

**MED-WIS project**  
**“Preparation of a metadata catalogue of**  
**water information sources”**  
**SIME981**

-

**Task 1 - Review of existing tools**

**VERSION 1.2**

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Prepared By S.Grellet / International Office for Water



## Report meta-information

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## **Disclaimer:**

*“This report was drawn up with the assistance of the European Commission. The contents of this document are the sole responsibility of the International Office for Water mandated by EMWIS Technical Unit under the contract “Towards a Mediterranean Water Information Mechanism compatible with WISE” ref. 21.0401/2007/485730/UB/D2 and may not be deemed to be reflecting the opinion of the European Union.”*



## EXECUTIVE SUMMARY

On the basis of the project funded by the DG Env of the European Commission, entitled "Towards a Mediterranean Water Information Mechanism compatible with the Water Information System for Europe (WISE)", EMWIS Technical Unit is preparing an Information System aiming at streamlining access to quality data related to water in the Mediterranean Partners Country (MPC).

Work package n°2 of this project, related to the development of a metadata catalogue of water information sources in MPC is addressed by the present work.

Developing such a solution implies various tasks:

1. A review of existing tools taking into account EMWIS, INSPIRE and WISE requirements on metadata tools in order to identify the most suitable solution to be set up and to ensure the technical interoperability with the main identified European Metadata catalogue tools,
2. A definition of reference labeling dealing with the content of the metadata themselves. Keywords, glossary and profiles need to be examined in order to ensure a common metadata understanding and usage among MPC. Multilingual issues will also need to be carefully studied to comply with the main languages used in the MPC,
3. The animation of an expert workshop on metadata management to agree on common procedures and common rules on metadata management,
4. The online implementation of the elected metadata catalogue tool and the transmission of the necessary skills to feed the tool via guidance documents,
5. Finally, the metadata collection aiming at filling-in the tool with metadata harvested or directly written on a web interface.

The task 1 "review of existing tools" is the objective of the present report. It was organized as follow:

- Identification of requirements based on EMWIS' needs and INSPIRE specifications on metadata catalogues.
- Then, an inventory of the main existing metadata catalogues directly or indirectly used for water resource management was carried out. Existing catalogues at International, European, National and Euro-Mediterranean levels were taken into account,
- Once the main metadata catalog tools were identified, they were confronted to the requirements identified in step 1. One tool was proposed to be used for the next steps of the project.
- Eventually, interoperability between this tool and main identified European catalogues was addressed.

In the framework of the feasibility study on the Mediterranean Water Observation Mechanism, Geonetwork open source software has been successfully tested. Strengthened by this experience EMWIS contacts have now a good overview of their needs toward a metadata catalogue tool. Interviews with EMWIS representatives have helped identifying 14 mandatory and 6 optional elements.

INSPIRE Implementing Rules on Metadata have been published in EU Member States languages at the beginning of December 2008. Most of those requirements are about Metadata Elements specifications, their definition and multiplicity. It does not directly address metadata management tools development. But INSPIRE

literature has been intensively used to extract requirements on metadata management tools. Thus, 13 requirements have been identified that way. An analysis matrix was then built upon those 27 mandatory and 6 optional elements.

Before confronting several tools to this analysis matrix, a state of the art of the current metadata tools deployed in water related web sites was carried out. Two main open-source tools and specific developments were identified. In order to be as complete as possible, using the common literature on this subject (reference Internet websites, forums ...), six other tools were added to this selection.

From the requirement matrix analysis process, Geonetwork Open Source was proposed as the most suitable tool for the next steps of this project. This tool is fulfilling all mandatory requirements plus some optional ones. It has an ever growing community and involvement in metadata catalog projects all around the world.

The technical interoperability between Geonetwork and main existing metadata catalogs (WISE, INSPIRE, EUROSTAT) will be assured given that the same international protocols are, or will be, implemented in all the solutions.

Specific metadata interoperability issues (profile or glossary/thesaurus) have also been mentioned. These points will be addressed in the second task of this project.

## I. LIST OF ACRONYMS

ANZLIC	Australian, New ZeaLand Information Council
CSW	Catalog Service for the Web
ebRIM	e-business Registry Information Model
ESA	European Space Agency
FGDC	Federal Geographic Data Committee
GEMET	GEneral Multilingual Environmental Thesaurus
GISCO	Geographic Information System of the European Commission
INSPIRE	Infrastructure for Spatial Information in the European Community
IR	Implementing Rule
JDBC	Java Database Connectivity
JRC	Joint Research Center
OAI-PMH	Open Archives Initiative Protocol for Metadata Harvesting
OGC	Open GIS Consortium
SDI	Spatial Data Infrastructure
WISE	Water Information System for Europe
XML	Extensible Markup Language
XSD	XML Schema

## II. INTRODUCTION

The objective of the task 1 is to carry out a comparison of existing tools in order to find-out the most suitable solution for the project entitled "Towards a Mediterranean Water Information Mechanism compatible with the Water Information System for Europe (WISE)".

This document is organized as follow:

- Summary of EMWIS' needs, INSPIRE and WISE specifications on metadata catalogue tools: this sub-task is addressed in part IV & V of the present document,
- Inventory and characterization of main existing metadata catalogues directly or indirectly involved in water resource management. Existing catalogues at International, European, National and Euro-Mediterranean levels have been taken into account,
- Main existing metadata catalogue tools inventory and classification based on the solution they provide to the needs and specifications identified in the first two sub-tasks,
- Possible interoperability solutions between catalogues identified in part VI and the tool elected in the previous sub-task.



### III. EMWIS SPECIFICATIONS ON METADATA CATALOGUE TOOLS

Interviews with EMWIS Technical Unit have led to the following table summarizing functionalities and specifications expected by EMWIS.

Functionality	Level of priority
Web based application	Mandatory
Multilingual user interface	Mandatory
Easy implementation on Windows or Linux OS server	Mandatory
Free/Open source software	Mandatory
Compatible with Inspire metadata specifications	Mandatory
Easy Interface with Inspire metadata tool/catalogue	Mandatory
Facilitating shared participations for metadata entry	Mandatory
Set Internet privileges to "view" and "download"	Mandatory
Harvesting and access through Catalogue Services	Mandatory
Customisable multilingual management of closed selection lists (keywords, categories, geographical areas, etc.)	Mandatory
Simple workflow management: Ability for non registered user to input metadata and validation by site managers	Mandatory (at least data input for non registered users)
Add/Edit/delete metadata with direct Access to Metadata Element Definitions	Mandatory
Operating Instruction Manual	Mandatory
Import/ export metadata	Mandatory
Interface with other metadata catalogues formats	Optional 1
User interface customisable "look-and-feel"	Optional 1
Integrated Map Viewer for data formats such as SHP	Optional 1
Interactive Web Map Viewer	Optional 1
Service-chain search access to local and distributed geospatial catalogues	Optional 1
Metadata stores in external database	Optional 1

**Table 1 - EMWIS functionalities / specifications**

## IV. INSPIRE, WISE AND EUROSTAT SPECIFICATIONS ON METADATA CATALOGUE TOOLS

INSPIRE Implementing Rules for metadata have been successfully adopted on May 2008 14<sup>th</sup> and were published in the beginning of December 2008.

Most of those requirements are about Metadata Elements specifications, their definition and multiplicity. It does not directly addresses metadata management tools development.

Thus, we have to infer INSPIRE specifications on metadata management tools from the literature available in INSPIRE sphere. EMWIS being related to the Water topic, WISE GIS Guidances have also been taken into account where no specific rules were coming from the INSPIRE side.

For such an exercise the following information sources have been used:

- The INSPIRE Directive, 2007-04-25<sup>1</sup>,
- INSPIRE Implementing Rules (IRs) for Metadata and their various technical implementations :
  - o Voted INSPIRE Implementing Rules on Metadata, 2008-06-05<sup>2</sup>.
  - o Implementing Rules for (IR) Metadata - Version 3, 2007-10-26<sup>3</sup>,
  - o INSPIRE metadata implementing rules - summary of process, 2008-06-05<sup>4</sup>,
  - o ISO 19115-19119: INSPIRE Metadata Implementing Rules: Technical Guidelines based on EN ISO 19115 and EN ISO 19119, 2008-12-19<sup>5</sup>,
  - o ISO 15836 (Dublin Core): State of progress in developing guidelines to express the INSPIRE metadata elements using ISO 15836 (Dublin Core), 2008-06-05<sup>6</sup>,
- INSPIRE Network Services : Draft Implementing Rule: Discovery Services (Version 3.0), 2008-11-04<sup>7</sup>,
- INSPIRE architecture documentation :
  - o Network Services Architecture - Version 3, 2008-09-30<sup>8</sup>
  - o Technical Architecture Overview, 2007-11-05<sup>9</sup>,
- WISE Updated GIS Guidances version 1.2, 2008-09-23<sup>10</sup>,

<sup>1</sup><http://eur-lex.europa.eu/JOHtml.do?uri=OJ:L:2007:108:SOM:EN:HTML>

<sup>2</sup><http://ec.europa.eu/transparency/regcomitology/searchform/DocumentDetail.cfm?GYzXOQBhbKyP5HsXwGZXxe8Piw51LhOKnYcqh5lfwshM2G5e1MEqSakKrkdCfdOk>

<sup>3</sup><http://inspire.jrc.ec.europa.eu/reports.cfm>

<sup>4</sup>[http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/metadata/IR\\_Metadata%20process.pdf](http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/metadata/IR_Metadata%20process.pdf)

<sup>5</sup>[http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/metadata/MD\\_IR\\_and\\_ISO\\_20081219.pdf](http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/metadata/MD_IR_and_ISO_20081219.pdf)

<sup>6</sup>[http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/metadata/MD\\_IR\\_and\\_DC\\_state%20of%20progress.pdf](http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/metadata/MD_IR_and_DC_state%20of%20progress.pdf)

<sup>7</sup>[http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/network/D3.7\\_IR3\\_Discovery\\_Services\\_v3.0.pdf](http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/network/D3.7_IR3_Discovery_Services_v3.0.pdf)

<sup>8</sup>[http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/network/D3\\_5\\_INSPIRE\\_NS\\_Architecture\\_v3-0.pdf](http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/network/D3_5_INSPIRE_NS_Architecture_v3-0.pdf)

<sup>9</sup>[http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/network/INSPIRETechnicalArchitectureOverview\\_v1.2.pdf](http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/network/INSPIRETechnicalArchitectureOverview_v1.2.pdf)

<sup>10</sup>[http://eea.eionet.europa.eu/Public/jrc/eionet-circle/eionet-teleomatics/library?l=/technical\\_developments/wise\\_technical\\_group/guidance\\_document&v=m=detailed&sb=Title](http://eea.eionet.europa.eu/Public/jrc/eionet-circle/eionet-teleomatics/library?l=/technical_developments/wise_technical_group/guidance_document&v=m=detailed&sb=Title)

- Eurostat / sdiinspire call for tender on the "*Development of the technical components of a European Commission Spatial Data Infrastructure compliant with the provisions of INSPIRE*"<sup>11</sup>.

## A. Global requirements from Inspire directive

### **INSPIRE requirements concerning Metadata management tool n°1:**

Metadata must be managed in an electronic format making it possible to search for spatial data sets and services on the basis of the content of the corresponding metadata and to display the content of the metadata.

INSPIRE Directive Article 5 and 11 are the starting points in the definition of metadata management.

INSPIRE directive leads to the development of various coupled services. The first one, the discovery service, should be provided by a metadata management tool and is defined as:

*"discovery services making it possible to search for spatial data sets and services on the basis of the content of the corresponding metadata and to display the content of the metadata"*.

Implicitly, searching for Metadata implies storing them in an electronic format.

### **INSPIRE requirements concerning Metadata management tool n°2:**

The elected software must be able to implement metadata elements listed in Annex I of this document and respect their multiplicity.

Part 2.3 "Conditions and Relationships to the Directive" from INSPIRE Metadata Draft Implementing Rules - Version 3, 26/10/2007 introduces INSPIRE metadata elements implementation:

*In order to be conformant to INSPIRE Implementing Rules, the metadata describing a spatial dataset or a spatial dataset series shall comprise the metadata elements or groups of metadata elements listed according to their expected multiplicity and their related condition. When no condition is expressed, the metadata element is mandatory.*

INSPIRE metadata elements are summarized in Annex I of the present document.

### **INSPIRE requirements concerning Metadata management tool n°3**

The elected software must provide Metadata for datasets and (INSPIRE) services

Interoperability is the backbone of INSPIRE directive. INSPIRE Directive Article 11 presents the various services Member States have to set up:

*"Member States shall establish and operate a network of the following services for the spatial data sets and services for which metadata have been created in accordance with this Directive:*

*(a) discovery services making it possible to search for spatial data sets and services on the basis of the content of the corresponding metadata and to display the content of the metadata;*

<sup>11</sup> [http://www.inspire-geoportal.eu/newsevt/newsevt\\_index.jsp?id=2420&type=news](http://www.inspire-geoportal.eu/newsevt/newsevt_index.jsp?id=2420&type=news)

- (b) view services making it possible, as a minimum, to display, navigate, zoom in/out, pan, or overlay viewable spatial data sets and to display legend information and any relevant content of metadata;
- (c) download services,
- (d) transformation services,
- (e) services allowing spatial data services to be invoked."

## B. Norms and standards required for metadata storage and interoperability

### **INSPIRE requirements concerning Metadata management tool n°4:**

The elected software must be able, at least, to implement INSPIRE metadata IRs following ISO 19115-19119 norms.

INSPIRE metadata implementing rules - summary of process clearly states in IR development Phase 2 that:

*"metadata elements are defined at an abstract level in order to make the Implementing Rules independent of specific encoding or possible future changes in standards. The Commission agreed to establish, in collaboration with stakeholders and relevant standardization organizations, detailed guidelines and instructions for implementation and interoperability of metadata. These include instructions on how the European standards EN ISO 19115 and EN ISO 19119 shall be used to disseminate INSPIRE metadata, should one chose to use these standards.."*

Thus, two guidance documents are being written aiming at implementing INSPIRE IRs on Metadata in the two main ISO metadata standards:

- Guidance for ISO 19115-19119<sup>12</sup>: *INSPIRE Metadata Implementing Rules: Technical Guidelines based on EN ISO 19115 and EN ISO 19119,*
- Guidance for ISO 15836 (Dublin Core)<sup>13</sup>: *State of progress in developing guidelines to express the INSPIRE metadata elements using ISO 15836 (Dublin Core).*

The latter precises that some INSPIRE metadata elements are *"Not supported in Dublin Core without creating an additional resource"*.

*"Typically, the IRs include both metadata on the information resource, and metadata on the metadata record itself (metadata responsible party, metadata date, metadata language). ISO 15836 follows a different model and provides metadata only on the information resource.*

*To provide metadata on the metadata record it would be necessary to define each metadata record as a resource in its own right, thus creating unnecessary burden. Therefore, the appropriate perspective on these guidelines is that they will provide ways to express a core subset of the INSPIRE Implementing Rules based on ISO 15836."*

Using only a subset of the INSPIRE IRs would not suit EMWIS' needs.

<sup>12</sup> ISO 19115 : Norm on Geographic information – metadata

ISO 19119 : Norm on Geographic information – services (including services metadata)

<sup>13</sup> ISO 15836 : Norm on metadata on the information resource (more electronic document management oriented)

Moreover, ISO-19115 has been especially set up for geographic information metadata cataloguing needs we will then advise to use guidelines for Metadata Implementing Rules using EN ISO 19115/19119.

**INSPIRE requirements concerning Metadata management tool n°5**

The elected software must implement OGC services.

Network Services Architecture -Version 3 document clearly states that: "*as the INSPIRE directive advises to utilize existing standards, OGC service bindings are taken as a guidance.*"

## C. Metadata search

**INSPIRE requirements concerning Metadata management tool n°6:**

The elected software must show in its interface the following search criteria :

- Keywords,
- Classification of spatial data and services,
- The quality and validity of spatial data sets,
- Degree of conformity with the implementing rules provided for in Article 7(1),
- Geographical location,
- Conditions applying to the access to and use of spatial data sets and services,
- The public authorities responsible for the establishment, management, maintenance and distribution of spatial data sets and services.

INSPIRE Network Services - Draft Implementing Rule: Discovery Services (Version 3.0) summarizes the minimum functionalities needed to search for Metadata.

*"The starting point for the Query abstract model is article 11 (2) of the Directive: "the Discovery service*

*shall implemented as a minimum the following combination of search criteria:*

- (a) keywords;*
- (b) classification of spatial data and services;*
- (c) the quality and validity of spatial data sets;*
- (d) degree of conformity with the implementing rules provided for in Article 7(1);*
- (e) geographical location;*
- (f) conditions applying to the access to and use of spatial data sets and services;*
- (g) the public authorities responsible for the establishment, management, maintenance and distribution of spatial data sets and services."*

In Annex II of this document, search criteria as outlined in the Directive article 11 (2) are mapped to the abstract metadata elements.

## D. Multilingual aspects

**INSPIRE requirements concerning Metadata management tool n°7:**

The elected software must implement at least GEMET Multi-Lingual Thesaurus to address Multilingual issues.

INSPIRE Metadata Draft Implementing Rules - Version 3, 26/10/2007 reminds that "*The Directive does not mandate the use of any particular natural language for the*

*metadata content. The Directive recognizes the importance of multi-lingual aspects and mandates the use of multi-lingual thesauri in the context of interoperability of spatial datasets and services (Art. 8-2 (c))".*

Moreover, in the voted IRs, GEMET thesaurus<sup>14</sup> is clearly stated in the 'KEYWORD' metadata element description:

*"If a resource is a spatial data set or spatial data set series, at least one keyword shall be provided from the General Environmental Multi-lingual Thesaurus (GEMET) describing the relevant spatial data theme as defined in Annex I, II or III to Directive 2007/2/EC."* (In Annex III of this document, INSPIRE Directive annexes are summarized).

**INSPIRE requirements concerning Metadata management tool n°8:**

The elected software must allow the user to view metadata, at least, in English.

Network Services Architecture - Version 3 also considers multilingual aspects in the following terms:

*"For all INSPIRE network services the operation providing the service metadata should return a list of the supported languages for the requested service. For every INSPIRE network service a mandatory parameter LANGUAGE is introduced which defines the client's preferred language. The response documents are returned in this preferred language if it is supported. If there is no support for the requested language, the documents are returned in the service default language (generally the Member State language being one of the official 23 European languages). However in following the European Interoperability Framework (EIF, see chapter 7.1) services should at least support parts of the service responses to be provided in English. To identify the different languages a language code list is provided".*

## E. Metadata management

**INSPIRE requirements concerning Metadata management tool n°9:**

The elected software must provide a web-based entry point

INSPIRE Directive Article 15.2, specifies that *Member States may also provide access to INSPIRE services through their own access points.*

Services concerned by metadata are more specifically detailed in chapter "G.INSPIRE Services" of the present report.

**WISE requirements concerning Metadata management tool n°10**

The elected software must provide Metadata import/export functionalities involving XML schemas.

WISE Updated GIS Guidances are addressing metadata management as follow:

*"The authoring and editing of metadata in WISE can be done in a number of ways including:*

- *The use of a dedicated WISE metadata web-based entry page, with basic client-side validation. At the present time this does not exist, but could be developed in the future,*

<sup>14</sup><http://www.eionet.europa.eu/gemet>

- *The use of a metadata editor, capable of outputting metadata according to the recognized WISE metadata XML schema. This can be direct (i.e. if the tool can be configured to export according to this schema), or indirect (i.e. using XSL transformations to map from the native XML schema of the specific tool to the WISE XML schema).*

There are many tools which allow metadata editing and which are based on the ISO standards."

## F. INSPIRE Services

### **INSPIRE requirements concerning Metadata management tool n°11**

The elected software must provide access via Catalogue Services.

INSPIRE Network Services Architecture - Version 3 document defines various services types, discovery services are among them.

"Discovery Service" term refers to various names assigned within the geographic community to instruments for discovering spatial data and services through the metadata properties; Catalogue Services is one of those names.

It derives from the requirement n°9 that Catalogue Services are a direct INSPIRE requirement for a metadata management tool.

### **EUROSTAT requirements concerning Metadata management tool n°12**

The elected software must allow the user to invoke datasets having map services

Requirement n°11 is strengthened by a recent call for tender from Eurostat concerning the "Development of the technical components of a European Commission Spatial Data Infrastructure compliant with the provisions of INSPIRE". OGC CSW is among the required interface of the Metadata Editor Application Service.

There is a clear link between discovery and view services enabling the user to view datasets he has elected.

This link is addressed in the recent call for tender from Eurostat :

*"An interoperable metadata catalogue service shall enable:*

- *metadata administrators to manage metadata for the web services and datasets,*
- *users to search for public and access controlled services as well as for data themes provided by them.*

*As far as WEB applications are concerned:*

- *Web services registered with the metadata information systems must be invocable from this environment,*
- *Web application must support the management of all the needed metadata."*

### **INSPIRE requirements concerning Metadata management tool n°13:**

The elected software must provide the user with a direct link to download datasets.

Another clear link is between discovery services and download services as stated in the requirement n°3.

Requirement number	Requirement
1	Metadata must be managed in an electronic format making it possible to search for spatial data sets and services on the basis of the content of the corresponding metadata and to display the content of the metadata.
2	The elected software must be able to implement metadata elements listed in Annex I and respect their multiplicity.
3	The elected software must provide Metadata for datasets and services
4	The elected software must be able, at least, to implement INSPIRE metadata Implementing Rules following ISO19115-19119 norms.
5	The elected software must implement OGC services
6	The elected software must show in its interface the following search criteria : - Keywords, - Classification of spatial data and services, - The quality and validity of spatial data sets, - Degree of conformity with the implementing rules provided for in Article 7(1), - Geographical location, - Conditions applying to the access to and use of spatial data sets and services, - The public authorities responsible for the establishment, management, maintenance and distribution of spatial data sets and services
7	The elected software must implement at least GEMET Multi-Lingual Thesaurus to address Multilingual issues.
8	The elected software must allow the user to view metadata, at least, in English.
9	The elected software must provide a web-based entry point
10	The elected software must provide Metadata import/export functionalities involving XML schemas.
11	The elected software must provide access via Catalogue Services.
12	The elected software must allow the user to invoke datasets having map services
13	The elected software must provide the user with a direct link to download datasets.

Table 2 - INSPIRE, WISE and EUROSTAT specifications on metadata catalogue summary table

## V. INVENTORY OF THE MAIN EXISTING WATER RELATED METADATA CATALOGUES

Main metadata catalogues directly or indirectly linked with water resource management at International, European, Country, Euro-Mediterranean levels have been identified.

For each of them, the link and the technology used (based on the information available) are specified.



## A. International level

- UNEP: United Nations Environment Programme
  - o Link: <http://geodata.grid.unep.ch>
  - o Technology: specific php development
- FAO: Food and Agriculture Organization
  - o Link: <http://www.fao.org/geonetwork>
  - o Technology: Geonetwork
- WHO: World Health Organization GIS Resources
  - o Link: <http://www.who.int/geonetwork>
  - o Technology: Geonetwork
- CGIAR-CSI - Consortium for Spatial Information
  - o Link: <http://geonetwork.csi.cgiar.org/geonetwork/srv/en/main.search?extended=off&remote=off&attrset=geo&any=water&template=on&similarity=.8&hitsPerPage=20>
  - o Technology: Geonetwork
- IMWI: International Water Management Institute
  - o Link: <http://geonetwork.iwmi.org:8080/geonetwork/srv/en/main.home>
  - o Technology: Geonetwork
- Somalia Water and Land Information Management
  - o Link: <http://geonetwork.faoswalim.org:8080/geonetwork>
  - o Technology: Geonetwork
- Ministerio do Meio Ambiente, Brasil
  - o Link: <http://mapas.mma.gov.br/geonetwork/srv/br/main.search?any=aqua>
  - o Technology: Geonetwork
- ICIMOD: International Centre for Integrated Mountain Development - Hindu Kush-HimalayasvRegions
  - o Link: <http://arcsde.icimod.org.np:8080/geonetwork/srv/en/main.search?any=water>
  - o Technology: Geonetwork

## B. European level

- Eurostat - GISCO
  - o Link: [http://epp.eurostat.ec.europa.eu/portal/page?\\_pageid=2254,62148876,2254\\_62153824&\\_dad=portal&\\_schema=PORTAL](http://epp.eurostat.ec.europa.eu/portal/page?_pageid=2254,62148876,2254_62153824&_dad=portal&_schema=PORTAL)
  - o Technology: Specific development. This is not a true metadata catalogue. It is not possible to search for metadata and also metadata information are not following INSPIRE IRs but International Monetary Fund – SDDS (Special Data Dissemination Standard) Metadata Profile. When writing the present document it was not clarified whether this

specific development was open source or no and, if yes, whether it was possible to reuse the source code.

- INSPIRE-JRC
  - o Link: <http://www.inspire-geoportal.eu/catalogues.htm>
  - o Technology: Specific Conterra development. This development is not open source thus not reusable for EMWIS's needs. A Call for tender has been released for a new version development.
- WISE – SDIGER project
  - o Link : <http://www.ideo.es/searchSDIGER/indexLayout.jsp?PAGELANGUAGE=en>
  - o Technology: Specific Java development. When writing the present document it was not clarified whether this specific development was open source or no and, if yes, whether it was possible to reuse the source code.
- ESA – Kopernicus
  - o Link: [http://www.geoportal.org/web/guest/geo\\_search\\_overview?p\\_p\\_id=srgPortlet\\_WAR\\_geoportal&p\\_p\\_action=0&p\\_p\\_state=normal&p\\_p\\_mode=view&p\\_p\\_col\\_id=column-1&p\\_p\\_col\\_pos=2&p\\_p\\_col\\_count=5&srgPortlet\\_WAR\\_geoportal\\_searchType=browse&srgPortlet\\_WAR\\_geoportal\\_sbald=5](http://www.geoportal.org/web/guest/geo_search_overview?p_p_id=srgPortlet_WAR_geoportal&p_p_action=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-1&p_p_col_pos=2&p_p_col_count=5&srgPortlet_WAR_geoportal_searchType=browse&srgPortlet_WAR_geoportal_sbald=5)
  - o Technology: Geonetwork
- eWater: Portal to hydrogeological data developed in the frame of the project "Multilingual cross-border access to ground water databases" (eWater) that was co-financed by EC eContentplus program.
  - o Link: <http://www.ewater.eu/geonetwork4ewater/srv/en/main.newsearch>
  - o Technology: Geonetwork
- NatureSDI Plus: Best Practice Network for SDI in Nature Conservation co-funded by EC eContentplus program
  - o Link: <http://www.nature-sdi.eu/>
  - o Technology: MDWeb 2, site under development

## C. Country level

- France
  - o Geocatalogue
    - Link: <http://www.geocatalogue.fr/SearchTileForward.do>
    - Technology: Specific proprietary Java development.
  - o OIEau - Sandre
    - Link: <http://sandre.eaufrance.fr/geonetwork/srv/fr/main.home>
    - Technology: Geonetwork
  - o IFREMER: Sextant
    - Link: <https://www.ifremer.fr/sextant/>
    - Technology: Geonetwork
- Spain

- IEES: Infraestructura de Datos Espaciales de España
  - National entry point link:  
<http://www.idee.es/search/indexLayout.jsp?PAGELANGUAGE=es>
  - Technology: Specific Java development. When writing the present document it was not clarified whether this specific development was open source or no and, if yes, whether it was possible to reuse the source code.
  - Other regional link available :  
[http://www.idee.es/show.do?to=pideep\\_catalogoIDEE.ES](http://www.idee.es/show.do?to=pideep_catalogoIDEE.ES)
- Kosovo
  - Kosovo Water Information System
    - Link: <http://82.114.76.20/katinfo/srv/en/main.home>
    - Technology: Geonetwork
- Romania - Hungaria
  - KOCRIS
    - Link: <http://81.255.115.229/catkocris/srv/en/main.home>
    - Technology: Geonetwork
- Holland
  - Geonovum
    - Link: <http://www.geonovum.nl/metadata/>
    - Technology: Geonetwork
- Slovakia
  - Link: [http://isu.enviroportal.sk/index.php/item/vstup-cgs?source\\_1=7&country=0&complex=0&set=0&sort=obsah+ASC](http://isu.enviroportal.sk/index.php/item/vstup-cgs?source_1=7&country=0&complex=0&set=0&sort=obsah+ASC)
  - Technology: Specific PHP development. Not open source.

## D. Euro-Mediterranean level

- EMWIS/MEDWIP
  - Link: <http://81.255.115.229/catmedwip/srv/en/main.home>
  - Technology: Geonetwork

## VI. METADATA CATALOGUE TOOLS ANALYSIS

Let alone specific developments who where not, for those identified in the previous part, re-usable in EMWIS's context, Geonetwork and MDWeb 2 where the main metadata catalogue tools directly or indirectly linked with water resource management at International, European, Country, Euro-Mediterranean levels.

Using the common literature on this subject (reference Internet websites, forums ...), six other tools where added to this selection.

These eight main existing geographical metadata catalogue tools have all been classified based on the solution they provide to the needs and specifications identified in part IV and V.

Three of them are proprietary software: ESRI ArcCatalog v9.2, MetadataEditor, Conterra sdi.suite. EMWIS mandatory requirement n°4 was to use "Free/Open source software". So, these three tools will not be considered for the prototyping exercise and further analysis.

Among the remaining five open source software, one was not considered being mature enough (e.g partial implementation of ISO 19115 Geospatial Metadata) to continue the identification process: gvSIG metadata prototype.

The remaining four open source software solutions are analyzed in the following table.



SEMIDE Needs / INSPIRE, WISE & Eurostat Requirements	Functionality	Level of priority	GeoNetwork V2.3	MDWeb2	M3CAT v1.6	Catndedit
INSPIRE 1	Metadata must be managed in an electronic format making it possible to search for spatial data sets and services on the basis of the content of the corresponding metadata and to display the content of the metadata		X	X	X	X
INSPIRE 2	The elected software must be able to implement metadata elements listed in Annex I and respect their multiplicity.		X	X	X	X
<b>SUPPORTED STANDARDS</b>						
SEMIDE 5	Compatible with Inspire metadata specifications	Mandatory	X (ongoing improvement with BRGM)	X		
INSPIRE 4	The elected software must be able, at least, to implement INSPIRE metadata IRs following ISO19115-19119 norms.		X	X	X	X
	ISO 19115 Geospatial Metadata		complete	complete	complete	complete
	ISO19110 Feature Catalog		partial (cf. Geosource project)	complete		
	ISO19119 Services		complete	complete		
	ISO profil		France, Switzerland, ANZLIC	France, INSPIRE		
	Other format		Dublin Core, FGDC, SensorML	EbRIM, SensorML, Dublin Core	CSDGM, CSDGM_NBII, GILS, user imported XSO	
INSPIRE 3	The elected software must provide Metadata for datasets and services		X	X		
SEMIDE 15	Interface with other metadata catalogues formats	Optional 1	X (ESRI, FGDC, DC, ISO profiles)	DC, ISO		
<b>IMPORT/EXPORT</b>						
WISE 10	The elected software must provide Metadata import/export functionalities involving XML schemas.		X	X	X	X
SEMIDE 14	Import metadata	Mandatory	X	X		
			(WebDav, LAN, CSW, ESRI ArcCatalog, GeoNetwork, FGDC)			
	Export metadata	Mandatory	X	X		
<b>USER INTERFACE</b>						
INSPIRE 6	The elected software must show in its interface the following search criterias : - Keywords, - Classification of spatial data and services, - The quality and validity of spatial data sets, - Degree of conformity with the implementing rules provided for in Article 7(1), - Geographical location, - Conditions applying to the access to and use of spatial data sets and services, - The public authorities responsible for the establishment, management, maintenance and distribution of spatial data sets and services.		X	X	?	
INSPIRE 8	The elected software must allow the user to view metadata, at least, in English.		X	X	X	X
SEMIDE 7	Facilitating shared participations for metadata entry	Mandatory	X	X	X	
SEMIDE 8	Set Internet privileges to "view" and "download"	Mandatory	X			
				Under Construction (Role Based Access Control using (Geo)XACML)		
SEMIDE 16	User interface customisable "look-and-feel"	Optional 1	X (Using XSL)	X		
SEMIDE 17	Integrated Map Viewer for data formats such as SHP	Optional 1				
SEMIDE 18	Interactive Web Map Viewer	Optional 1	X	X		

Table 3 – Metadata Catalogue Tools Classification Part I



SEMIDE Needs / INSPIRE, WISE & Eurostat Requirements	Functionality	Level of priority	GeoNetwork V2.3	MDWeb2	M3CAT v1.6	Catmdedit
<b>METADATA MANAGER</b>						
SEMIDE 11	Simple workflow management: Ability for non registered user to input metadata and validation by site managers	Mandatory (at least data input for non registered users)	X			
SEMIDE 12	Add/Edit/delete metadata with direct Access to Metadata Element Definitions	Mandatory	X			
	Metadata validation		X (XSD and schematron)	Working progress		
<b>APPLICATION ENVIRONNEMENT</b>						
SEMIDE 1	Web based application	Mandatory	X	X	X	
INSPIRE 9	The elected software must provide a web-based entry point		X	X	X	
	Desktop					X
	Other applications linked		GvSIG, ArcCatalogue, Talend	Puzzle-GIS plug-in under Development		
	Language		Java	Java		Java
SEMIDE 2	Multilingual user interface	Mandatory	X	X		
			fr, en, de, it, es, cn, (br), (ar)	fr, en	en, fr	
SEMIDE 3	Easy implementation on Windows or Linux OS server	Mandatory	X	X		
	Operating system		Windows, Linux, Mac	Windows, Linux, Mac	Windows	Windows, Linux, Mac
SEMIDE 20	Metadata stored in external database	Optional 1	X (JDBC)	X (JDBC)		
SEMIDE 4	Free/Open source software	Mandatory	X	X	X	X
	Community		400+ user mailing list 200+ dev mailing list	100 users/dev mailing list		
	Source code		X	V2 Not Available (January 2009)	X	X
	Contributors		22 committers (trunk & sandbox)	5 committers (trunk)		
	Download		1000-1500 downloads/month			
<b>THESAURUS</b>						
INSPIRE 7	The elected software must implement at least GEMET Multi-Lingual Thesaurus to address Multilingual issues.		Working progress	X		
SEMIDE 10	Customisable multilingual management of closed selection lists (keywords, categories, geographical areas, etc.)	Mandatory	X		X	
<b>INTEROPERABILITY</b>						
INSPIRE 5	The elected software must implement OGC services		X	X		
INSPIRE 11	The elected software must provide access via Catalogue Services.		X	X		
EUROSTAT 12	The elected software must allow the user to invoke datasets having map services		X	X v2.1 (January 2009)		
INSPIRE 13	The elected software must provide the user with a direct link to download datasets		X	X	X	X
SEMIDE 6	Easy Interface with Inspire metadata tool/ catalogue	Mandatory	X	X		
SEMIDE 9	Harvesting and access through Catalogue Services	Mandatory	X	X		
			CSW, Z39.50, OAI-PMH, opensearch	CSW		
SEMIDE 19	Service-chain search access to local and distributed geospatial catalogues	Optional 1	X (Harvesting)	X (Harvesting and Cascading)		
<b>DOCUMENTATION</b>						
SEMIDE 13	Operating Instruction Manual	Mandatory	X (en, fr)	X (en, fr)		
	Website URL		<a href="http://geonetwork-opensource.org/">http://geonetwork-opensource.org/</a>	<a href="http://docs.codehaus.org/display/MDWEB/Home">http://docs.codehaus.org/display/MDWEB/Home</a>	<a href="http://www.intelec.ca/html/fr/technologies/m3cat.html">http://www.intelec.ca/html/fr/technologies/m3cat.html</a>	<a href="http://sourceforge.net/projects/catmdedit">http://sourceforge.net/projects/catmdedit</a>

Source :  
 - <http://www.fgdc.gov/metadata/iso-metadata-editor-review>  
 - direct contact with metadata management tools developing teams.

Table 4 – Metadata Catalogue Tools Classification Part II

Catmedit (used in WISE – SDIGER project aiming at defining a WISE metadata profile) and M3CAT v1.6 are lacking too many requirements to be used as a prototype in the next steps of this project. For example, they are not compatible with Inspire metadata specifications, they don't implement OGC web services and don't provide access via Catalogue Service.

MDWeb 2 won't be kept because of its lacks in the metadata manager part of the classification. Simple workflow management, Add/Edit/delete metadata with direct Access to Metadata Element Definitions and Metadata Validation are among EMWIS' mandatory requirements. The customisable multilingual management of closed selection lists (keywords, categories, geographical areas, etc.) is also part of EMWIS' requirements and is not managed by MDWeb 2 recent version. Even if this tool is not kept for the next parts of the project, this project has to be watched closely due to its planned enhancements.

Geonetwork is suiting both EMWIS and INSPIRE, WISE mandatory requirements. Both remaining implementations (implementing INSPIRE specifications and GEMET) are planned to be available in the coming weeks. It is also answering optional EMWIS' needs such as "User interface customisable "look-and-feel"" and "Interactive Web Map Viewer". Its continuously growing community of users and developers and its successful OSGEO incubation reflect the quality of the project and confirm the advice to use Geonetwork for the next parts of this project.

## VII. INTEROPERABILITY BETWEEN ELECTED TOOLS AND MAIN EXISTING METADATA CATALOGUES

All metadata catalogues need to be interoperable as different nodes are supposed to communicate together between different levels (regional, local, european, international ...) and different themes (oceans, inland waters ...) in different languages using common format (ISO19139/119) and common protocol (Z39.50 and probably more and more CSW).

In order to insure interoperability between catalogues identified in the third task and tools elected in the previous task, the following recommendations are:

- Use catalogues based on ISO standards for storage of metadata,
- Use catalogues implementing or compliant with OGC-CSW protocol for communication (query, harvest, transaction). Regarding multilingual metadata management, no recommendations are defined in OGC-CSW specification or INSPIRE IR except using at least one GEMET word in the 'KEYWORD' metadata element description. No implementation exists at the moment in order to edit multilingual metadata as defined in ISO19115. Currently one initiative in Switzerland based on GeoNetwork focuses on multilingual metadata management allowing one metadata record to contain text in multiple languages according to the ISO19139 specific encoding. The editor will allow users to translate specific free text parts of the metadata record in other languages. For example the title and abstract of a metadata.

Main European metadata catalogues (WISE, INSPIRE, EUROSTAT) are, or will be soon, implementing CSW standard and INSPIRE metadata elements.

INSPIRE IRs on metadata are officially published since December 2008 4<sup>th</sup>. They will enter into force on December 2008 24<sup>th</sup> which means that public authorities will have to expose INSPIRE Compliant Metadata by December 2010 24<sup>th</sup> for INSPIRE Annex I Themes and by December 2013 for Annex II & III themes.

Following advised interoperability technologies and INSPIRE profile will then insure efficient interoperability with the above identified catalogues.

Nevertheless, a specific issue has to be raised. When harvested by another catalogue, every specific part of a Metadata Profile or specific codes won't be dealt with by the harvesting catalogue.

For example, in France, a French ISO 19115 profile has been developed (and is currently under revision process). One evolution of this profile is to solve the fact that nothing in ISO-19115 norm allows to indicate, for a metadata, who is the actual owner of the usage restriction rights (and also access rights). Thus, following ISO rules, ISO-19115 MD\_LegalConstraints class has been extended to suit French needs. Once harvested, French extra elements won't be used and displayed by a metadata catalogue working outside French scope.

Another example: using river basin codes (code lists) will only be valid at EMWIS's level and will lose its sense when harvested by another catalogue which users are not aware of those code lists meanings.

This observation will have to be taken into account in task 2- Definition of reference labeling.



## VIII. CONCLUSION

The inventory of EMWIS, INSPIRE and WISE requirements have been gathered and structured leading to a complete analysis matrix made up of 27 mandatory and 6 optional elements.

In a second phase, the main existing metadata catalogue tools used on websites related to water at International, European, Country and Euro-Mediterranean levels have been identified. Where specific software developments were used it was asked whether they were under open-source license and, consequently, reusable in the framework of this project. A good overview of involved technologies which could be confronted to the requirement matrix was thus available.

In order to be as complete as possible other main existing metadata catalogues tools have been short listed and analysed with the requirement matrix.

From this analysis, Geonetwork Open Source solution is proposed as the most suitable software for the next steps of this project. This tool is fulfilling all mandatory requirements plus some optional ones. It has an ever growing community and involvement in metadata catalog projects all around the world.

One of EMWIS's main objectives is the interoperability between the elected tool (i.e: Geonetwork) and main existing metadata catalogs (WISE, INSPIRE, EUROSTAT). Given the implemented international common protocols in both Geonetwork and identified main catalogs, technical interoperability will be assured. Specific metadata (profile, or vocabulary) interoperability issues have been mentioned. These points will be addressed in the second task of this project.



## IX. ANNEX I

Extract from the voted INSPIRE Implementing Rules on Metadata.

**Table 1: Metadata for spatial data sets and spatial data set series**

Reference	Metadata elements	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	

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**Table 2: Metadata for spatial data services**

Reference	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 linkage to the service is available.
1.6	Coupled resource	0..*	Mandatory if linkage to data sets on which the service operates are available.
2.2	Spatial data service type	1	
3	Keyword	1..*	
4.1	Geographic bounding box	0...*	Mandatory for services with an explicit geographic extent.
5	Temporal reference	1..*	
6.2	Spatial resolution	0..*	Mandatory when there is a restriction on the spatial resolution for this service.
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	



## X. ANNEX II

Extract from the INSPIRE Network Services : Draft Implementing Rule: Discovery Services (Version 3.0),

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**Table 3: INSPIRE search criteria**

INSPIRE Directive search criteria Article 11 (2)	INSPIRE queryable metadata elements	Mandatory search criteria for INSPIRE Discovery Service <sup>2</sup>
(a) keywords	Keyword value	Yes
(b) classification of spatial data and services;	Topic category	Yes, if resources of type 'dataset' or 'series' are supported by the discovery service instance
(b) classification of spatial data and services	Spatial data services type	Yes, if resources of type 'service' are supported by the discovery service instance.
(c) the quality and validity of spatial data sets	Lineage	Yes
(c) the quality and validity of spatial data sets	Spatial resolution	Yes, if resources of type 'dataset' or 'series' are supported by the discovery service instance
(d) degree of conformity with the implementing rules provided for in Article 7(1)	Degree	Yes
(d) degree of conformity with the implementing rules provided for in Article 7(1)	Specification	Yes
(e) geographical location	Geographic bounding box	Yes, if resources of type 'dataset' or 'series' are supported by the discovery service instance
(f) conditions applying to the access to and use of spatial data sets and services	LimitationsOnPublicAccess	Yes
(f) conditions applying to the access to and use of spatial data sets and services	ConditionApplyingToAccessAndUse	Yes
(g) the public authorities responsible for the establishment, management, maintenance and distribution of spatial data sets and services	Responsible party	Yes

The mandatory metadata elements in Table 3 are the minimum set of search criteria. The Discovery service shall implement as well a combination of search criteria. Combination means that a filter is used to identify a subset of resources based on a combination of search criteria from a collection of resources whose property values satisfy a set of logically connected predicates. If the property values of a resource satisfy all the predicates in a filter then that resource is considered to be part of the resulting subset.

For the Discovery service a combination of search criteria is expressed through the filter capabilities, that are included in the service metadata to describe which elements of the predicate language are supported. The filter capabilities shall support at least the following filter operators to offer queries as a combination of search criteria:

- Logical operators: And, Or, Not

<sup>2</sup> See Article 11 (2) of the directive

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- Comparison operators: PropertyIsEqualTo, PropertyIsNotEqualTo, PropertyIsLessThan, PropertyIsGreaterThan, PropertyIsLessThanOrEqualTo, PropertyIsGreaterThanOrEqualTo, PropertyIsLike
- Spatial operator: BBOX

## XI. ANNEX III

### INSPIRE Directive annexes.

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#### ANNEX I

##### SPATIAL DATA THEMES REFERRED TO IN ARTICLES 6(A), 8(1) AND 9(A)

1. **Coordinate reference systems**  
Systems for uniquely referencing spatial information in space as a set of coordinates (x, y, z) and/or latitude and longitude and height, based on a geodetic horizontal and vertical datum.
2. **Geographical grid systems**  
Harmonised multi-resolution grid with a common point of origin and standardised location and size of grid cells.
3. **Geographical names**  
Names of areas, regions, localities, cities, suburbs, towns or settlements, or any geographical or topographical feature of public or historical interest.
4. **Administrative units**  
Units of administration, dividing areas where Member States have and/or exercise jurisdictional rights, for local, regional and national governance, separated by administrative boundaries.
5. **Addresses**  
Location of properties based on address identifiers, usually by road name, house number, postal code.
6. **Cadastral parcels**  
Areas defined by cadastral registers or equivalent.
7. **Transport networks**  
Road, rail, air and water transport networks and related infrastructure. Includes links between different networks. Also includes the trans-European transport network as defined in Decision No 1692/96/EC of the European Parliament and of the Council of 23 July 1996 on Community Guidelines for the development of the trans-European transport network <sup>(1)</sup> and future revisions of that Decision.
8. **Hydrography**  
Hydrographic elements, including marine areas and all other water bodies and items related to them, including river basins and sub-basins. Where appropriate, according to the definitions set out in 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 <sup>(2)</sup> and in the form of networks.
9. **Protected sites**  
Area designated or managed within a framework of international, Community and Member States' legislation to achieve specific conservation objectives.

<sup>(1)</sup> OJ L 228, 9.9.1996, p. 1. Decision as last amended by Council Regulation (EC) No 1791/2006 (OJ L 363, 20.12.2006, p. 1).

<sup>(2)</sup> OJ L 327, 22.12.2000, p. 1. Directive as amended by Decision No 2455/2002/EC (OJ L 331, 15.12.2001, p. 1).

ANNEX II

SPATIAL DATA THEMES REFERRED TO IN ARTICLES 6(A), 8(1) AND 9(B)

1. Elevation

Digital elevation models for land, ice and ocean surface. Includes terrestrial elevation, bathymetry and shoreline.

2. Land cover

Physical and biological cover of the earth's surface including artificial surfaces, agricultural areas, forests, (semi-)natural areas, wetlands, water bodies.

3. Orthoimagery

Geo-referenced image data of the Earth's surface, from either satellite or airborne sensors.

4. Geology

Geology characterised according to composition and structure. Includes bedrock, aquifers and geomorphology.



ANNEX III

SPATIAL DATA THEMES REFERRED TO IN ARTICLES 6(B) AND 9(B)

1. Statistical units  
Units for dissemination or use of statistical information.
2. Buildings  
Geographical location of buildings.
3. Soil  
Soils and subsoil characterised according to depth, texture, structure and content of particles and organic material, stoniness, erosion, where appropriate mean slope and anticipated water storage capacity.
4. Land use  
Territory characterised according to its current and future planned functional dimension or socio-economic purpose (e.g. residential, industrial, commercial, agricultural, forestry, recreational).
5. Human health and safety  
Geographical distribution of dominance of pathologies (allergies, cancers, respiratory diseases, etc.), information indicating the effect on health (biomarkers, decline of fertility, epidemics) or well-being of humans (fatigue, stress, etc.) linked directly (air pollution, chemicals, depletion of the ozone layer, noise, etc.) or indirectly (food, genetically modified organisms, etc.) to the quality of the environment.
6. Utility and governmental services  
Includes utility facilities such as sewage, waste management, energy supply and water supply, administrative and social governmental services such as public administrations, civil protection sites, schools and hospitals.
7. Environmental monitoring facilities  
Location and operation of environmental monitoring facilities includes observation and measurement of emissions, of the state of environmental media and of other ecosystem parameters (biodiversity, ecological conditions of vegetation, etc.) by or on behalf of public authorities.
8. Production and industrial facilities  
Industrial production sites, including installations covered by Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control <sup>(1)</sup> and water abstraction facilities, mining, storage sites.
9. Agricultural and aquaculture facilities  
Farming equipment and production facilities (including irrigation systems, greenhouses and stables).
10. Population distribution — demography  
Geographical distribution of people, including population characteristics and activity levels, aggregated by grid, region, administrative unit or other analytical unit.
11. Area management/restriction/regulation zones and reporting units  
Areas managed, regulated or used for reporting at international, European, national, regional and local levels. Includes dumping sites, restricted areas around drinking water sources, nitrate-vulnerable zones, regulated fairways at sea or large inland waters, areas for the dumping of waste, noise restriction zones, prospecting and mining permit areas, river basin districts, relevant reporting units and coastal zone management areas.

<sup>(1)</sup> OJ L 257, 10.10.1996, p. 26. Directive as last amended by Regulation (EC) No 166/2006 of the European Parliament and of the Council (OJ L 33, 4.2.2006, p. 3).

12. Natural risk zones

Vulnerable areas characterised according to natural hazards (all atmospheric, hydrologic, seismic, volcanic and wildfire phenomena that, because of their location, severity, and frequency, have the potential to seriously affect society), e.g. floods, landslides and subsidence, avalanches, forest fires, earthquakes, volcanic eruptions.

13. Atmospheric conditions

Physical conditions in the atmosphere. Includes spatial data based on measurements, on models or on a combination thereof and includes measurement locations.

14. Meteorological geographical features

Weather conditions and their measurements; precipitation, temperature, evapotranspiration, wind speed and direction.

15. Oceanographic geographical features

Physical conditions of oceans (currents, salinity, wave heights, etc.).

16. Sea regions

Physical conditions of seas and saline water bodies divided into regions and sub-regions with common characteristics.

17. Bio-geographical regions

Areas of relatively homogeneous ecological conditions with common characteristics.

18. Habitats and biotopes

Geographical areas characterised by specific ecological conditions, processes, structure, and (life support) functions that physically support the organisms that live there. Includes terrestrial and aquatic areas distinguished by geographical, abiotic and biotic features, whether entirely natural or semi-natural.

19. Species distribution

Geographical distribution of occurrence of animal and plant species aggregated by grid, region, administrative unit or other analytical unit.

20. Energy resources

Energy resources including hydrocarbons, hydropower, bio-energy, solar, wind, etc., where relevant including depth/height information on the extent of the resource.

21. Mineral resources

Mineral resources including metal ores, industrial minerals, etc., where relevant including depth/height information on the extent of the resource.

