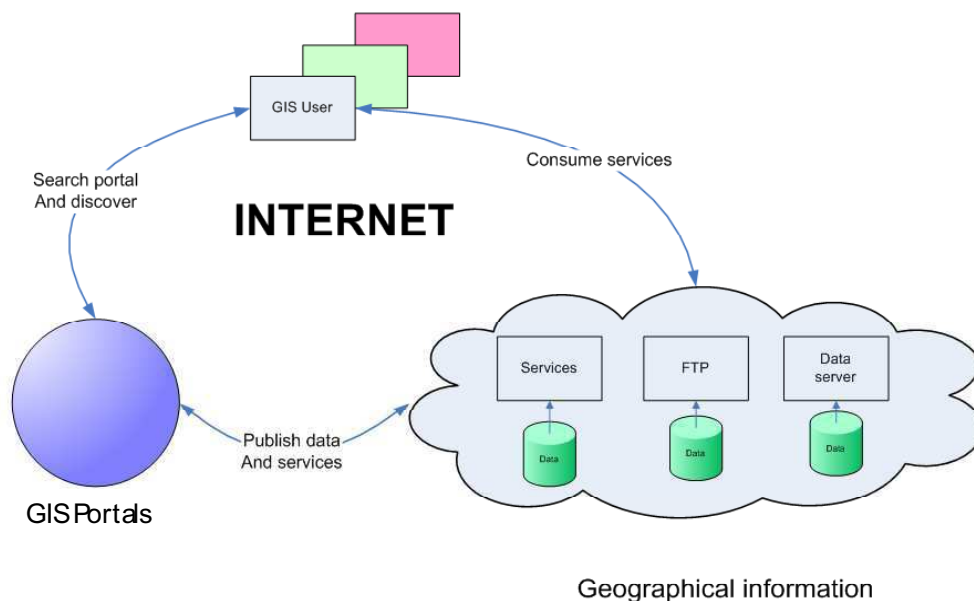
Figure 1. A key component of a GIS Portal is a metadata catalog that supports search and discovery of geospatial resources.

GIS Portals is an underlying concept in Spatial Data Infrastructures (SDI) that has been emerging during the last decade.

2.2 Metadata in a GIS Portal

Metadata can be defined as "data about data". In the context of GIS Portals a more appropriate definition is used within the INSPIRE directive (PE-CONS 3685/2006): "information describing spatial resources, making it possible to discover, inventory and use them". Metadata is often categorized based on the intended use of the metadata:

Metadata for discovery – the minimum amount of information that needs to be provided to convey the inquirer the nature and the content of the data resources.

Metadata for evaluation (or inventory) – the amount of information sufficient to enable an inquirer to ascertain that a spatial resource fit/suitable for a given purpose exists, to evaluate its properties, and to reference some point of contact for more information.

Metadata for use – information required to access, transfer, load, interpret and apply a spatial resource in the end application where it is exploited.

In order to make queries on metadata records and to produce responses of high quality, it is necessary that metadata conforms to common specifications. A number of metadata standards have emerged over the years, both on national levels and within thematic communities. Since 2003 there exists an international standard for spatial metadata (ISO 19115), which has become widely adopted in the design of GIS Portals and SDI's.

ISO 19915 contains a large number of metadata elements and a flexible model to describe information on different levels, e.g. data series, datasets, feature types, feature in-

stances and the implementation of the standard is far from trivial. However, a basic set of metadata elements focused on the discovery and basic evaluation of spatial datasets is also defined in the standard (ISO 19115 Core Metadata), which often forms the basis for metadata requirements in GIS Portals. Still, in a GIS Portal it is often necessary to define more specific requirements adapted to the needs of the user community of the GIS Portal.

2.3   Description of the BALANCE Data Portal

2.3.1   Overwiew

The GIS Portal used in the BALANCE project is implemented using GIS Portal Toolkit developed by ESRI Inc. The ESRI GIS Portal Toolkit provides the necessary elements of a GIS portal. Through its framework, map viewer, administration, publishing and harvesting modules, the portal extension supports and facilitates a complete workflow for enabling a fully functional GIS Portal.

The GIS Portal Toolkit was at the time of project startup close to a commercial of the shelf (COTS) product, which was an important factor in selecting the technical solution for the BALANCE Data Portal.

The GIS Portal Toolkit is based on ArcGIS® and requires ArcIMS and ArcSDE. The ArcGIS Desktop ArcCatalog™ application can optionally be used for creating metadata. In addition, the portal requires a Web server development and deployment environment and a standard RDBMS. This system environment fitted well with the existing GIS environment at SGU that was to host the BALANCE Data Portal, as well as with the environment at other key partners. With the basic GIS environment already in place at SGU, the GIS Portal Toolkit meant that no additional licensing costs was generated.

The GIS Portal Toolkit is implemented at several relevant reference sites like:

• Geodata.gov (http://www.geodata.gov)

• INSPIRE (http://eu-geoportal.jrc.it)

• India NSDI (http://gisserver.nic.in/nsdiportal)

• Norway (http://www.geonorge.no)

2.3.2   Key Features

The BALANCE Portal consists of the following key components:

GIS Portal application and Metadata repository

The GIS Portal offers end user functionality (e.g., searching metadata, sorting results, customizing views and browsing metadata records by categories), administrator functionality (e.g., record administration, advanced searches and sorting) and publisher

functionality (e.g., ability to enter metadata, upload documents and remove previously published documents).

Map Viewer application

The Map Viewer allows portal users to browse, navigate and query map data, view multiple map services, change projections on the fly and save map views. The Map Viewer supports Open Geospatial Consortium (OGC) - ISO Web Map Service (WMS), Web Feature Service (WFS), and web Coverage Service (WCS) as well as ArcIMS based map services, see Fig. 2.
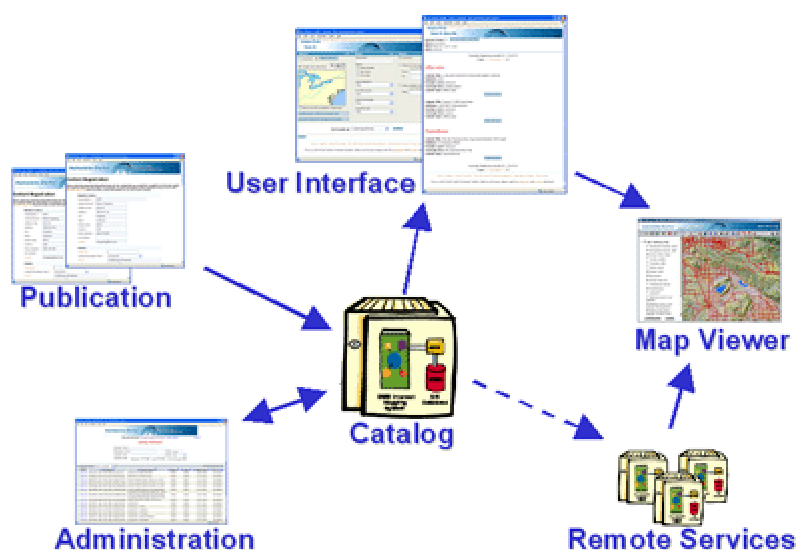
Figure 2. Key components of the Portal

2.4 How to use the Portal

2.4.1 Roles in the Portal
There are four different roles with different properties in the BALANCE Data Portal. They are Administrator, Publishers, Channel Stewards and Public users.

Administrator

The Administrator handles account management, metadata reviewing, approval and batch loading. This role has been handled by SGU.

Publishers

Publishers can publish metadata records as single records one at a time, either as uploading XML-metadata files or through the on-line form within the Portal.

Most BALANCE partners have had Publisher accounts and published metadata.

Channel Stewards

The Channel stewards is responsible for managing different channels (themes or categories) used to support browsing of metadata records and present other relevant information. In the BALANCE project, SGU is the channel steward for all channels.

Public users

Any user with an Internet connection has access to the BALANCE Data Portal. Public users can browse and search the Portal for metadata. They can also view Live Data and Maps with the Map viewer.

2.4.2   Features of the BALANCE Data Portal

Data Categories:
Web pages that help you discover and access a wide variety of geographic information for a particular data theme or data community by browsing metadata records. The content of Data Categories is customized using a channel editor tool creating the necessary XML files. In the BALANCE Data Portal this has been done by SGU, and the metadata records are organized by contributing organization.

Current Event or Application Topics:
Web pages that help you discover and access a wide variety of geographic information for a specific application area or current event.

Search Page:
The Search page enables you to discover and access a wide variety of geographic information resources within the GIS Portal Toolkit, Fig 3. This geographic information, provided by government, commercial, and noncommercial organizations, includes map images, map services, geographic datasets, geographic activities, spatial solutions, clearinghouses and land references.

Performing a Search:
To find content, you can set a search area by place name or you can use the Map Viewer to define your search, Fig. 3. Once your search area is established, you can set your search criteria based on content type, such as map service, geographic datasets, activities etc., data theme, keywords or date ranges. The results of the search are displayed along with metadata and if appropriate a map.
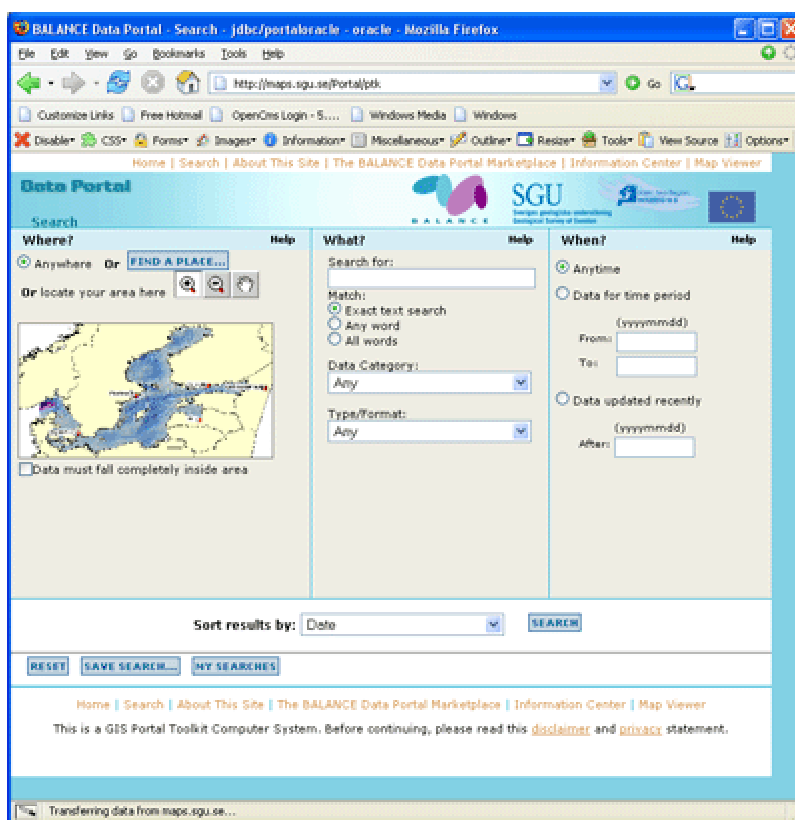
Figure 3. Advanced search page.

Data types

There are a variety of data types that can be available to discover and use on the Balance Data Portal.

Live Data and Maps - GIS users can access "live" data and maps, such as ArcIMS or WMS map services, using software tools such as ArcGIS, ArcExplorer-Java Edition or ArcExplorer Web available on this site.

Downloadable Data - Data downloads enable you to perform custom downloads of digital data you are viewing to access locally with GIS software. Visit the Free Viewers page for a list of free GIS data viewers.

Offline Data - Many publishers offer data that can be ordered online and delivered in CD or DVD format or as other shippable media. This data cannot be directly downloaded to your computer.

Documents - Several types of documents are available:

Map files - digital maps that can be viewed in a GIS mapping application. Map files are typically completed maps that are ready for viewing, publishing and printing.

Static Maps - You cannot directly interact with static map images as you can with dynamic data and maps. You can view them and download them to your computer.

Other Documents - includes geographic information stored in text files, spreadsheets or other formats and can be used in conjunction with geographic data. In many cases, they can be viewed and downloaded.

Applications - An online application is built using geodata.gov content, map services or other Internet-hosted data. The application includes a complete user interface and set of geographic content needed to perform one or more tasks in a Web browser.

Geographic Services - Geographic services are Internet applications with a geographic focus-using data and related functionality to perform basic geoprocessing tasks such as place name searches, address matching or routing.

Clearinghouses - A clearinghouse is a Web site that contains references and links to a variety of free geographic data. Many clearinghouses offer geographic data for download while other sites include metadata references or links to datasets that may be acquired through other mechanisms.

Geographic Activities - Geographic Activities show what people are doing, what data they need (Marketplace Data Requests) and what data collection activities they have planned (Marketplace Planned Acquisitions).

View Metadata:
You can use the metadata detail and the full metadata view to display the contents of a metadata record, Fig.4 . Map data can be viewed in the Map Viewer or with GIS software to display multiple data sources from the BALANCE Data Portal along with data from local sources.
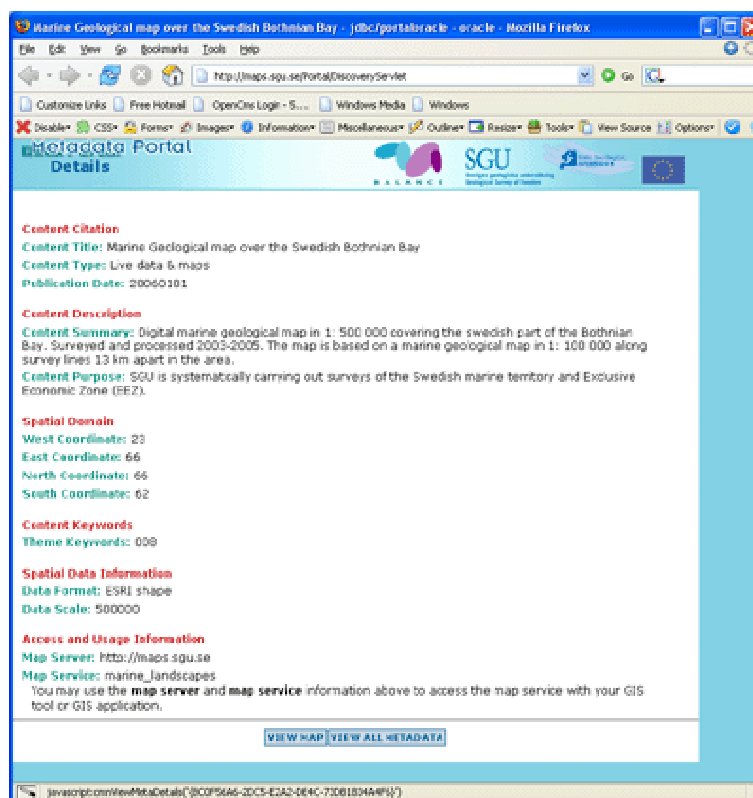
Figure 4. Example of Metadata document from BALANCE Data Portal

Map Viewer:

The Map Viewer tool allows you to interact with map services referenced in the meta-data, and to browse through datasets provided by project partners, Fig. 5. The Map Viewer also allows you to save maps for later use, set transparency levels, query map information, and provides rich functionality to overlay map services. Several map services both ArcIMS services and OGC WMS services can be combined to one map view.

The Map Viewer has support for OGC WMS 1.0, 1.1 and 1.1.1 map services. OGS WFS 1.0 and OGS WCS 1.0 are also supported.
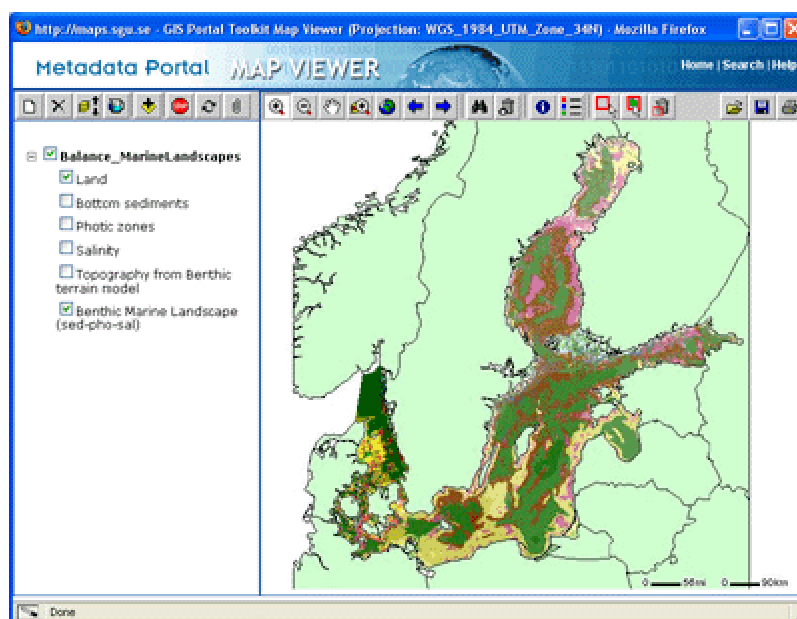
Figure 5. Marine landscapes map viewed in BALANCE Portal Map Viewer

Publish Data

You can provide geographic data by publishing map services and images, geographic datasets, geospatial services, spatial solutions, geographic and land reference material and geographic activities or events to share with others through submission of on-line provider forms within the GIS Portal Toolkit portal. Publishing is performed via an on-line form or an upload utility.

2.4.3 How to Publish Metadata to the BALANCE Data Portal

To be able to publish metadata a user has have the role of a publisher, granted by the administrator of the BALANCE Data Portal. Metadata records can be published to the BALANCE Data Portal in to ways, Fig. 6:

upload ISO XML-formatted metadata to the Portal

or

create metadata using the Portal online publication form

The option to automatically harvest metadata from existing metadata services or web accessible folders is not implemented to date.

The metadata requirements for the BALANCE Data Portal are described in section 3.1.

Metadata Upload

In the Balance project the preferred way to publish metadata was intended to be by uploading XML-formatted metadata created using the ISO-metadata editor available in the ESRI ArcCatalog application. By default ArcCatalog creates and stores metadata compliant with the US Federal metadata standard (FGDC). To create ISO-metadata to be used in the Balance project some preparations must be made in ArcCatalog.

To upload your XML-formatted metadata the publisher uses the "Upload Metadata file" tool. After uploading the metadata records it is recommended to navigate to "Manage my metadata" and check the content by clicking "update". This will bring up the online publication form with the most relevant metadata elements. At this stage metadata elements that were not present in the original XML-formatted metadata file can be added.

Metadata Direct Entry

If publishers do not have access to the ArcCatalog metadata editor, they can use the online publication form provided at the BALANCE Data Portal. The online publication form has been used by a majority of users, since there has been some inconsistencies in using the upload method.

To enter metadata using the form the publisher navigates to "Publish online form", selects the type of content and proceeds to enter the metadata elements manually.
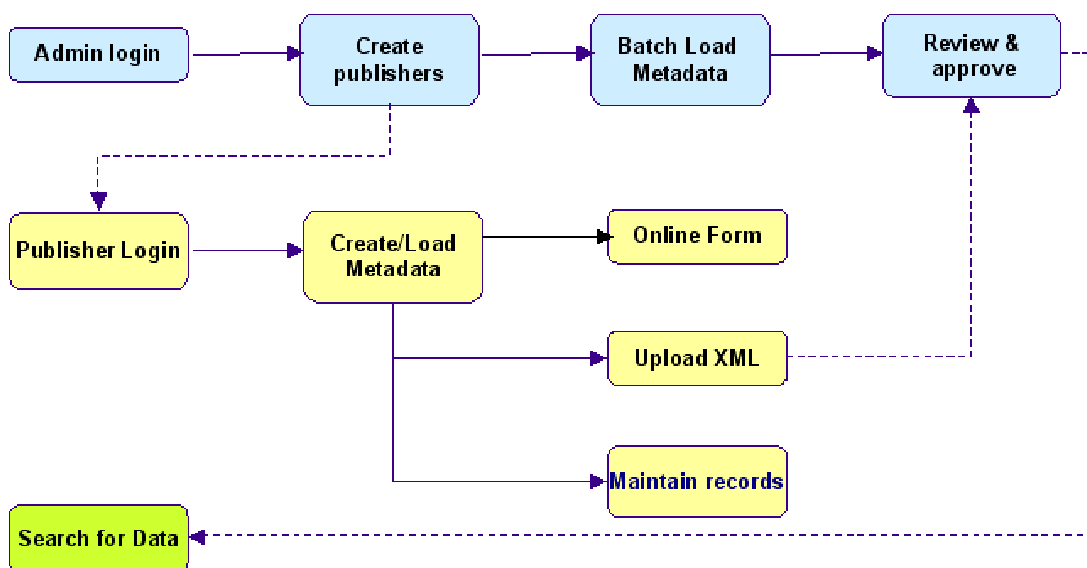
Figure 6. Portal workflow for publishing and reviewing

2.5   Technical overview

Software Requirements for GIS Portal Toolkit 2

OS: Windows Server 2003

Database: Oracle9i

ArcSDE 9.1, ArcIMS 9.1, (ArcGIS 9.1 optional)

Web server: Apache 2.0.48

Java SDK: J2SDK1.4.2_06

Servlet engine:Tomcat 5.0.28

Web application logic: Different open source Java Class Libraries e.g. Struts, Batik.

Architecture

The BALANCE Data Portal architecture is a multi-tier web application with Data management components, Spatial management components and Web Portal components, Fig. 7.

It is based on Java Beans and Java Servlets for application logic and JSP templates for presentation. A large part of the core functionality is based on third party Java class libraries.

E.g Struts from apache.org is a framework for building MVC (Model-View-Control) webapplications and is used in the Portal Design. The Portal uses standard web technlogy for the presentation layer including HTML, JavaScript, CSS, XML and XSLT.

ESRIs ArcIMS and ArSDE are required for Metadata services and Spatial Data management.
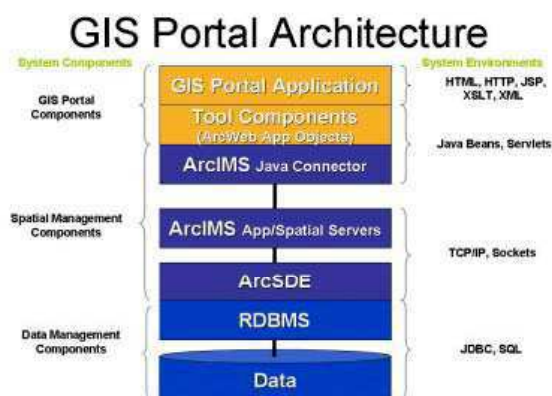
Figure 7. Architecture of the Portal

3 STANDARDS

3.1 Metadata in the BALANCE Data Portal

3.1.1 Background

The BALANCE implementation of ESRI's GIS Portal Toolkit is using the international standard ISO 19115. ISO 19115 defines an extensive set of metadata elements that can be used to describe data on different levels, e.g. database, data set and feature type. To facilitate basic implementations primary used for discovery purposes, a core of 22 basic metadata elements is identified in the standard itself. The BALANCE Data Portal is based on this core metadata set. Metadata is restricted to dataset level.

In the BALANCE project two methods of creating metadata documents is recommended. Most partners have access to an ISO metadata editor in ESRI's ArcCatalog application, which produces metadata documents that can be uploaded to the BALANCE Data Portal. An alternative option has been to use the online entry form in the GIS Portal Toolkit application.

3.1.2 Requirements and recommendations

The ISO Core Metadata has mandatory, conditional and optional elements. The implementation of the core metadata differs slightly between the ISO editor in ArcCatalog and the online form. Both applications mark what elements the application regards as mandatory. The ArcCatalog editor is a much more complete and flexible tool and is the preferred way to create metadata documents. The online form is more focused on the needs of the portal application, and has some mandatory elements that are not part of the ISO Core, and are not mandatory in the ArcCatalog editor. An inventory of the different implementations was made to form a basis for recommendations of metadata requirements in the BALANCE project, Table 1.

Comparison between ISO 19115 Core Metadata and metadata entry in GIS Portal Toolkit and ArcCatalog (M = Mandatory, O = Optional, C = Conditional)			
ISO Core metadata	**ISO obligation**	**Portal online form**	**ArcCatalog ISO editor**
Dataset title	(M)	Title (M)	Title (M)
Dataset reference date	(M)	Publication date (M)	Creation date (M) Publication date (O)
Dataset language	(M)	Not present! -add manually as supplemental information	Language in data (M)
Dataset topic category	(M)	Primary theme (M) 1:1	Themes or Categories (M) 1:*
Abstract describing the dataset	(M)	Abstract (M)	Abstract (M)
Dataset responsible party	(O)	Originator (O) Publisher (M)	Choose function from list 0:*
Geographic location of the dataset (by four coordinates or by geographic identifier)	(C)	Spatial domain (M) Bounding box in decimal degrees	Geographic bounding box in decimal degrees (M)
Additional extent information for the dataset (vertical and temporal)	(O)	Time Period of Content (O)	Temporal (O) Vertical (O)
Lineage	(O)	Not present! -add manually as supplemental information	History (O)

Dataset character set	(C)	Not present	Not present
Spatial resolution of the dataset	(O)	Data resolution (O) Mandatory for Raster Data	Resolution (O) or Scale (O)
Spatial representation type	(O)	Data Type (O)	Automatic
Reference system	(O)	Data projection (O) 0:* Free text	Coordinate system (M) Automatic or list
Metadata point of contact	(M)	Organisation (M) Contact Person (M) Phone Number (M)	Name (M) Organisation (M) Position (M) Function(M)
Metadata date stamp	(M)	Automatic	Automatic
Metadata language	(C)	Not present –should always be English	Metadata Language (M)
Metadata character set	(C)	Not present	Automatic
Metadata file identifier	(O)	Automatic	Automatic
Metadata standard name	(O)	Free text (O)	Automatic
Metadata standard version	(O)	Free text (O)	Automatic
Distribution format	(O)	Data Formats (O) Free text 0:*	Publication Format (C) Free text
On-line resource	(O)	Online Linkage (O)	URL
Non-Core metadata in the GIS Portal Tool-kit online form	**ISO obligation**	**Portal online form**	**ArcCatalog ISO editor**
Purpose	Non-Core	Purpose (M)	Not present (add into abstract)
Distributor information	Non-Core	Organisation (M) Contact Person (M) Phone Number (M) Email (M)	Distribution information (C)
Supplemental information	Non-Core	Supplemental information (O) –add lineage and dataset language here if not added elsewhere	Not present
Status	Non-Core	Progress (O) Maintenance and update (O)	Maintenance (C)
Keywords	Non-Core	Theme Keywords (O) + reference Place Keywords (O) + reference	Theme Place Temporal Stratum Discipline + reference
Constraints	Non-Core	Access (O) Use (O) Other (Free text) (O)	Access (O) Use (O) Legal (O) Security (O)
Browse Graphic	Non-Core	Browse Graphic URL (O) Browse Graphic Caption (O) Browse Graphic File Type (O)	Automatic if thumbnail is present (file path)

Table 1. Rows in dark grey marks elements that are mandatory in the GIS Portal Tool-kit application, light grey marks highly recommended elements, white marks recom-mended elements.

When formulating requirements for metadata it is important to reach a balance between a large number of mandatory elements that give a user a good description of the dataset and the practical implications of gathering all this metadata for the publisher. Ideally, requirements should not discourage the publication of metadata. The BALANCE proj-

ect does not enforce a formal set of elements to be mandatory other than the elements that are required by the GIS Portal Toolkit application. Instead a practical approach is promoted to regard all the elements present in the online form as recommended and of importance for the intended users. In the table above a simple prioritization of the elements is made to guide publishers. By using the ISO editor in ArcCatalog more elements could be added.

3.2 Spatial Reference

Datum: **WGS 84**

Coordinate system for whole Balance area: **Universal Transversal Mercator** (**UTM)
zone 34N (extended)**

Coordinate system for detailed pilot areas: **UTM with appropriate zone**

3.2.1 Discussion

The objectives for choosing spatial reference system were

Standard reference system

Easy to use (implemented in most commercial GIS)

Minimal areal distortion

The choice of UTM based on WGS 84 and with a single extended zone fulfils the two first objectives. The Balance area covers parts of UTM zones 32N – 36N with its major part within zone 34N, Fig. 8.
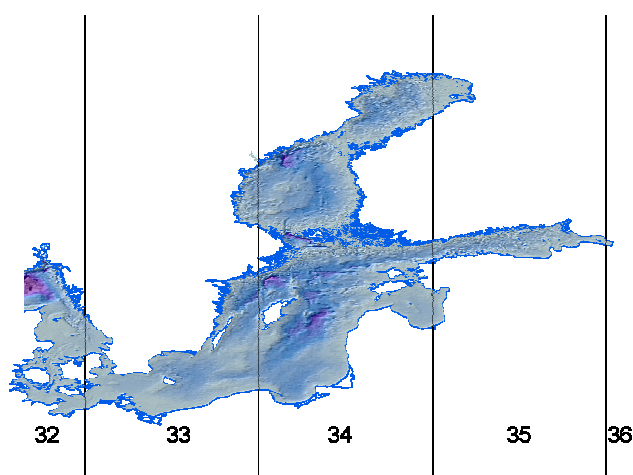
Figure 8. UTM zones

Total minimal areal distortion is obtained if zone 34N is chosen as the extended zone for the whole Balance area. Figure 9 depicts the relative areal errors of the Balance area within the different UTM zones.
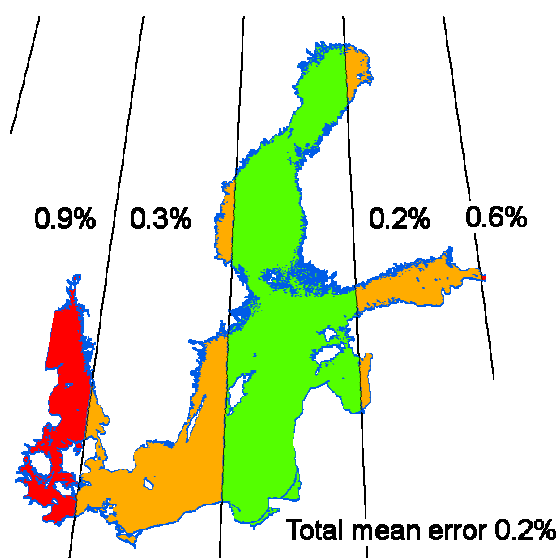
Figure 9. The relative areal errors of the Balance area within the different UTM zones.

3.3 Base Maps

The following datasets are recommended and may, by the courtesy of ESRI Inc., be freely used within the Balance project

Coastlines 1:15 000 000

Excerpt from the *"World Countries 2002"* dataset published in *"ESRI Data & Maps"*. Originator: ESRI Inc.

Coastlines 1:250 000

Excerpt from the *"Europe Countries"* dataset published in *"ESRI Data & Maps"*.

Originator: AND Data Solutions B.V. and ESRI Inc.

3.4 Data Exchange Formats

Exchange of spatial data within the Balance project was done with one of the following formats:

Vector data as shape files with projection files

Raster data as ESRI GRID, binary or ASCII format

Images as TIFF (uncompressed), JPEG, PNG or other "standard" image format. The images should be georeferenced by ESRI worldfiles.

All data should be in WGS 84 datum, geographic or UTM projection.

3.5   *Physical, biological and socio-economical data*

The use of internationally agreed protocols and standards is crucial for a consistent future approach to mapping programmes and facilitation of data exchange and aggregation. Protocols apply to methods and ensure consistency in survey methodology, consistency in data interpretation, and common methods for extrapolation, interpolation and aggregation of data across spatial scales. Standards apply to data and ensure quality assurance of data, common terminology and formats, and compatibility of data between different techniques and technologies. Protocols and standards need to be established for each of the main mapping techniques, together with various combinations of techniques.

Here we apply categories, which fit with common use and most recent international standards, for the data that are used for the derivation of marine landscape classification and mapping as well as strategic and spatial planning. The categorisation is arrived through common practice and accepted standards, see, for example, the European "SEASEARCH" project http://www.sea-search.net/. In addition, links to existing standards are provided for data collection and management as well as examples of data sets to be used in the process of deriving marine and habitat landscapes, and of use when spatially planning the marine environment.

3.5.1   *Bathymetry*
Data Sets:

Depth contours (Vector elevation curves), Gridded surface, Digital Elevation Models (DEM).

Depth areas: Dredged areas, dredged disposal areas.

Standards for data collection and management:

Remote sensing methods: Satellite imagery, airborne techniques, see Development of a framework for Mapping European Seabed Habitats (MESH):
http://www.searchmesh.net/.

Hydroacoustic methods: Multibeam echosounder, echosounder (single-beam Acoustic Ground Discrimination System (AGDS)), interferometry, see MESH:
http://www.searchmesh.net/ and also the International Hydrographic Organization (IHO) at: http://www.iho.org/.

3.5.2 Shoreline Morphology
Data Sets:

Shorelines, land cover, topographic maps, imagery, unclassified images, annotations

Natural Topography: Sea cover, coastal type, ice, bedform.

Hydrology: Lakes, rivers.

Land uplift areas.

3.5.3 Substrates (geology)
Data Sets:

Seabed Sediments, erosion/sedimentation, Holocene and Pleistocene geology, bedrock geology, cores and samples, results of analyses, interpretations, reports and maps.

The data should be harmonised toward regional and area specific maps of bottom substrate, see, for example, Kotilainen et al. (2007), Reijonen & Kotilainen (2007) and Erlandsson & Lindeberg (2007).

Standards for data collection and management:

Hydroacoustic methods: Multibeam echosounder backscatter, interferometric sonar, side-scan sonar, sub-bottom profiling, seismic, see MESH: http://www.searchmesh.net/.

Video and imagery: Camera, Remote Operated Vehicles (ROV), see MESH: http://www.searchmesh.net/.

In situ sampling: Core sampling, grab sampling, particle size analysis of sediments, see MESH: http://www.searchmesh.net/.

3.5.4 Geochemistry
Data Sets:

Sample locations and sample analyses of sediment and organic and inorganic components.

Standards for data collection and management:

See MESH: http://www.searchmesh.net/.

See also the Marine Monitoring Protocols Manual at: http://cmsdemo.fcsolns.co.uk/mmpm/index.php?option=com_frontpage&Itemid=1.

3.5.5 Physical Oceanography
Data sets:

In situ: Wave measurements, surface and subsurface water temperatures, surface and subsurface currents, surface and subsurface salinity, sea level, secchi depth, tidal amplitudes.

Satellite: Sea level, geostrophic currents.

Model: Gridded modelled nowcasts and hindcasts of most of the above parameters at a range of resolutions in time and space.

Standards for data collection and management:

International Council for the Exploration of the Seas (ICES) provides guidelines at: http://www.ices.dk/ for most types of measurements of Physical oceanography. See also, e.g., Joint WMO-IOC Technical Commision for Oceanography and Marine Meteorology (JCOMM) at: http://ioc.unesco.org/jcomm/ and IHO (2001).

3.5.6 Chemical Oceanography
Data sets:

Water Column Chemicals: Organic and inorganic, nutrients from "Smart Buoys", moorings (temporary and permanent), monitoring stations (temporary and permanent), cruises, radiation monitoring.

Suspended Sediments: From "Smart Buoys", moorings (temporary and permanent), monitoring stations (temporary and permanent), cruises, remote sensing.

See, for example, the Danish Natural Environmental Research Institute National Database of Marine Data (MADS) at: http://www.dmu.dk/Vand/Havmiljoe/MADS/.

Standards for data collection and management:

See, e.g., the European project QUASIMEME (Quality Assurance of Information for Marine Environmental Monitoring in Europe - http://www.quasimeme.org/) and the ICES guidelines at: http://www.ices.dk/.

3.5.7 Marine meteorology
Data sets:

In situ: Surface wind velocities, surface temperatures (air and sea surface), sea level pressure, relative humidity, wave measurements, wave exposure, ice cover.

Satellite: Surface winds and waves, sea surface temperatures, ice cover.

Model: Gridded modelled nowcasts and hindcasts of most of the above parameters at a range of resolutions in time and space.

Standards for data collection and management:

See various documentation available through the World Meteorological Organization (WMO) at: http://www.wmo.ch and JCOMM at: http://ioc.unesco.org/jcomm/. On these sites are also found, e.g., WMO Guides on Quality Management - Guide to Meteorological Instrumentation and the JCOMM observations program area.

3.5.8   Biology
Data sets:

- in situ data sets (+ diving).
- modelled data (+ fish stocks) e.g. habitat modelling data.

Distribution of key organisms.

Plankton surveys, trawls.

Fish (including fisheries related / derived data)

Fish spawning areas, fish nursery areas, fish abundance and spatial distribution, fish behaviour, age, scales.

Fisheries: Fish catches, mean length on age, year class strength, catch per unit effort.

Marine Mammals

Populations of e.g. seal; breeding sites.

Marine Birds

Populations of waders and wildfowl, seabirds, breeding sites.

Benthic Marine Flora/ Fauna

Marine Benthic surveys of species and habitats, images and videos, ROV-image data and side-scan sonar image data.

Standards for data collection and management:

See, e.g., Bergström et al (2007), Dinesen et al. (2007) and Kautsky (1999).

Video and imagery: Towed video sledges, camera, sediment profile imagery, ROV, see MESH http://www.searchmesh.net/.

In situ sampling: Diver surveys, trawls and dredges, grab sampling, drop-trap, beam-trawl, push-net, white plates and scoops, juvenile trawl, low impact pressure wave, see MESH http://www.searchmesh.net/.

See also the EU project Biological Effects Quality Assurance in Monitoring (BEQUALM) at http://www.bequalm.org.

3.5.9 Structures
 Data sets:

Shoreline Constructions

Piers, pontoons, slipways, training walls.

Obstructions

Outfalls, diffusers, barriers.

Offshore Installations

Surface Structures: wind turbines, wave energy devices.

Sub-surface Structures: marine turbines, pipelines (oil and gas, other), cables (communication, electrical, other).

Navigational Aids

Buoys, beacons, light vessels.

Wrecks, Archaeology

3.5.10 Human Activities

Dats sets:

National Limits and boundaries

Administrative Boundaries: Port Limits, exclusion zones, pollution control zones.

Political and administrative boundaries.

Shipping, Transportation

Traffic separation, reporting areas, anchorage areas, vessel routes, shipping density, transportation / shipping routes.

Activity and Licence Areas

Military exercise areas, aggregate extraction areas, wind farm development areas, disposal sites, standing approvals for dispersants.

Aquaculture

Fish and shellfish farm areas.

Fisheries

Fisheries areas, sensitive fish areas, fish shellfish growing waters, closed fishing areas.

3.5.11 Natural Environment
 Data sets:

Reserves with marine components, Natura 2000 sites, Baltic Sea Protected Areas (BSPA) etc. including seal sanctuaries.

Bathing Waters, recreational waters, environmental pollution, environmental impact assessment, monitoring environmental risk, nitrate vulnerable zones, industrial discharge surveys, bathing water quality and marine litter surveys.

Other Examples: The Helsinki Commission (HelCOM) regional sea boundaries, river basin districts, coastal waterbodies, transitional waterbodies, environmental resources, protection and conservation.

3.5.12 Derived Data Sets

Data Sets:

Topographically distinct areas that suffer of anoxia, habitat classifications, biodiversity, coastal habitats, wave exposure data, marine landscapes, bed-forms.

Integrated Assessments:

Strategic environmental assessments and environmental impact assessments.

Standards for data collection and management:

See the Oslo Paris Comission (OSPAR) nutrient status assessments at:
http://www.ospar.org

Marine landscapes

See e.g. Al-Hamdani & Reker (2007), Connor et al. (2007) and Connor et al. (2003).

Habitats

The European MESH programme (http://www.searchmesh.net/) has developed a set of internationally agreed protocols and standards for seabed habitat mapping. See also, e.g. Connor et al. (2007), Connor et al. (2003) and Dinesen et al. (2007).

Habitat types should be defined within the European Environment Agency's European Nature Information System (EUNIS) see e.g. http://eunis.eea.europa.eu/habitats.jsp) and Erlandsson & Lindeberg (2007).

Biodiversity

See, e.g., an integration of different resources related to marine biodiversity at the European project Marine Biodiversity and Ecosystem Functioning EU Network of Excellence (MarBEF) homepage http://www.marbef.org/.

Socio-Economic Data

See, e.g., Water Information System for Europe (Water Framework Directive) at:
http://wise2.jrc.it/wfdwebinterface/php/index.php.

4 PERSPECTIVES

4.1 Experiences from the BALANCE Data Portal

4.1.1 Functionality

The BALANCE Data Portal is using ESRI's GIS Portal Toolkit 2.01 and was put into production during the autumn 2005. Installation and localization of the application and setup of the database was relatively straightforward, after attending the mandatory 3-day training course at ESRI Sweden.

The GIS Portal Toolkit allows for some basic localization and customization, but the adoption of the overall organization and functionality is more cumbersome and has not been part of the BALANCE project. The localization and customization carried out has focused on creating relevant documentation, a BALANCE start page, and map services covering the project area to be used for geographical searches and background in the map viewer application. Channels or categories have been created for every partner to be used for browsing the content of the Portal. This is done with a separate desktop tool provided by ESRI, which has been functioning well. Some administration tools for handling users and channels would have made administration easier.

Since the production start, the application has been running very stable with few disturbances. However, there have been some disturbing problems related to uploading, editing and displaying metadata documents.

When creating ISO-formatted metadata documents using the ISO-editor in ArcCatalog, the GIS Portal has had problems to display the documents correctly for editing and review. This has caused a lot of manual work for the administrator, and has made it difficult to use the ISO-editor as the preferred way to publish metadata. Using the online form instead has meant more manual work for publishers and caused less metadata to be entered.

The search functions and the map viewer application have generally performed well with small disturbances.

Since the start of the project at least two releases of GIS Portal Toolkit has been distributed. So far it has not been considered efficient to update the application given the amount of work involved, and that several problems stills seems to remain unsolved.

4.1.2 User survey

After the BALANCE Data Portal had been running during 2006 a user survey was conducted among the partners to evaluate the use of the Portal. The experience of the search and display functionality was in general positive, but there was a disappointment with the number of metadata documents published.

The less than expected number of documents published might in part be explained with the difficulty in publishing metadata created in the ISO-editor in the ArcCatalog™ application which often has made it necessary to use manual entry in the on-line form. A probable explanation is also that it has been up to every partner to decide what resources or data types that should have metadata published on the BALANCE Data Portal, and that the requests for data has found other channels. This situation focuses on that a lot of work has to be put into organizational issues when running a data portal. The BALANCE Data Portal would probably have benefited from a more formalized cooperation between data producers, data users and Portal administrators.

4.1.3 The metadata content

The number of metadata documents published has not at all reached the expected. A total number of 69 documents was published and approved on the BALANCE Data Portal, while more than a hundred relevant documents were expected. The published metadata documents are shown in Table 2 and describe different data types with the following distribution:

Live Data and Maps	11
Downloadable data	0
Offline data	43
Map documents	3
Other documents	12
Other resources/activities	0

As mentioned above there have existed some problems in the functionality for publishing metadata, but this is not considered as a major explanation for the "lack" of published metadata documents. Publishers that have tried to publish documents have managed to publish with some extra effort.

A possible explanation is that it has been up to every partner to decide which resources or data types that should have metadata published on the BALANCE Data Portal, and that the requests for data have found other channels.

Table 2. Metadata documents published in the BALANCE Data Portal organised after country/organisation and publisher. Data categories are applied and information about each dataset is provided.

Country/ Organisation	Nr.	Publisher	Content Title	Data	Info
Denmark					
National Environmental Research Institute	1	NERI	Bottom fauna samples in Danish waters 1970-2005	Biology	Sampling of soft bottom fauna.
	2	NERI	Bottom fauna samples in BALANCE Pilot Area 1	Biology	Dataset contains information on several samples per station in a grid.
	3	NERI	Near Real Time data - NRT	Physical Oceanography	Data from CTD casts (salinity and temperature) and concentrations of total nitrogen (TN) and total phosphorous (TP).
	4	NERI	Water chemistry data from Danish waters	Geochemistry	Water chemistry data from Danish waters including nitrate, phosphourus, TN, TP, silicate and chlorophyll a.
	5	NERI	CTD data from Danish waters	Physical Oceanography	CTD data are available through the web.
Geological Survey of Denmark and Greenland	6	GEUS	Marine Landscape	Physical Oceanography/Substrates (geology)	This dataset is the result of a raster calculation on the 3 underlying maps: Sediment, Photic-depth and Salinity.
	7	GEUS	Salinity layer	Physical Oceanography	Consists of 6 classes: <5 psu, 5-7.5 psu, 7.5-11 psu, 11-18 psu, 18-30 psu and >30 psu.
	8	GEUS	Photic zone	Physical Oceanography	Consist of two classes: Euphotic zone and Non-Photic zone.
	9	GEUS	Sediment layer	Substrates (geology)	Consist of 5 classes: Bedrock, Hard bottom complex, Sand, Hard clay and Mud.
	10	GEUS	Topographic Marine Landscape	Substrates (geology)/Physical Oceanography/Shoreline Morphology	Four underlying maps: Sediment, Photic-depth, Salinity and Topography from the Benthic Terrain Model.
	11	GEUS	5 m dybdekurver	Bathymetry	Digital elevation model (DEM)- consisting of polygons in 5 meter intervals-of land and seabed.
Estonia					
Estonian Marine Institute, University of Tartu	12	EMI	Estonia - sediment	Substrates (geology)/Biology	Seabed sediment data: digital geological maps and point data from macrozoobenthos grab sampling stations.

	13	EMI	Estonia - benthos	Biology	Coastal sea. Biomass of benthic macrophytes. Biomass and abundance of benthic macroinvertebrates.
	14	EMI	Estonia - hydrography	Physical Oceanography/ Geochemistry/Biology	Hydrographic (salinity, temperature, nutrient profiles) and plankton (phytoplankton, zooplankton) data from 25 stations.
	15	EMI	Estonia - bathymetry	Bathymetry	Digital bathymetric data (depth isolines) of the Estonian coastal sea.
Finland					
Geological Survey of Finland	16	GTK	Northern Baltic Sea Sediment Map	Substrates (geology)	BALANCE sediment data from the Northern Baltic Sea.
	17	GTK	Archipelago Sea Sediment Map	Substrates (geology)	Data is based on the marine geological maps that have been reclassified into the BALANCE substrate classes.
	18	GTK	Topographic features	Bathymetry, substrates (geology)	Map of the topographic features of the Baltic Sea (including Kattegat and parts of Skagerrak). Features are identified/modeled from Balance datasets of bathymetry and sediment data.
	19	GTK	Coastal landscape	Bathymetry, substrates (geology), physical oceanography	Map of the Coastal/Physiographic landscapes of the Baltic Sea (including Kattegat and Skagerrak). Features are identified/modeled from Balance datasets of coastline, bathymetry and salinity.
Metsähallitus Natural Heritage Service	20	METSA	Archipelago zonation	Natural environment/Shoreline Morphology	Zonation in SW Finland, categorized to three classes (inner, middle and outer archipelago).
	21	METSA	Communication infrastructure	Natural environment/Biology/ Socioeconomics	A predictive map of communication infrastructure indicating the pressure induced by anthropogenic influence on marine nature; (1 = lowest, 5 = highest) classes.
	22	METSA	Effects of marine management activities on fishing	Natural environment/ Socioeconomics	A predictive map of the probable effects of marine management activities on fishing; classified to five (1 = lowest, 5 = highest) classes.
	23	METSA	Effects of recreational fishing on sensitive habitats	Natural environment/ Socioeconomics	A predictive map of effects of recreational fishing on sensitive habitats; (1 = not vulnerable, 2 = moderately vulnerable, 3 = highly vulnerable) classes.
	24	METSA	Habitat heterogeneity	Substrate (geology)/Bathymetry/ Marine meterology/Shoreline Morphology	A predictive map of habitat heterogeneity created using depth, wind exposure and shoreline data; classified to five (1 = lowest, 5 = highest) classes.
	25	METSA	Human influence on coastal lagoons	Natural environment/Biology/ Socioeconomics	The map is a prediction of anthropogenic influence on coastal lagoons classified to five classes (1 = lowest, 5 = highest).

	26	METSA	Marine noise disturbance from vessels	Natural environment/Biology/Socioeconomics	A predictive map of noise disturbance in the marine environment induced by vessel traffic; classified to five (1 = lowest, 5 = highest) classes.
	27	METSA	Potential dredging sites	Natural environment/Biology/Socioeconomics	A predictive map of potential dredging sites associated with maritime traffic and recreational boating.
Finnish Environment Institute	28	SYKE	Water turbidity in the Archipelago Sea	Physical Oceanography/Biology/Natural Environment	The turbidity of surface water in the Archipelago Sea is monitored during the open water season using MERIS and Terra/MODIS satellite images.
	29	SYKE (HELCOM)	Harbours	Structures/Natural environment	Dataset contains the ports (with commercial traffic) of the Baltic Sea.
	30	SYKE (HELCOM)	Oil Terminals	Structures/Natural environment	This dataset includes information about the oil terminals along the Baltic Sea coastline, which have an annual turnover of more than 3 million tonnes.
	31	SYKE	Shipping lanes	Structures/Natural environment	The dataset contains the main shipping and boat lanes in the Finnish coastal waters (excluding the Åland islands).
	32	SYKE (HELCOM)	Exclusive Economic Zones in the Baltic Sea (EEZ)	Structures/Natural environment	Dataset contains the borderlines of the Exclusive Economic Zones in the Baltic Sea.
	33	SYKE (HELCOM)	Baltic Sea Subbasins	Structures/Natural environment	Dataset consists of the sub-divisions of the Baltic Sea sub-basins according the HELCOM's Combine Manual (www.helcom.fi).
	34	SYKE	Bathymetry	Bathymetry	The dataset is a rasterised TIN-model of the bathymetry of the Finnish coastal waters, based on the depth data (shorelines, depth points and depth iso-curves).
	35	SYKE	Secchi depth	Physical Oceanography	Dataset consits of point observations of secchi depth in the Finnish Sea areas from 1995 to 2006. The dataset contains 1647 sites and some 56000 observations.
	36	SYKE	Turbidity and surface water temperature in Finland (1995-2005)	Physical Oceanography/Marine meterology	The dataset contains surface water (0-1 meters) temperature data from the Finnish coast as well as turbidity data of the area. The data is collected in 1995-2005.
	37	SYKE	Surface water salinity in Finland (1995-2005)	Physical Oceanography/Marine meterology	The dataset contains surface water (0-1 meters) salinity data from the Finnish coast.
	38	SYKE	Bottom water salinity in Finland (1995-2005)	Physical Oceanography	The dataset contains bottom water salinity data from the Finnish coast.
	39	SYKE	Wave exposure	Physical Oceanography/Marine meterology	Wave exposure grids created using the method SWM (Isæus) A nested-grids technique was used to ensure long distance effects on the local wave exposure regime.

	40	SYKE (Lant-mäteriet)	Land-uplift model NKG2005LU	Shoreline Morphology	The estimated apparent land uplift in mm/year in the Scandinavia based on the model NKG2005LU.
	41	SYKE	Average ice-days 1996-2000	Marine meterology	Dataset contains the average number of days of ice-cover at the Finnish coastal observation stations between 1996-2000 (228 points).
	42	SYKE (HELCOM)	Baltic Sea Protected Areas (BSPAs)	Natural environment/Biology	The dataset contains the Coastal and Marine Protected Areas in the Baltic Sea Region (HELCOM) and the new proposed offshore Baltic Sea Protected Areas.
	43	SYKE (BirdLife International)	Important bird areas (IBAs)	Natural environment/Biology	Dataset contains the important bird areas (IBAs) in the Baltic Sea area.
	44	SYKE	Natura 2000 sites in Finland (lines)	Natural environment/Biology	The dataset contains those Finnish NATURA 2000 sites according to the Finnish government decisions.
	45	SYKE	Natura 2000 sites in Finland (polygons)	Natural environment/Biology	The dataset contains the Finnish NATURA 2000 sites according to the Finnish government decisions.
	46	SYKE	Natura 2000 sites in Åland	Natural environment/Biology	The dataset contains the NATURA 2000 sites in the Åland Islands according to the Finnish government decisions.
	47	SYKE (HELCOM)	Ramsar and EU Bird Directive Areas	Natural environment/Biology/Structures	Dataset consists of Ramsar and EU Bird Directive Areas in the Baltic Sea based on Baltic Pipeline System: Environmental Impact on the Baltic.
	48	SYKE (HELCOM)	UNESCO Biosphere Reserves	Natural environment/Biology/Socioeconomics	Dataset contains the Unesco Man and the Biosphere (MAB) Biosphere reserves, promoting solutions to reconcile the conservation of biodiversity.
Lithuania					
Coastal Research and Planning Institute	49	CORPI	Red algae Furcellaria lumbricalis reefs in the Lithuanian coastal waters	Biology/Substrate (geology)/Shoreline Morphology/Physical Oceanography	Statistical model for prediction of reefs, based on habitat mapping data. Model prediction map considers photic zone of from the coastline to the 20 m depth.
	50	CORPI	EUNIS habitats types in the Lithuanian Exclusive Economic Zone	Biology/Substrate (geology)/Bathymetry/Structures	Map of EUNIS habitat types Coastline vector data set, raster layers of sediment composition and bathymetry were used along with biological variables.
	51	CORPI (Klaipeda University)	Biodiversity study and mapping of marine habitats in the vicinity of the Butinge Oil Terminal.	Biology/Substrate (geology)/Socioeconomics/Bathymetry	Habitat distribution in coastal waters in the Butinge Oil Terminal area, by integrating biological material with the bathymetry data and sediment distribution maps.

	52	CORPI (Geological Survey of Lithuania)	Geological Atlas of the Lithuanian part, the Baltic Sea	Substrate (geology)/Shoreline Morphology/Natural environment	The dataset contains information on sediments and geological geomorphological map and map of the antrophogenic strain (1 : 5 000) and explanatory script.
	53	CORPI (Fisheries Department under the Ministry of Agriculture)	Baltic Sea, Lithuanian part, fishery map	Substrate (geology)	The map contains information on sediments compiled by integrating marine chart and geological images.
	54	CORPI (Lithuanian Maritime Safety Administration)	Baltic Sea middle part, approaches to port Klaipeda	Bathymetry/Substrate (geology)/Structures	The map supplies information on the bathymetry. The map also informs about light characters, colors of lights and buoys, nature of seabed.
	55	CORPI (Geological Survey of Lithuania)	Baltijos juros Lietuvos krantu geologinis atlasas	Shoreline Morphology/Substrate (geology)/Structures	The dataset contains information on coastline, geological geomorphological map and map of the antrophogenic strain.
Norway					
The Norwegian Institute for Water Research	56	NIVA	Predictions of Laminaria hyperborea at the Norwegian Skagerrak coast	Bathymetry/Substrate (geology)/Biology/Natural environment/Physical Oceanography/Marine meterology	This map was created using GRASP to model presence of Laminaria hyperborea. Predictors: wave exposure, depth, curvature and light exposure.
	57	NIVA	Predictions of Nephrops norvegicus at the Swedish Skagerrak coast	Bathymetry/Substrate (geology)/Biology/Shoreline/Physical Oceanography/Marine meterology	This map shows predictions (probablilities from 0-1) for presence of Nephrops norvegicus, created in GRASP. Data: depth, slope, aspect and substrate.
Sweden					
National Board of Fisheries	58	National Board of Fisheries	Perch nursery habitat	Biology/Bathymetry/Substrates geology)/Physical Oceanography	Fish habitat modelling.
	59	National Board of Fisheries	Roach nursery habitat	Biology/Bathymetry/Substrates (geology)/Physical Oceanography	Fish habitat modelling.

	60	National Board of Fisheries	Perch spawning habitat	Biology/Bathymetry/ Substrates (geology)/Physical Oceanography	Fish habitat modelling.
	61	National Board of Fisheries	Pike nursery habitat	Biology/Bathymetry/Substrates (geology)/Physical Oceanography	Fish habitat modelling.
	62	National Board of Fisheries	Sander nursery habitat	Biology/Bathymetry/Substrates (geology)/Physical Oceanography	Fish habitat modelling.
Geological Survey of Sweden	63	SGU	Bottom substrate types in the Baltic	Substrate (geology)	Tentative representation of bottom substrate types in the Baltic.
	64	SGU	Marine Geological maps of the Baltic, Bothnian Sea and Bothnian Bay	Substrate (geology)	Digital marine geological maps.
	65	SGU	Marine Geological map of the Skagerrak area	Substrate (geology)	Digital marine geological maps.
	66	SGU	Marine Geological Map of the Gävle area	Substrate (geology)	Digital marine geological maps.
	67	SGU	Marine Geological map over the Norrtälje area	Substrate (geology)	Digital marine geological maps.
	68	SGU	Marine Geological map of the Umeå area	Substrate (geology)	Digital marine geological maps.
	69	SGU	Bathymetric map of the Bothnian Bay	Substrate (geology)/Bathymetry	Digital bathymetric raster map of 50x50 meters resolution over the Bothnian Bay.

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Compliance reporting

WP 1, Milestone 1, Start December 2005

Planned outputs in application	Delivered outputs
A1) Metadata requirements and set up of a GIS portal for publishing metadata and data delivery; B1) Draft guidelines for intercalibration of data and survey methodology; C1) A working paper on required data and data formats from other WP's and data delivery to marine landscape development (WP2); D1) Definition of pilot areas and identification of case study areas based on data availability.	A1) Done. B1) Done. C1) Done. D1) Done.

WP1, Milestone 2, January-June 2006

Planned outputs in application	Delivered outputs
A2) Partner data and metadata published through the GIS portal. Overviews of available data for further work; B2) Updated standards & protocols document on cross-sectoral data intercalibration and a report on survey results from the study areas including assessments of survey methodologies; C2) Final data delivery for marine landscape development. Workshop report on habitat requirements.	A2) Done. B2) Done. C2) Done.

WP1, Milestone 3, July-December 2006

Planned outputs in application	Delivered outputs
A3) A report on the functionality of the GIS portal including data harmonisation. Marine landscapes and partners metadata published through the GIS portal; B3) Report on how to intercalibrate field sampling & statistical processing results of the data; C3) Data delivery for production of habitat maps & models (to WP2).	A3) Done. B3) Done. C3) Done.

WP1, Milestone 4, January-June 2007

Planned outputs in application	Delivered outputs
A4) Metadata base freely available for viewing and downloading; B4) Updated protocols and standards report, which includes verification results; C4) A short report validating the marine landscapes; D4) A draft report for WP1 activities to be distributed for commenting by the involved partners.	A4) Done. B4) This report was not done, in agreement with the Project secretariat, because a comprehensive report about protocols and standards has been published by the project "Development of a framework for mapping European Seabed habitats" (MESH) partly financed by INTERREG, and because the responsible person moved to another job. C4) Done through inputs to Workpackage 2. D4) Done.

WP1, Milestone 5, July-December 2007

Planned outputs in application	Delivered outputs
A final report will include: A1-5) guidelines on how to set up a metadatabase with multiple users & a freely accessible GIS portal for BSR stakeholders; B1-5) Protocols and standard for BS marine habitat mapping with guidance on intercalibration of cross-sectoral and transnational data sets; C1-5) Guidelines on how to compile data validate and update BS marine landscape and habitat maps.	A1-5) Done. B1-5) Done. C1-5) Partly done, see B4 and C4 above.

About the BALANCE project:
This report is a product of the BSR INTERREG IIIB project "BALANCE".

The BALANCE project aims to provide a transnational marine management template based on zoning, which can assist stakeholders in planning and implementing effective management solutions for sustainable use and protection of our valuable marine landscapes and unique natural heritage. The template will be based on data sharing, mapping of marine landscapes and habitats, development of the blue corridor concept, information on key stakeholder interests and development of a cross-sectoral and transnational Baltic zoning approach. BALANCE thus provides a transnational solution to a transnational problem.

The BALANCE partnership is composed of the following institutions based in 10 countries: The Danish Forest and Nature Agency (Lead), The Geological Survey of Denmark and Greenland, The National Environmental Research Institute/University of Aarhus, The Danish Institute for Fisheries Research, WWF Denmark, WWF Germany, Institute of Aquatic Ecology at University of Latvia, Estonian Marine Institute at University of Tartu, Coastal Research and Planning Institute at Klaipeda University, Metsähallitus Natural Heritage Service, The Finnish Environment Institute, The Geological Survey of Finland, WWF Finland, The Swedish Environmental Protection Agency, The National Board of Fisheries – Department of Research and Development, The Geological Survey of Sweden, County Administrative Board of Stockholm, Department of Marine Ecology at Gothenburg University and WWF Sweden. The following institutes contribute as consultants to the partnership: The Geological Survey of Norway, Norwegian Institute for Water Research, DHI Water & Environment, The Leibniz Institute of Marine Sciences, The Sea Fisheries Institute, The Finnish Game and Fisheries Research Institute, Metria Miljöanalys and The Nature Conservancy.