INSPIRE
Infrastructure for Spatial Information in Europe

Drafting Team "Data Specifications" Definition of Annex Themes and Scope

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Table of contents

Foreword

INSPIRE is a Directive proposed by the European Commission in July 2004 setting the legal framework for the establishment and operation of an Infrastructure for Spatial Information in the European Community. The purpose of such infrastructure is to support the formulation, implementation, monitoring activities and evaluation of Community policies and activities that may have a direct or indirect impact on the environment at various levels of public authority, European, national and local.

INSPIRE should be based on the infrastructures for spatial information that are created and maintained by the Member States. The components of those infrastructures include: metadata, spatial data themes (as described in Annexes I, II, III of the Directive), spatial data services; network services and technologies; agreements on data and service sharing, access and use; coordination and monitoring mechanisms, processes and procedures.

The guiding principles of INSPIRE are that the infrastructures for spatial information in the Member States should be designed to ensure that spatial data are stored, made available and maintained at the most appropriate level; that it is possible to combine spatial data and services from different sources across the Community in a consistent way and share them between several users and applications; that it is possible for spatial data collected at one level of public authority to be shared between all the different levels of public authorities; that spatial data and services are made available under conditions that do not restrict their extensive use; that it is easy to discover available spatial data, to evaluate their fitness for purpose and to know the conditions applicable to their use.

The text of the INSPIRE Directive is available from the INSPIRE web site (http://www.ec-gis.org/inspire). The Directive identifies what needs to be achieved, and Member States have two years from the date of adoption to bring into force national legislation, regulations, and administrative procedures that define how the agreed objectives will be met taking into account the specific situation of each Member State. To ensure that the spatial data infrastructures of the Member States are compatible and usable in a Community and transboundary context, the Directive requires that common Implementing Rules (IR) are adopted in a number of specific areas. Implementing Rules are adopted as Commission Decisions, and are binding in their entirety. The Commission is assisted in the process of adopting such rules by a regulatory committee composed by representatives of the Member States and European Parliament[1]. The committee is chaired by a representative of the Commission (this is known as the Comitology procedure). The committee was established on 15 August 2007.

The IR will be shaped in their legal structure and form by the Commission legal services on the basis of technical documents prepared by especially convened Drafting Teams, for each of the main components of INSPIRE: metadata, data specifications, network services, data and service sharing, and monitoring procedures. For data specifications, the technical documents for each spatial data theme will be prepared by especially convened Thematic Working Groups.

This document represents a contribution of the Data Specification Drafting Team.

This deliverable identifies definitions and scope of INSPIRE spatial data themes, taking the feasibility and relevance for community policy into account. It is based on existing reference material, especially INSPIRE position papers, summarising the results in a single document.

The deliverable shall help to outline the individual spatial data themes, which will be described in more detail by Data Specifications later in the INSPIRE Thematic WorkingGroups. These Data Specifications will provide a detailed definition of data content by means of application schema and feature catalogue. Furthermore the Data Specifications will specify requirements to data quality, data consistency, reference systems and metadata. The theme description, scopes and examples in this deliverable D2.3 may serve as a starting point for the development of the Data Specifications.

[1] The implementing rules are formally adopted through the comitology procedure that has been amended by Council Decision of 17 July 2006 (2006/512/EC). Under the new regulation, the Parliament and the Council are on equal footing for all comitology procedures related to co-decision acts. As a consequence, all measures must be ratified by all three institutions to come into force.

This document is not a draft Implementing Rule, but is targeted to help in the process of developing Data Specifications that will become Implementing Rules.

This document will be publicly available as a non-paper, as it does not represent an official position of the Commission, and as such can not be invoked in the context of legal procedures.

Purpose of the document

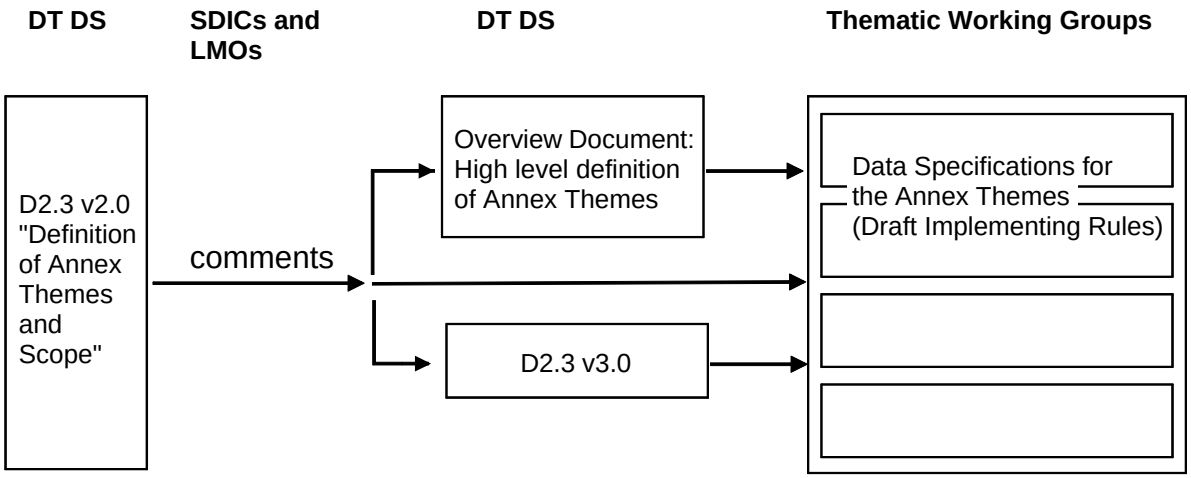
This document contains the proposal of the Drafting Team "Data Specifications" for description and scope of INSPIRE spatial data themes. Preliminary versions of this document have already been revised in the light of comments from the INSPIRE Consolidation team and the registered SDICs and LMOs.

This deliverable of the Drafting Team “Data Specifications” is an intermediate document between the theme definitions in the Directive and the Draft Implementing Rules. It is considered as a starting point for the development of Data Specifications. It should be noted that the document draws mainly from the experience of the experts in the Drafting Team “Data Specifications”. For that reason, the descriptions of individual spatial data themes have been established at different level of detail. The usage examples, the outline of data content and the list of potential reference documents are not yet aligned with the European Commission needs analysis, and the wider User Community in general.

The D2.3 v2.0 has passed a review by the SDICs and LMOs. The comment resolution process included a workshop with their representatives. Based on the discussions, the Drafting Team “Data Specifications” proposed comments resolutions that were revised by the Consolidation Team. Their comments on the general outline of themes have been considered for this version 3.0. The table containing the comments and the resolution is available on the INSPIRE web-site http://www.ec-gis.org/inspire/reports/ImplementingRules/DataSpecifications/D2.3-Comments-Resolutions-Table-09072008.pdf. The Drafting Team “Data Specifications” finishes work on the document at this stage. No further revisions are foreseen. Based on this document and the comments from SDICs and LMOs, the Drafting Team “Data Specifications” has developed an overview description of each theme with approx. 250 words per theme. This description together with the name of the theme and its definition (from the Directive) will be managed in the Feature Concept Dictionary.

The Thematic Working Groups (TWGs) have taken over the responsibility for the description of themes. The Overview descriptions, the D2.3 v3.0 and the comments from SDICs and LMOs provide a baseline for the development of Data Specifications. The content of D2.3 is not binding for the TWG work.

Figure 1 – Further steps from D2.3 v2.0



1 Scope

This deliverable identifies definitions and scope of INSPIRE spatial data themes, taking the feasibility and relevance for community policy into account. It is based on existing reference material, especially INSPIRE position papers, and the results are summarised in this single document.

For each spatial data themes (as described in Annexes I, II, III of the Directive), the document provides:

- **Definition** – as given in the Annexes I, II, III of the Directive.
- **Description** – explains the spatial data theme in more detail
- **Scope, Use examples** - prominent use examples and reference to Community policies. The use examples should refer to a pan-European application, a cross-border cooperation, or stem from EU legislation. The Drafting Team "Date Specifications" emphasises that the examples in D2.3 should not be interpreted as recommendations or proposals for the upcoming specification. This issue need to be referred to the TWGs for proper analysis.
- **Important feature types and attributes** – this is a non-exhaustive list of the most prominent feature types and attributes. The list is not yet an attempt to define content requirements, but shall illustrate the definition/outline of the theme.
- **Overlaps and links with other themes -** known overlap with and/or dependencies from other spatial data themes. This list considers overlaps that are relevant to the definition/outline of the theme. The TWGs for the two themes need to mark out their area of work and cooperate closely, or the themes should be combined in one TWG. The list does not consider overlaps and links that refer to organisational constraints (e.g. two themes are managed by the same authority) or general real-world constraints (e.g. objects from both themes often share geometry).
- **Reference material** - List of the reference documents that are considered relevant to the theme. This list of reference material includes the documents used for the construction of D2.3, the documents submitted by SDICs and LMOs as reference material until March 31 2007, plus the material suggested by SDICs and LMOs during the review of D2.3 v2.0

This deliverable is accompanied by the document **Survey of initiatives relevant to INSPIRE data specifications** that has been prepared by the Consolidation Team. This document includes the classification of Reference Materials submitted for INSPIRE Data Specifications, a preliminary analysis on SDICs and LMOs registered and potential distribution by Themes and a review of organisations regarding the Article 7(1) of the INSPIRE Directive.

2 Terms and abbreviations

2.1 Terms

(1) application data
data in support of user requirements

NOTE The term is generally used as a complementary term to “reference data". For example, the road network objects is considered “reference data” and navigation information attached to the road network objects is considered “application data”.

(2) data harmonisation
providing access to **spatial data** through network services in a representation that allows for combining it with other harmonised data in a coherent way by using a common set of **data product specifications**

NOTE This includes agreements about coordinate reference systems, classification systems, application schemas, etc.

(3) data product specification
detailed description of a dataset or dataset series together with additional information that will enable it to be created, supplied to and used by another party [ISO/FDIS 19131 Geographic Information – Data Product Specification]

(4) dataset
identifiable collection of data [ISO 19115:2005, Geographic information — Metadata]

(5) endonym
Name of a **spatial object** in one of the languages occurring in that area where the object is situated [UNGEGN Glossary of Terminology - modified]

(6) exonym
name used in a specific language for a **spatial object** situated outside the area where that language is spoken, and differing in its form from the name used in an official or well-established language of that area where the **spatial object** is located [UNGEGN Glossary of Terminology - modified]

(7) feature
abstraction of real world phenomena [ISO 19101:2005, Geographic information — Reference model]

NOTE The term “(geographic) feature” as used in the ISO 19100 series of International Standards and in this document is synonymous with **spatial object** as used in this document. Unfortunately “spatial object” is also used in the ISO 19100 series of International Standards, however with a different meaning: a spatial object in the ISO 19100 series is a spatial geometry or topology.

(8) feature catalogue
catalogue(s) containing definitions and descriptions of the **spatial object types**, their attributes and associated components occurring in one or more **spatial data sets**, together with any operations that may be applied [ISO 19110:2006, Geographic information — Methodology for feature cataloguing – modified]

(9) feature concept dictionary
dictionary containing definitions and descriptions of feature concepts and feature-related concepts [ISO/CD 19126 Geographic Information – Feature concept dictionary and registers]

(10) gazetteer
directory of instances of a class or classes of features containing some information regarding position [EN ISO 19112:2005, Geographic information — Spatial referencing by geographic identifiers]

NOTE A gazetteer can be considered as a geographical index or dictionary.

(11) geographic identifier
spatial reference in the form of a label or code that identifies a location [EN ISO 19112:2005, Geographic information — Spatial referencing by geographic identifiers]

EXAMPLE 1 Place names: Paris, Rhine, Mont Blanc

EXAMPLE 2 Postal codes: 53115, 01009, SW1, IV19 1PZ

(12) INSPIRE data specification
data product specification for a **theme** adopted as an implementing rule

(13) interoperability
possibility for spatial data sets to be combined, and for services to interact, without repetitive manual intervention, in such a way that the result is coherent and the added value of the data sets and services is enhanced [INSPIRE Directive]

(14) metadata
information describing **spatial data sets** and spatial data services and making it possible to discover, inventory and use them [INSPIRE Directive]

NOTE A more general definition provided by ISO 19115 is "data about data"

(15) object
in this document used synonymous with ***spatial object***

(16) object referencing
method of referencing **application data** to existing **reference data** describing their location to ensure spatial consistency across the **spatial objects** associated in this way

(17) reference data
spatial objects that are used to provide location information in **object referencing**

NOTE Typical reference data are topographic or cadastral data.

(18) spatial data
data with a direct or indirect reference to a specific location or geographic area [INSPIRE Directive]

NOTE The use of the word “spatial” in INSPIRE is unfortunate as in the everyday language its meaning goes beyond the meaning of “geographic” – which is considered by the Drafting Team as the intended scope – and includes subjects such as medical images, molecules, or other planets to name a few. However, since the term is used as a synonym for geographic in the draft Directive, this document uses the term “spatial data” as a synonym for the term “geographic information” used by the ISO 19100 series of International Standards.

(19) spatial data set
identifiable collection of spatial data [INSPIRE Directive]

(20) spatial object
abstract representation of a real-world phenomenon related to a specific location or geographical area [INSPIRE Directive]

NOTE It should be noted that the term has a different meaning in the ISO 19100 series. It is also synonymous with "(geographic) feature" as used in the ISO 19100 series.

(21) spatial object type
classification of **spatial object**s

EXAMPLE Cadastral parcel, road segment or river basin are all examples of potential spatial object types.

NOTE In the conceptual schema language UML a spatial object type will be described by a class with stereotype <<FeatureType>>.

(22) spatial reference system
system for identifying position in the real world, , which does not necessarily use coordinates [EN ISO 19112:2005, Geographic information — Spatial referencing by geographic identifiers - modified]

EXAMPLE Geographic coordinates describing positions on the Earth surface (coordinate reference system), linear measurements along a river centreline from the intersection of a bridge (linear reference system), postal codes identifying the extent of postal zones (gazetteer).

(23) theme
grouping of **spatial data** according to Annex I, II and III of the INSPIRE Directive

2.2 Acronyms and abbreviations

AFE	Atlas Florae Europaeae
BGR	Bundesanstalt für Geowissenschaften und Rohstoffe
CAP	Common Agricultural Policy
CBD	UN Convention on Biological Diversity
CBD	Central business district
CDDA	Common Database on Designated areas
CEN	European Committee for Standardisation
CGMS	Crop Growth Monitoring System
CGRS	Common European Chorological Grid Reference System
CORINE	Coordination of Information on the Environment
CRS	Information and Service for European Coordinate Reference Systems
DEM	Digital Elevation Model
DG ENV	Directorate-general Environment
DG INFSO	Directorate-general Information Society
DG TREN	Directorate-general Transport and Energy
DIGEST	Digital Geographic Information Exchange Standard: NATO Standardization Agreement (STANAG) 7074
DMEER	Digital Map of European Ecological Regions
DT DS	INSPIRE Drafting Team Data Specifications
EAP	Environmental Action Programme
ECCP	European Climate Change programme
ECMWF	European Centre for Medium-range Weather Forecasting
ECOMET	Economic Interest Grouping of the National Meteorological Services of the European Economic Area
EEA	European Environment Agency
EEAC	European Environmental Advisory Councils
EIA	Environmental Impact Assessments
EIONET	European Environment Information and Observation Network
EMEP	Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe
ENVASSO	Environmental Assessment of Soil for Monitoring
EPER	European Pollutant Emission Register
ESBN	European Soil Bureau Network
ETC	European Topic Centre or : 'INSPIRE ETC': INSPIRE Environmental Thematic Coordination Group
ETRS	European Terrestrial Reference System
ETRS89	European Terrestrial Reference System 89
EULIS	European Land Information Service
EUNIS	European Nature Information System
EUREF	IAG Subcommision for the European Reference Frame

EuroGOOS	Association of Agencies to further the goals of GOOS (Global Ocean Observing System, IOC)
EUROSTAT	Statistical Office of the European Communities
EUSIS	European Soil Information System
EUVN	European Vertical Reference Network /
EVRS	European Vertical Reference System
FACC	Feature and Attribute Coding Catalog (DIGEST)
FIG	International Federation of Surveyors
GBIF	Global Biodiversity Information Facility.
GEOLAND	Integrated GMES project on land Cover and Vegetation
GEOSS	Global Earth Observation System of Systems
GIS	Geographic Information System
GISCO	Geographic Information System of the Commission
GMES	Global Monitoring for Environment and Security
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GTOS	Global Terrestrial Observing System
HALO	Harmonised coordination of Atmosphere, Land and Ocean integrated projects of the GMES backbone
HELCOM	Helsinki Commission > Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area
IAG	International Association of Geodesy
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ICZM	Integrated Coastal Zone Management
ID	Identifier
IGN	Institut Géographique National / Instituto Geográfico Nacional
IMS	INSPIRE Implementation Strategy Group
INSPIRE	Infrastructure for Spatial Information in Europe
IOC	Intergovernmental Oceanographic Commission of UNESCO
IODE	International Oceanographic Data and Information Exchange (of IOC)
IPCC	Intergovernmental Panel on Climate Change
ISIC	International Standard Industrial Classification
ISO	International Organization for Standardization
JRC	Joint Research Centre
LAU	Local Administrative Units
LBS	Location Based Services
LCCS	Landcover Classification System
LMO	Legally Mandated Organisation
LRTAP	UN/ECE Convention on Long-Range Transboundary Air Pollution
MERSEA	Marine Environment and Security for the European Area (GMES project)
MEUSIS	Multiscale European Soil Information System
MGRS	Military Grid Reference System
NACE	Nomenclature statistique des Activités économiques dans la Communauté Européenne
NMCA	National Mapping and Cadastral Agencies
NUTS	Nomenclature of Territorial Units for Statistics (EUROSTAT)
NWP	Numerical Weather Prediction
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic (Oslo-Paris-Convention)
PCC	Permanent Committee on Cadastre in the European Union
PSU	Primary Sampling Unit
PRTR	Pollutant Release and Transfer Register
PTRDB	Pedotransfer Rules Database
Ramsar	The Convention on Wetlands, signed in Ramsar, Iran
RDM	Reference Data and Metadata
RISE	Reference Information Specifications for Europe
SDIC	Spatial Data Interest Community
SDIGER	A cross-border inter-administration Spatial Data Infrastructure to support WFD information access for Adour-Garonne and Ebro River basins

SEA	Strategic Environmental Assessment
SERIEE	Système Européen pour le Rassemblement des Informations Economiques sur l'Environnement / European System for the collection of economic information on the environment
SGDBE	Soil Geographical Database of Europe
SMU	Soil Mapping Units
SSU	Secondary Sampling Unit
STU	Soil Typological Units
UELN	United European Levelling Network
UN	United Nations
UN-ECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNGEGN	United Nations Group of Experts on Geographical Names
UTM	Universal Transverse Mercator
WFD	Water Framework Directive
WMO	World Meteorological Organization (at the UN)
WPLA	Working Party on Land Administration, operating under the auspices of the UN-ECE Committee on Human Settlements.
WRB	World Reference Base for Soil Resources

3 History of INSPIRE Data Specification

This chapter provides an overview on reports and assessments that are relevant to the definition of INSPIRE thematic content. These were used as the main source material for this document.

The thematic content of the European Spatial Data Infrastructure, with special reference to the text to be used in the INSPIRE Directive, has been discussed at INSPIRE expert meetings since 2002 and has been in focus in several of the assessments and reports being produced in the preparations for INSPIRE. It is relevant that the reader is aware of these documents and their input into the work in developing the Implementing Rules for INSPIRE from October 2005 onwards. The two position papers (referenced below) from 2002 have the most detailed description of data themes, but later developments have changed priority and theme definitions somewhat.

INSPIRE position paper: Reference data: Oct 2002.
In the initial phase of INSPIRE there were discussions among a broad group of participants about what a European Spatial Data Infrastructure was to contain. There was support to include a broad set of reference data, but there were different views to which detail. Work was lead by EUROSTAT, who edited the report.

See report:

(INSPIRE RDM, 2002) INSPIRE position paper: Reference Data. October 2002
URL: http://www.ec-gis.org/inspire/reports/position_papers/inspire_rdm_pp_v4_3_en.pdf

INSPIRE position paper: Environmental and thematic data: Oct 2002.
Simultaneously to the work on reference data a working group dealt with the need for other kinds of thematic data. There were discussions regarding the necessity and convenience of a division between reference and thematic data. The work was organised by EEA (European Environment Agency) which relied on material from the topic centres and EIONET concerning an assessment of data needs. The report describes needs in thematic data policies, both for reporting and implementation at the local level. It contains the description of a thematic categorisation system and descriptions of each of the data themes. Furthermore the report provides some examples on implementation/quality obligations and suggests a phased implementation. Examples of data sets within each of the data themes can be found in the appendix.
See report:

(INSPIRE ETC, 2002) INSPIRE position paper: Environmental thematic user needs by: INSPIRE Environmental Thematic Coordination Group. Editor: Arvid Lillethun. 10 Oct. 2002
URL: http://www.ec-gis.org/inspire/reports/position_papers/inspire_etc_pp_v2_3_en.pdf

INSPIRE IMS: Implementation Strategy Issues - Data requirements. Apr 2003.
The INSPIRE Expert Group was interested to establish a common document regarding data content of the infrastructure and an outline of possible obligations to be set forward in a Directive. A working group with a broad representation discussed this topic and then developed the report. This concluded that there should be a treatment of a large set of spatial data in many different themes.
See report:

(INSPIRE IMS, 2003) Implementation Strategy Issues - Data Requirements by: INSPIRE Implementation Strategy Group, subgroup data requirements, Editor: Arvid Lillethun, 28 April 2003

INSPIRE public consultation, Phase II, May 2003.
An Internet consultation was undertaken by the European Commission in 2003. It included questions on which issues should be addressed by INSPIRE. The material published included the data specifications and implementation examples as found in the INSPIRE IMS document referred to above. There were 17 themes with additional sub-themes. The tables include details on scale, important attributes etc.

See appendix in :

(INSPIRE Consultation, 2003) Consultation Paper on a forthcoming EU Legal Initiative on Spatial Information for Community Policy-making and Implementation.
URL: http://www.ec-gis.org/inspire/reports/INSPIRE-InternetConsultationPhaseII.pdf

INSPIRE scoping paper, April 2004
In response to the consultation and also to the objective of linking the INSPIRE Directive more directly to the EU environmental policies, a scoping paper was then developed. Here several topics/themes that earlier on had been included were omitted . The paper comes up with different categories of data in different annexes. Each theme is briefly described.

See report:

(INSPIRE Scoping, 2004) INSPIRE Scoping paper.
By: Task Force Scoping. Editor: C. Steenmans. 24 March 2004.
URL: http://www.ec-gis.org/inspire/reports/inspire_scoping24mar04.pdf

Proposal INSPIRE framework Directive
Material from the previous documents where processed internally in the European Commission. This process resulted in the Appendix I-III descriptions found in the Directive, being adjusted through Parliament/Council processes.

Original proposal, *presented by the Commission:*

(INSPIRE, 2004) Proposal for a Directive of the European Parliament and the Council establishing an infrastructure for spatial information in the Community (INSPIRE) COM(2004) 516, Brussels, July 2004

*'**Parliament' version**, texts adopted by European Parliament at first reading on 7 June 2005:*

(INSPIRE, 2005 Parliament)

*'**Council' version**, political agreement reached at the Council meeting on 24 June 2005:*

(INSPIRE, 2005 Council) Proposal for a Directive of the European Parliament and the Council establishing an infrastructure for spatial information in the Community (INSPIRE) – political agreement
Council of the European Union, 10553/05, Brussels, 29 June 2005

'*Conciliation' version, ioint text approved by the Conciliation Committee:*

(INSPIRE, 2007) Directive of the European Parliament and of the Council establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) , PE-CONS 3685/06, Brussels, 16 January 2007

4 Structure of spatial data

The INSPIRE Directive is using terms such as data set and data theme. Themes are grouped in different annexes. This chapter clarifies issues related to terms, concepts and the structure of data specifications.

The early documents in INSPIRE refer to reference data and thematic data. **Reference data** is a series of dataset that everybody involved with geographic information uses to reference his/her own data as part of their work. It provides a common link between applications and thereby provides a mechanism for the sharing of knowledge and information amongst people. It is used as a common base to which thematic data may be referenced. (INSPIRE RDM, 2002).

Reference data must fulfil three functional requirements:

- provide an unambiguous location for a user's information
- enable merging of data from various sources
- provide a context to allow others to better understand the information that is being presented

The RDM position paper (INSPIRE RDM, 2002) identified seven components of reference data:

1. Geodetic reference data
2. Units of administration
3. Units of property rights (parcels, buildings)
4. Addresses
5. Selected topographic themes (hydrography, transport, height)
6. Orthoimagery
7. Geographical names

The reference data was expected to be mainly produced or organised by the National Mapping and Cadastral Agencies. Most other parts of the data for INSPIRE was expected to be primarily used and produced by the environmental sector, although some derive from other sectors e.g. roads. Many of the data components containing multi-purpose data have been termed core thematic data.

The user needs in the environmental sector were elaborated under the guidance of EEA. The ETC position paper (INSPIRE ETC, 2002) describes the user needs and defines possible environmental data components to be defined in the INSPIRE legislation.

The discussion after the release of the position papers revealed difficulties in distinguishing reference data from thematic data (since any spatial object can be referenced by another). There is considerable overlap, for instance in hydrography. As a consequence, the next proposals for the **grouping of themes** were no longer based on the role of the data in the infrastructure and the producing organisation. Instead, the themes were grouped according to common characteristics in data content.

The INSPIRE IMS data requirement paper (INSPIRE IMS, 2003) prepared by the INSPIRE Implementation Strategy Working Group, proposes a hierarchical structure. Ideally, the structure of spatial data would reflect the high-level categorisation of real world spatial objects that are logically related. However, the process of organising or modelling the real world objects is a long term process and should be treated as separate projects within different working groups under INSPIRE. Therefore, a pragmatic approach has been adopted by categorising data into:

- **Spatial data themes**: High level thematic categories
- **Spatial data components**: sub-categories. A spatial data component comprises a group of spatial data with similar characteristics irrespective of scale
- **Spatial data sets**: lowest level of this conceptual framework, spatial data sets contain real data with defined content and accuracy/scale.

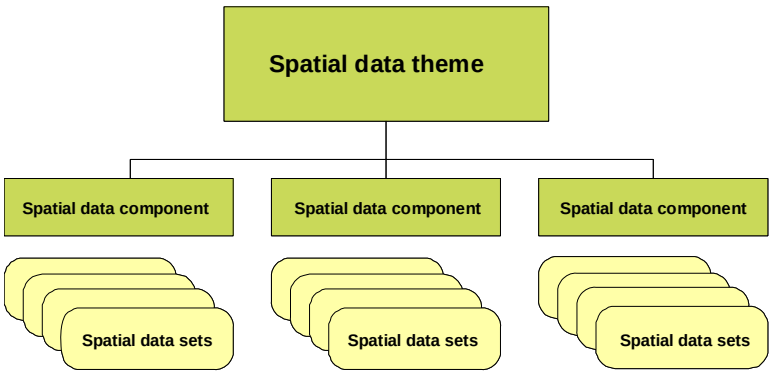


Figure 1: hierarchical structure to group spatial data. (INSPIRE IMS, 2003)

The actual data sets can be identified under each of the spatial data components. Each data set (data set specification) is only placed within one of the spatial data components.

Both the INSPIRE position paper on environmental user needs (INSPIRE ETC, 2002) and the INSPIRE IMS data requirement paper (INSPIRE IMS, 2003) contain a thematic hierarchy or grouping of themes. The ETC paper had 20 main data themes and the IMS had 17 data themes. The IMS paper built on definitions also referred to in Reference data and Metadata position paper (INSPIRE RDM, 2002) and the ETC paper. Other thematic structures were considered, such as the thematic structure found in ISO 19115 Metadata (topic category), but this thematic structure was not found to be relevant for grouping environmental/thematic and reference geographical data given priority in the INSPIRE drafting process. The spatial data themes and their spatial data components (sub-themes) as defined by the IMS group are described in Table 1.

The list of themes that we find in the current Annexes of the Directive is based on the structure in the IMS paper. Some themes which had been discussed in the drafting process where left out, others were merged into other themes. Later, in the processes in the European Parliament and the European Council, titles and definitions of some of the themes were changed, other themes were again included. When defining the content of each theme referred to in the INSPIRE annexes it is therefore essential to consider the earlier documents and processes.

In the INSPIRE scoping paper from 2004 (INSPIRE Scoping, 2004) the thematic structuring was left out, and a rough structure of appendixes were introduced. The grouping of themes in **Annex I, Annex II and Annex III** represents a grouping for addressing different actions concerning harmonisation, dissemination and other actions formulated in the Directive. Different time schedules are linked to the data in the three annexes I, II and III. There is no thematic hierarchy in the INSPIRE Directive, however each theme represent a cluster/collection of different data sets. The existing structure and content of the Annex I, II and III are described in Table 2.

In order to understand the relationship between the different themes, it could be of help to group them thematically in a kind of hierarchy. This may also be relevant in the preparations before the detailed description of themes are carried out, including data modelling of each thematic area.

Table 1: INSPIRE IMS spatial data themes and their spatial data components (sub-themes). The wide range of themes covered represents the broad needs for fulfilling expected actions for sustainable development and the multi-purpose needs for eGovernment actions.

1. Geographical location
- 1.1 Geographical reference systems
- 1.2 Geographical names
- 1.3 Geographical grids

2. Administrative units
- 2.1 Official administrative units
- 2.2 Government management zones
- 2.3 Blocks, census and statistical districts
- 2.4 Civil security units
- 2.5 Environment management & reporting units
- 2.6 Postal codes/regions

3. Properties, buildings and addresses
- 3.1 Properties
- 3.2 Buildings
- 3.3 Addresses

4. Elevation
- 4.1 Terrestrial elevation
- 4.2 Bathymetry
- 4.3 Coastline

5. Geo-physical environment
- 5.1 Soil
- 5.2 Bedrock geology
- 5.3 Geo-morphology

6. Land surface
- 6.1 Land cover
- 6.2 Orthophoto-images

7. Transport
- 7.1 Transport networks
- 7.2 Transport services

8. Utilities and facilities
- 8.1 Transmission lines and pipelines
- 8.2 Environmental protection facilities
- 8.3 Production facilities, industry
- 8.4 Agricultural facilities
- 8.5 Trade and service facilities

9. Society and population
- 9.1 Urban and rural settlement
- 9.2 Population distribution-demography
- 9.3 Human health and safety
- 9.4 Cultural heritage
- 9.5 Natural amenities

10. Area regulation
- 10.1 Land use plans
- 10.2 Protected sites
- 10.3 Area restriction/regulation zones

11. Air and climate
- 11.1 Air and atmospheric conditions
- 11.2 Meteorological spatial features
- 11.3 Climate zones

12. Water bodies/Hydrography
- 12.1 Surface water bodies/ Hydrography networks
- 12.2 Water catchments
- 12.3 Groundwater bodies/aquifers

13. Ocean and seas
- 13.1 Oceanographic spatial features
- 13.2 Sea regions

14. Biota/biodiversity
- 14.1 Bio-geographical regions
- 14.2 Vegetation
- 14.3 Habitats and biotopes
- 14.4 Species distribution
- 14.5 Landscape diversity

15. Natural resource
- 15.1 Ecosystem resources
- 15.2 Water resources
- 15.3 Agricultural land and soil resources
- 15.4 Forest resources
- 15.5 Fishery resources
- 15.6 Geological resources
- 15.7 Renewable energy resources

16. Natural and technological risks
- 16.1 Natural risk vulnerability zones
- 16.2 Technological risk vulnerability zones
- 16.3 Technological accidents and natural disasters

17.Areas under anthropogenic stress
- 17.1 Polluted areas
- 17.2 Noise and radiation zones
- 17.3 Areas of intensive exploitation

Table 2: Current structure of the themes (INSPIRE, 2007)

Annex I

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

Annex II

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

Annex III

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

5 Annex I Themes

5.1 Coordinate reference systems

Definition:

(INSPIRE, 2007) 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.

Description:

The theme establishes a structure for spatial referencing of features by coordinates. This topic shall link to appropriate standards for information technology and data where possible, and provide a framework for the development of sector-specific applications using geographic data.

ISO 19111 describes the conceptual schema and defines the description for a minimum data to two cases for which 1-, 2- and 3- dimensional coordinates reference system information shall be given. The first case is given by a coordinate reference system to which a set of coordinates is related. The second case consists of a coordinate operation (coordinate transformation, coordinate conversion, concatenated coordinate operation) to change coordinate values from one coordinate reference system to another.

There are no explicit accuracy numbers given in ISO 19111. We must consider that it has been developed for geographic information in general, but not for precise positioning. Spatial information may be referenced to the earth surface with an improving accuracy on the global scale for the future. Such high accuracy level may be required for some themes of the Directive, e.g., the trans-European railway transport network. Spatial referencing could no longer be considered as constant in time, if we reach the sub-centimetre level. We need additional parameters compared to ISO 19111 in that case, because that document considers changes in time of the coordinate reference only system through the “date of realisation”. This model is not suitable to describe continuous movements of the spatial reference. Kinematic models or so-called “loading models” are examples to incorporate such dynamics. A re-iteration of accuracy aspects may be needed, if specifications for Annex I and II are ready.

The spatial referencing is usually referred to selected points of the earth surface. Such point are, e.g., given by geodetic markers, stations performing permanent satellite observations, levelling benchmarks, or tide gauges. As soon as the marker coordinates are given, they provide a direct access to the realisation of the coordinate reference system.

Scope, use examples:

All users of GI-data need geodetic reference data to be in place. From that point of view the coordinate reference systems are a prerequisite for a successful realisation of all themes of the Directive. The use of GNSS for accurate mapping needs special services that provide various information and corrections from GNSS permanent reference stations (accuracy level 1 m to 1 cm). Selected themes, e.g., sea level rise, require the spatial reference and the corresponding changes of control stations for better than 1 mm/year.

ISO 19111 could be used as a basis for the implementation of coordinate reference systems in a European infrastructure for spatial information. The ISO document describes the **definition of a coordinate system** as well as **coordinate operations** to change from one coordinate system to another one. Changes in time are only considered in ISO 19111 through the date of realisation. It has to be studied, whether **kinematic** spatial information could be described by the attributes of coordinate operations as determined in ISO 19111. Alternatively new attributes will have to be defined in addition to

the ISO standard to implement this theme. Implementation rules for coordinate reference systems should account for reference systems that are realised in real-time, e.g., through a GNSS real-time correction service provider. It has to be confirmed that ISO 19111 features are suitable to describe the reference system information as transmitted by the service provider. The full set of reference information data will not likely be transmitted by the correction service and thus requires further conventions.

The **ETRS89** is an example for a coordinate reference system in Europe, which has been adopted by the European Commission (ref COGI action decision 2003 - F/GIS/69/EN). It is today realised through a network of more than 200 permanent operating GNSS observing stations of the EUREF organization. This realisation not only provides static, but furthermore kinematic information of spatial referencing. This geodetic reference is widely used in continental Europe. Furthermore the increasing use of GPS networks incline countries to use the European system.

The new European Satellite Navigation System GALILEO will maintain its own coordinate reference frame, the Galileo Terrestrial Reference Frame (GTRF). It will be aligned to the International Terrestrial Reference Frame (ITRF) and is covered by the ISO 19111 standard.

The **European Vertical Reference System (EVRS)** is a gravity related height system and was defined by EUREF. Gravity related heights are required to describe various environmental phenomena, e.g., all occurrences concerning water level. EVRS was recommended the European Commission as reference height system for geo data. It is realised by the geopotential numbers and normal heights of nodal points of the United European Levelling Network 95/98 (UELN 95/98) to which the name EVRF 2000 is given. Significant improvements to the realisation of EVRS are expected in the coming years from the ESA satellite mission GOCE. Similarly, developments in GNSS like GALILEO will improve the ETRS89 realizations. An appropriate mechanism to accommodate new, improved coordinates in the INSPIRE is the version numbering according to ISO 19108. This issue is independent of the kinematic aspects discussed previously.

ETRS89 and EVRS could be implemented in a spatial information system following the ISO 19111 standards with the above mentioned restrictions concerning kinematic aspects.

Many national reference frames are distorted. Therefore, coordinates can only be transformed to the ETRS89 system with decimeter to meter accuracies.

An example of **Coordinate operations** in the scope of ISO 19111 is realised through the “Information and Service for European Coordinate Reference Systems (CRS)” at http://crs.bkg.bund.de, which was established by BKG, EuroGeographics and EUREF. This system provides among others the mathematical parameters to change the coordinates from national reference systems in Europe to the ETRS89.

Today, most Web services identify coordinate reference systems by means of the **EPSG** codes (see wwww.epsg.org).

Important feature types and attributes:

The following important features are extracted from ISO 19111 for

a) Coordinate reference system
- coordinate reference system identifier
- datum identifier
- datum type
- datum anchor point
- datum realization epoch
- datum valid area
- ellipsoid identifier
- ellipsoid flattening

and

b) Coordinate operation
- coordinate operation identifier
- coordinate operation valid area
- source coordinate reference system identifier
- target coordinate reference system identifier
- coordinate operation method name
- coordinate operation method formula
- coordinate operation parameter value

Links and overlaps with other themes:

The coordinate reference systems are a prerequisite for a successful realisation of all themes of the Directive.

Reference documents:

International Standard ISO 19111:2003, Geographic information – Spatial referencing by coordinates

EUREF Publication No. 14 - Report on the Symposium of the IAG Sub-commission for Europe (EUREF) held in Bratislava, 2 – 5 June 2004

Map Projections for Europe. Institute for Environment and Sustainability, JRC, EC, 2003. COGI action decision 2003 - F/GIS/69/EN

From the reference material submitted by SDICs and LMOs, many documents relate with this theme. See categorised list of reference material, compiled by JRC

5.2 Geographical grid systems

Definition:

(INSPIRE, 2007) Harmonised multi-resolution grid with a common point of origin and standardised location and size of grid cells.

Definition adopted by Workshop on "European Reference Grids"
A grid for representing thematic information is a system of regular and geo-referenced cells, with a specific shape and size, and an associated property.

Description:

Geographical grids are an agreed, defined and harmonised grid net for Pan-Europe with standardised location and size of grid cells. Examples of cell sizes could be 10x10 m, 100x100 m, 1x1 km, 16x16 km. A good candidate for the INSPIRE-focused Pan-European grid has been proposed as a result of the Workshop on "European Reference Grids".

The grid – proposed as Pan_European standard – is based on the ETRS89 Lambert Azimuthal Equal Area coordinate reference system with the centre of the projection at the point N 52^{o}, E 10^{o}. The grid is defined as hierarchical one in metric coordinates in power of 10.

The detail description of the proposed grid is available at the Proceedings of the Workshop on the European Reference Grids, EUR Report 21494 EN, 2005. The Proposal for a European Grid System is presented from page 39 to 46 of that document.

Other grids could be also used, however they need a lot of harmonisation work, as well as a number of conversion tools. Some international organisations, like WMO, perform their operations, using their own and purpose-oriented grid construction.

Scope, use examples:

Several grid-based inventories exist in many European organisations and professional communities. Some of them have a long time series of observations and have a strong standardising impact to the methodology of data collection, analysis and reporting.

Some important grid systems are listed below. The list is not exhaustive. It may be completed in the process of review by SDICs and LMOs.

MEUSIS (Multiscale European Soil Information System) has been developed in the framework of the activities of the European Soil Bureau and involves national soil surveys and soil science institutions in more than 45 countries of Europe, Siberia and part of North Africa and the Middle East. The system is based on the Soil Geographical Database of Europe (SGDBE) at scale 1 : 1 000 000. The reference grid of the MEUSIS will be based on the grid proposed for INSPIRE.

EMEP is a scientifically based and policy driven program under the *Convention on Long-range Transboundary Air Pollution* for international co-operation to solve transboundary air pollution problems. The inventory of air pollution is based on the models, which are using a grid system of two resolutions: 50 km x 50 km and 150 km x 150 km. The grid is based on a polar-stereographic projection with real area at latitude N 60^{o} and y-axis parallel to W 32^{o}. The EMEP 50 consists of matrix of 132 x 111 points, whereas EMEP 150 domain includes 44 x 37 points.

AFE (Atlas Florae Europaeae) is a project for mapping the distribution of vascular plants in Europe. The project was launched already in 1965 as a collaborative effort of European botanists and since then the secretariat has functioned at the Botanical Museum of the Finnish Museum of Natural History, Helsinki.

The chorological data are inserted into the map with squares of c. 50 x 50 km, based on the Universal Transverse Mercator (UTM) projection and the Military Grid Reference System (**MGRS**). The Military Grid Reference System (MGRS) is an extension of the UTM system. UTM zone number and zone character are used to identify an area 6 degrees in east-west extent and 8 degrees in north-south extent. UTM zone number and designator are followed by 100 km square easting and northing identifiers. The system uses a set of alphabetic characters for the 100 km grid squares. Starting at the 180 degree meridian the characters A to Z (omitting I and O) are used for 18 degrees before starting over. From the equator north the characters A to V (omitting I and O) are used for 100 km squares, repeating every 2,000 km. Northing designators normally begin with 'A' at the equator for odd numbered UTM easting zones.

CGMS (Crop Growth Monitoring System) grid has been developed in the framework of MARS (Monitoring Agriculture with Remote Sensing) and was based on collection of meteorological and remote sensing data. The data were transformed and modelled into crop parameters. The grid is based on the Lambert Azimuthal Equal Area projection with the centre of projection at N 48^{o} E 9^{o}. and consists of 5625 cells of 50 km x 50 km each.

Point statistical and measurement (e.g. monitoring observations) data converted to the grid elements can be another area of a geographical grid system use. There are a number of practical implementation of the conversion, however there is no international standard in that scope.

Atmospheric and Oceanographic numerical forecasting or climate models have 4-dimensional grids which change relatively frequently (often on a yearly basis) as the models (and the supercomputers they run on) develop. Data from these models are exchanged under WMO data specification standards which include the definition of the exchange grid within the metadata included with the data. The definition and registration of these grids are excluded from the scope of this clause because they are highly mutable and can be specific to the data implementation. The WMO approved a general purpose, bit-oriented data exchange format, designated FM 92-VIII Ext. GRIB (GRIdded Binary). It is an efficient vehicle for transmitting large volumes of gridded data to automated centres over high-speed telecommunication lines using modern protocols. GRIB can equally well serve as a data storage format, generating the same efficiencies relative to information storage and retrieval devices.

National grid systems need also to be taken into account because the great amount of data that has been geo-referenced using them. Sometimes national grid systems has been based on the sheet distribution of the national topographic map. The possibility of national grid systems harmonisation should be considered, however it seems to be long term task.

Important feature types and attributes:

The feature types and attributes depend on the thematic data collected and maintained in the framework of the grid referencing systems. The most important spatial identifiers for the theme A 1.2 are code of grid cells, which has been described at the section “Description”, above.

The following feature and attributes may be relevant:

Grid cell (area, line, point)

- grid cell system identifier
- grid cell system name
- grid cell identifier
- grid cell value

Links and overlaps with other themes:

The main links and overlaps are where grids area being used to locate registration/monitoring sites, for aggregation of data from different topics and for display. Links and overlaps with INSPIRE themes are:

- Orthoimagery,
- Statistical units,
- Soil,
- Human health and safety,
- Population distribution – demography,
- Atmospheric conditions,
- Meteorological geographical features,
- Oceanographic geographical features,
- Species distribution.

Reference documents:

http://www.emep.int/grid/griddescr.html

http://dataservice.eea.eu.int/dataservice/metadetails.asp?id=831

http://dataservice.eea.eu.int/dataservice/metadetails.asp?id=831

http://www.eumetsat.int/HOME/Main/Access_to_Data/Meteosat_Meteorological_Products/BUFR___GRIB2/index.htm?l=en

European Reference Grids. Proposal for a European Grid System. Workshop Proceedings and Recommendations. Edited by: Alessandro Annoni. JRC, Ispra, 27-29 October 2003. Institute for Environment and Sustainability, EUR Report 21494 EN, 2005.

5.3 Geographical names

Definition:

(INSPIRE, 2007) Names of areas, regions, localities, cities, suburbs, towns or settlements, or any geographical or topographical feature of public or historical interest.

Description:

Geographical names or place names describe features on Earth – a location or a landscape object, on land as well as on sea. Often the term topographical name is used to emphasize the spatial dependency and relation to the adjacent topographical features.
(INSPIRE ETC, 2002)

The geographical names on a specific landscape object can be different in the different languages. Multi-lingual aspects should be covered in the data sets. In some datasets their primary purpose is to depict geographical locations and in others they may be attributes, and of secondary importance. Geographical names should in both cases be provided in the official form(s) and language(s) of the country, including the minority language(s). (UNGEGN)

Scope, use examples:

DT DS emphasises that the examples in D2.3 should not be interpreted as recommendations or proposals for the upcoming specification, and refers the issue for proper analysis to the TWG

Geographical name datasets are commonly produced by mapping agencies and local authorities. Geographical names data with pan-European coverage exist e.g. in GISCO. (INSPIRE IMS, 2003)

The geographical names database should be suited to generalise to versions/scales. It should provide links between an endonym (name form used in the language spoken at the location of the geographical feature) and its exonyms (names forms used in various foreign languages).

The geographical names database can be used for:

- search and overview,
- location at all layers,
- as a basic layer on maps,
- effective operations at local level (e.g. transport and emergency operations),
- documenting geographical names forms in minority languages.

(INSPIRE IMS, 2003), (UNGEGN, 2002)

A **Gazetteer** is a geographical directory. According to the definition in ISO 19112 a gazetteer provides a master record of all location instances for a particular location type or types. Gazetteers are not just geographical names' indexes but may be records of any kind of feature type or types. The positional information may include a coordinate reference, but it may be purely descriptive. (INSPIRE ETC, 2002)

Important feature types and attributes:

Geographical Name

- Language
- Status (official, exonym, endonym,etc.)
- Importance (e.g. indicated by map scale)
- Classification (feature type)
- Spatial reference; direct by means of coordinates and/or indirect by link to a spatial dataset

Links and overlaps with other themes:

- Addresses, because the geographical name is a substantial element of the address.

Geographical Names serve as an indirect spatial reference system. As such their importance is similar to Coordinate Reference systems. Geographical Names are attributes to many feature types that appear in other themes of the Directive, for instance Administrative units, Hydrography and Elevation.

Reference documents:

(UNGEGN, 2007) Resolutions adopted at the nine United Nations Conferences on the Standardization of Geographical Names 1967, 1972, 1977, 1982, 1987, 1992, 1998, 2002, 2007. URL: http://unstats.un.org/unsd/geoinfo/uncsgnresolutions.htm

International Standard ISO 19112, Geographic information – Spatial referencing by geographic identifiers

IHO S-23 Limits of Oceans and Seas. URL: http://www.iho.int/PUBLICATIONS/Publications_E.htm#S23

Australia and New Zealand Intergovernmental Committee on Surveying and Mapping Harmonised Data Model Place Names application schema

Several SDICs and LMOs from EU Member States or Regions have submitted data specifications for datasets that include geographical names. See categorised list of reference material, compiled by JRC, March 2007.

5.4 Administrative units

Definition:

(INSPIRE, 2007) Units of administration, dividing areas where Member States have and/or exercise jurisdictional rights, for local, regional and national governance, separated by administrative boundaries.

Description:

Official administrative units should be provided according to the administrative levels used within each country. Each national territory is divided into administrative units. The administrative units are divided by administrative boundaries. (INSPIRE IMS, 2003)) The definition has been interpreted not to include administrative units such as census districts, post office regions and other sector-specific regions. In the INSPIRE IMS paper such regions were included under the heading "Administrative units", but with the Council version of INSPIRE definition for this theme, using the term "jurisdictional rights", such sector and management-specific units can not be included.

Administrative units and administrative boundaries form a partition of space.

Scope, use examples:

Administrative units data are used for

- operations and management,
- showing competent authorities,
- referencing of information and statistics,
- basis for generation of statistical map showing economic phenomena, demography etc.
- as a reference for correct location of objects
- for “cookie cutting” of databases.

(INSPIRE IMS, 2003)

The administrative division forms an indirect spatial reference system. The reference to an administrative unit provides a spatial dimension to data without using coordinates. (INSPIRE IMS, 2003)

Administrative boundaries are the key to horizontal interoperability between the products of national data custodians. Neighbours should agree on international boundaries with shared geometry at the best possible resolution. (INSPIRE RDM, 2002)

The reference date of the administrative units has to be considered for purpose of linkage to statistical information as for instance population figures.

Use example: EBM (EuroBoundaryMap), a pan-European administrative boundary dataset produced and distributed by EuroGeographics since 1995. EBM provides information on the geometry and hierarchical structure of administrative units in Europe, together with a link to the corresponding NUTS codes. By means of the NUTS codes the user can associate NUTS-based statistical information with spatial data from EBM. This serves areas of application such as:

- market analysis
- asset management
- geo-referencing demographic analysis
- thematic planning
- referencing statistical cross-border data

- geo-referencing demographic analysis

The DIAMONT project, managed by the European Academy in Italy, uses EuroBoundaryMap as reference information to advise the Alpine Convention on the creation of an Alpine-wide information system (SOIA) and the selection of appropriate indicators and relevant data for sustainable regional development. Another example is the European Environment Agency which is mapping NUTS-based information about the level of organic farming to the administrative division in Europe.

Important feature types and attributes:

Administrative unit

- Name(s): official name(s) of the administrative unit in the national language(s)
- National administrative level (1st, 2nd, …)
- National code: official code of the administrative unit used by the National Statistical Office
- Links with statistical codes, such as NUTS and LAU
- Country code according to the ISO 3166 definition

Administrative boundary

- National boundary level (international, 1st, 2nd, …)
- Status (e.g definite, in dispute, exclusive economic zone, territorial sea)

NUTS and LAU nomenclature is being used at the overall European scale, and could be considered more widely used also at lower levels in the context of INSPIRE. The Nomenclature of Territorial Units for Statistics (NUTS) was established by the European Office for Statistics (EuroStat) in order to provide a single uniform breakdown of territorial units for the production of regional statistics for the European Union. NUTS excludes specific territorial units and local units in favour of regional units of a general nature. At a more detailed level, there are the districts and municipalities. These are called Local Administrative Units (LAU) and are not subject of the NUTS Regulation. At the top of the hierarchy are the individual member states of the EU, below that are NUTS levels 1 to 3, then LAU levels 1 and 2. NUTS regions do not necessarily match with the national administrative units.

Links and overlaps with other themes:

The main overlaps are :

- Hydrography: The coastline is an essential feature for many applications that need to differentiate between land and water areas. The coastline should be integrated in the administrative units data. Administrative boundaries may coincide watercourses or shorelines.
- Geographical names: names of administrative units
- Cadastral parcels: Administrative boundaries do coincide in most (but not all) cases with the boundaries of Cadastre and Land registration.
- Statistical units
- Area management/restriction/regulation zones. Managing bodies are often organised according to administrative units.

Reference documents:

Regulation (EC) No. 1059/2003 of the European Parliament and the Council of 26 May 2003 on the establishment of a common classification of territorial units for statistics (NUTS). Official Journal L154, 21.06.2003

ISO 3166-1:1997 Codes for the representation of names of countries and their subdivisions - Part 1: Country codes

ABDS for the CEEC - Memorandum of Understanding

ABDS for the CEEC - Public Report

EuroGeographics: EuroBoundaryMap v1.1, User Guide and Data Specification

IHO S-23 Limits of Oceans and Seas. URL: http://www.iho.int/PUBLICATIONS/Publications_E.htm#S23

Several SDICs/LMOs from EU Member States or Regions have submitted data specifications for datasets that include administrative units. See categorized list of reference material, compiled by JRC, March 2007.

5.5 Addresses

Definition*:*

(INSPIRE, 2007) Location of properties based on address identifiers, usually by road name, house number, postal code.

NOTE from Drafting Team Data Specifications: besides road name, house number and postal code the other component is a geographical name (city, town, village, suburb/municipality, admin unit)

Description:

An address is an identification and abstract concept expressing the fixed location and path of access of a home, business or other building or land parcel (real property). The full address identification is a hierarchy consisting of components such as geographic names, with increasing level of detail, e.g.: town, street name, address (or building) numbers in addition to the postal code.. Addresses serve several purposes, such as their use in the delivery of mail. The VROM (2006) describes four functions of addresses: location function (e.g. for visits or the delivery of mail), identification function (e.g. in context of a building registration), jurisdiction function (e.g. which authority is responsible for object attached to address), and sorting- and ordering function.

Under real property a number of different objects types can be identified: land parcels, buildings (including apartments), but sometimes also other types such as utilities. For (apartment-) buildings there is in most cases an association with an address. In rural area's there exist buildings without a complete postal address; e.g. only town and street name and no house number. Same in urban area's: e.g. utility service buildings. Note: the registration of the addresses is currently not harmonized within Europe. Other 'non-building' objects that might have addresses include sport's grounds, (official) location of a mobile home (house trailer, caravan) or the location of a houseboat (mooring place).

Scope, use examples:

Today, addresses and address information is widely used for number of purposes within business, public administration and in citizens daily life. In a large number of applications, address information is used as a common administrative reference, geographic identification, and linking mechanism. Like similar name-based, reference systems (e.g. place names, cadastre), address data fulfil the requirement of being reference data. Address information might, because it is often considered in a postal context, not be considered true geo-information at the first sight. As an address' most important component is physical location they are geo-information. Addresses are used to link to many other sources of administrative information, which can be related to a location via addresses.

Many countries have their own specific standards for unique addresses (see References for a few examples, such as Norway, Finland, Switzerland, Italy, France, UK and the Netherlands), which are all a little different. There was an international standard ISO 11180:1993 'Postal addressing', but this has been withdrawn on 2004-01-15 by the responsible Technical Committee (TC 154). However, in practise the principles of this standard are still used in many countries. The ISO standard 19112:2003 'Spatial referencing by geographic identifiers' describes methods to specify spatial references via other geographic features (such as a road). This standard describes how to build a hierarchic gazetteer with a possibility to create unique geographic identifiers using parent-child relationships. Addresses are often shown in gazetteers (e.g. all towns in a region, all street names in a town, all house numbers along a street). It is also clear that within one country very often, different organisations are responsible for different aspects of the address (e.g. state/province for the official names of towns, municipality for the official road names and

house numbers, postal service for the postal code), which makes consistent updating of the addresses a non-trivial task.

Although all national or local address systems share the same concept and general properties, there exists differences in formal and informal standards, rules, schemas and data models within Europe. Differences also exists in the extend of the address system e.g. in rural areas. Also the way house numbers are assigned can be completely different (and some harmonization is welcomed). A number of alternatives are:

- house numbers are in sequence of their location within the street (with left/right having odd/even numbers and the low numbers towards city centres). The drawback is that this is not so very dynamic: inserting of new building or new entrances requires adding letters after a number or other 'tricks' such as non-used numbers.(note that one has to do very careful planning). In some countries letters after the numbers keep significant information, while in other countries they are just a way to create a unique designation.
- house numbers are in sequence of the creation, which is easy to realise and will provide unique numbers. However, for the users of this 'system' it may be difficult to find the proper location
- house numbers are derived from the distance to the start of the road; for example in the urban areas every 10 meters a number, and in rural areas every 100 meters a house number (even if there are no houses). Changing from urban to rural means adding one digit.
- not using house numbers but (2D or 3D) geographic coordinates directly

Cadastres and Land Registries do not in all cases maintain an address register (linked to coordinates). In most cases municipalities are responsible for establishment of road names and building numbers, national post for postal codes. Maintenance is not uniform. Front door or centroid coordinates are mostly available in a nationwide co-ordinate reference system.

Important feature types and attributes:

The main feature types are address with relationships to other features such as cadastral parcel, (apartment-) building and other immovable register objects (such as utilities). Relevant in the context of this theme is first of all the real property identifiers (possibly based on an administrative unit hierarchy), next the attributes relating this to address and/or reference coordinate of the object and possibly successor/predecessors (e.g. changed road names or house numbers).

Important address attributes are: Postal code, geographic coordinate of address reference point, town, road name, house number (and annexes), and textual descriptions. Note that in some area's waterways may play the role of 'road'. In International context also the country specification is relevant (ISO 3166-1). In between other levels might be mentioned (state, province, municipality, etc.).

The role of list of approved items is often an important part of the standards: approved official names of towns (in multiple language), roads, postal codes, etc.

Addresses should not be regarded just as an identifier for parcel, buildings or other objects. The address itself is an item (feature, object) that has a "location" attribute of type "geometry" (point or area). The feature (object class) "address" can be related to other features e.g. parcel, building, dwelling, bus stop, garbage can or a mailbox. All examples of real word phenomena that we may want to locate by an address.

Links and overlaps with other themes:

There are links with:

- Geographical names
- Buildings
- Cadastral parcels
- Transport (for street name and road number)
- Administrative units

Many countries have building registers (Annex III.2). A single building may consist of several units (and sometimes grouped in a specific way, e.g. by entrance). Those registers also often include buildings with building construction permissions. Addresses are linked to (apartment-) buildings, except P.O. boxes. There is no 1:1 relationship between addresses and parcels (or buildings). There can be addresses linked to zero (P.O. Boxes), one or more parcels (apartment buildings). Addresses do not cover all property units in a country especially in the countryside. For land parcels without a building there may not be a full (complete) postal address, but just an indication of the road name and for real property objects such as utilities it may even be more difficult. Addresses can therefore not be suitable for unique cadastral identification. The operation to obtain a coordinate related to an address is called geo-coding. For apartments this might even be a 3D coordinate (or 2D coordinate, with indication of the level). A building (or parcel) may have more than one address (eg. building is located at a street corner). A building (or parcel) may have more than one address (eg. building is located at a street corner).

Reference documents:

United Nations Economic Commission for Europe (UN-ECE). Guidelines on Real Property Units and Identifiers. United Nations, New York and Geneva, 2004.

Institut Géographique National (France): Service des Bases de Données Vecteurs, RGE – Composante Adresse, SPÉCIFICATIONS DE CONTENU, Version: 1.0, 2 sept. 2003.

INTERNATIONAL STANDARD, ISO 11180:1993, Postal addressing (withdrawn 2004-01-15 Technical committee TC 154)

INTERNATIONAL STANDARD, ISO 19112:2003, First edition, 2003-10-15 Geographic information — Spatial referencing by geographic identifiers

Schweizerische Normen-Vereinigun SN 612040:2004, Vermessung und Geoinformation - Gebäudeadressen - Struktur, Georeferenzierung, Darstellung und Datentransfer (Surveying and geographic information – Address of buildings – Structure, spatial referencing, presentation and data transfer method)

Nederlands Normalisatie Instituut NEN 5825:2002, Adressen- Definities, tekenset, uitwisselingsformats en fysieke presentatie (Addresses – Definities, character sets, interchange formats and physical prepresentation)

SERVIZI INFORMATIVI TERRITORIALI, AMBIENTALI E CARTOGRAFICI, STRUTTURA DB_STRADARIO_UNICO, Descrizione della struttura del DB dello Stradario Unico della Regione Piemonte

VROM (2006): Ministry of Housing, Spatial Planning and Environment (VROM), Catalogus Basis Registratie Adressen, 2006,

http://bag.vrom.nl/ufc/file/bag_sites/5b0aa26058fa5a33b0e2dee723f4acb8/pu/BRA_catalogus_2006_def.pdf

Norwegian feature catalogue including a UML application schema for addresses (in the process of being translated to English): http://www.statkart.no/sosi/UMLfullmodell/ADR/adr.htm

EUROPEAN STANDARD, EN 14142-1:2003 Postal services – Address databases – Part 1: Components of postal addresses

UNIVERSAL POSTAL UNION, Data definition and encoding standards S42a-5 International postal address components and templates – Part A: Conceptual hierarchy and template languages

EUROPEAN COMMISION, eGovernment Interoperability at Local and Regional level, Good practice case, The Finnish Address System, Case study, 27 October 2006

Kommunens adressystem. Anvisningar och rekommendationer. Kommunförbundet, Helsingfors 2007. ISBN 978-952-213-203-1. (Municipal Address System. Guidance and Recommendations. The Association of Finnish Local and Regional Authorities, Helsinki 2007)

British Standard BS 7666 Spatial dataset for geographical referencing

5.6 Cadastral parcels

Definition:

(INSPIRE, 2007) Areas defined by cadastral registers or equivalent.

The parcel definition of WPLA published in the document "Guidelines on Real Property Units and Identifiers" is the following:

> A single area of land or more particularly a volume of space, under homogeneous real property rights and unique ownership (WG-CPI, 2006).

Remark: By unique ownership is meant that the ownership is held by one or several owners for the whole parcel. By homogeneous property rights is meant that rights of ownership, leases and mortgages affect the whole parcel. This does not apply to specific rights as servitudes which may only affect part of the parcel.

Description:

Irrespective of the legal system adopted by each Member State, the Cadastre is defined as a register under the responsibility of the government. Its use complies with the principles of equality, security and justice to all the citizens of the European Union. Access to cadastral information is ruled by laws and regulations in order to protect the personal information. The Cadastre basic unit is the parcel. Parcels can be grouped in register units. A parcel has a nationwide unique real property identifier. The spatial description of the parcels and other cadastral objects should be provided with an adequate degree of accuracy. Descriptive data may include the nature, size, value and legal rights or restrictions associated with each separate land object under or over the surface (adapted from PCC, 2003). Cadastral parcels should cover a territory nationwide and there should be no overlaps or gaps (in reality). An exception to this rule may be government land (or public domain) not registered within the Cadastre (though this is not recommended practice).

Scope, use examples:

The scope of the cadastral information in the INSPIRE context is limited to the geographic side of the cadastral information systems (land administration) and does not cover the administrative or legal side, with objects such as rights and persons. However, a parcel has strong associations with these objects as its definition is based on this.

Every country (countries can be in a federation) in Europe has a Cadastral or Land Administration system operational, often as the responsibility of a national organisation, or as the responsibility of a more local government organisation. Due to different legal systems and different national tradition, there is a rich variety of cadastral systems around. As this limits interoperability (e.g. in the context of EULIS) and results in high system development and maintenance costs, non-governmental (international) organisations, such as the FIG, developed the core cadastral domain model (CCDM). The CCDM is submitted to and accepted by ISO TC211 as a new work item proposal, but is renamed to Land Administration Domain Model (LADM) as a result of the comments made during this process.

Cadastres or Land Information Systems form an important part of the Land Administration Systems of the Member States. Cadastral activity is related to the integrated creation and updating the alphanumerical and geographical information in the land parcel life cycle. The Cadastral Organisations in each Member State are those public organisations that have specific legal responsibility in creating and updating the

land parcel's alphanumerical and graphical georeferenced information, or its coordination at national level (PCC, 2003).

We find different situations of the Cadastre in the European Union. Cadastres are always institutions that comply with the European public model, albeit with a large range of possible variations. In brief, it could be pointed out that while in some countries a Cadastral model linked to Land Registers with functions of enhancing security in the real estate market has been designed, other countries have placed greater attention on tax issues and supporting agrarian and global development activities.

The Cadastral Organisations provide data for many purposes to the citizens, the Public Administration and to different sectors of society. They can have different aims, purposes, administrative belonging, and managing models from one country to another.

In most countries Cadastres are responsible for real property (including parcel) identification. In some countries the parcel coverage is not yet complete. There are no European or other standards for parcel identifiers. However, recently Guidelines on Real Property Units and Identifiers became available (UNECE, 2004).

Important feature types and attributes:

The main geographic feature types are Parcels, Boundaries, and (Survey) Points. The main administrative/ legal feature types are Right (Restriction, Responsibility) and Person (natural and non-natural), which will not be further described (outside the scope of this theme). Important attributes are the geometry (point, line depending on the feature and could be a bounding box for easy access), the source of data (reference field documents as field sketches and files from total stations or GNSS instruments or for example to the id of the photogrammetric project), quality (accuracy), legal area (included in the official legal documents, in general this area is not equal to calculated area from the spatial cadastral boundary vertices), and sometimes also value and use codes. The legal area may not always be available. A Right has the following attributes: type of right (country dependent), share in right, time specification of right (can be limited), references to legal source document and association with mortgage which may rest on the Right (or better RRR=Right, Restriction, Responsibility).

Cadastral parcels must have a unique real property identifier to which the legal status is attached. This identifier can be based on a hierarchy of administrative area's (provinces/districts/cantons/..., municipalities/communes/...., sections/polygons/...) and sometimes to the 'mother' parcel (subdivision of parcel ..../..../..../37 means for example ..../..../..../37/1 and ..../..../..../37/2). At a European level, the national identifiers should get a country code prefix to make them unique within Europe. Alternatively there could be explicit associations between predecessors and successors. The cadastral information should be maintained continuously in order to reflect the actual legal situation. Of course, in reality and in information provision there might be a slight delay. Due to the legal importance, the history is currently maintained in some countries, but this may be needed in many countries.

Besides ownership, cadastral parcels, or to be more general immovable register objects, can be associated with other types of real rights (usufruct, superficies, long lease,…), responsibilities or restrictions. The line where a discontinuity in the specific legal situation occurs is the cadastral boundary. Vertices of this boundary can be marked in the field (or not). In many cases field sketches with survey observations are available. Observations (existing coordinates, bearings and distances) are used to determine coordinates; those coordinates are adjusted to the cadastral map. Current practice is to express the coordinates in the cadastral map in the National reference system. In the future this might be changed to the European Terrestrial Reference System (ETRS89), because 1. more and more GNSS (GPS, GLONASS and Galileo) surveys will be used to collect data and 2. this will better enable data consistency near the country boundaries within Europe.

A boundary does have several attributes of its own. Filed sketches (or survey plans) can be used for boundary reconstruction. From a technical point of view the set of related boundaries is sometimes stored

as a closed polygon, with a risk for gaps and overlaps between parcels (quality problem in the database, not in reality). This also implies that every boundary would be stored at least two times (in left and right parcel), which is redundant. Further, boundaries do also have their own attributes, which have to be attached to a specific instance (which would imply a three representation). In order to avoid these issues, a parcel representation based on a topological structure is often used. Mostly boundaries do not have a meaningful (based on an administrative hierarchy) identifier, but could be associated with field sketches (which do have some kind of meaning full identifier, known in the outside world).

As space is getting more and more scarce, people are creating construction above and below each other. In a number of European countries the legal solutions for this are (being) created. One option for registering the resulting property, is the use of 3D volume cadastral parcels (based on 3D survey plans or field sketches).

The following core attributes of the cadastral parcel were identified by the joint working group of the PCC and EuroGeographics, (WG-CPI, 2006, note that these core data have to exist in digital form):

- Unique identifier
- Area
- Boundaries
- Georeference [in a national coordinate reference system]
- Origin and history of the parcel

The following additional content of the cadastral parcels was identified by the joint working group of the PCC and EuroGeographics (WG-CPI, 2006). This does not mean that these topics necessarily are part of the responsibility of the cadastral administrations. Some topics establish links with other INSPIRE themes (e.g. Addresses and Buildings), and again, some topics are probably out of the scope of INSPIRE (Owner, User, in these cases only references are included and not the content itself).

- Owner
- User
- Rights and restrictions
- Localisation
- Administrative boundaries (boundaries of administrative units)
- Buildings or parts of buildings and all kinds of constructions
- Official zoning (administrative restrictions)
- Land use: the manner in which land is used, including the nature of the vegetation upon its surface. (WPLA)
- Land cover (vegetation, crops, forest)
- Values/level of productivity
- Address(es)
- Description

It should be noted that the cadastral parcels model could be generalized and then be applied to other data themes and data set components (e.g. protected sites). That is, a similar model pattern may reoccur within models for different data themes; e.g. the pattern: ‘spatial object – relationship (right/ restriction/ responsibility) – person’ or the pattern ‘survey objects (observation & measurement) - resulting spatial object (interpretation)’. It is recommended that some of these themes and components be considered at a high level to identify these similarities in an early stage and make sure that the resulting models are harmonized, that is, based on the same model pattern. The Australia and New Zealand Intergovernmental Committee on Surveying and Mapping Harmonised Data Model provides an example of this approach and also has a number of commonalities with the CCDM approach.

Another relevant observation from the CCDM work is that it is recommended to use a modularised approach as per good UML modelling practice (dividing models into packages). Such an approach is particularly useful for large, cross-jurisdictional activities like INSPIRE because it allows responsibility for governance of different components of the model to be assigned to the most appropriate groups. The

simplicity of every package is an explicit design goal as the more complex the package becomes, the more difficult it is for people to provide conforming data (and to reach agreement!).

Links and overlaps with other themes:

A boundary can be just a parcel boundary and/or a boundary of an administrative unit (municipality, province, country); this is an important relationship with theme 4 from Annex I

Parcels and boundaries have associations with Buildings (Annex III) - sometime used as local reference for boundaries, but also used for orientation purposes

Parcels and boundaries have associations with Transport networks (Annex I) - same orientation purpose, but also roads, railroads, waterways are separate parcels as they are often owned by government.

A link exists between cadastral parcels and Addresses (Annex I)

A link exists between cadastral parcels and Geographical names (Annex I)

Links exist between cadastral parcels, land use (Annex III) and land cover (Annex II).

Reference documents

ISO 19107:2003 - Spatial schema

Kaufmann, J. and D. Steudler, 1998, 'Cadastre 2014, A Vision for a Future Cadastral System, FIG, July 1998, http://www.swisstopo.ch/fig-wg71/cad2014.htm

van Oosterom, P. and Lemmen, C, 2005, The Core Cadastral Domain Model: A Tool for the Development of Distributed and Interoperable Cadastral Systems, in Proceedings of UN Human Settlements Programme (UN-HABITAT) Expert Group Meeting (EGM) on "Innovative Land Tools for Sustainable Urban Development, Moscow on 25-27 October 2005.

Stoter, J.E., 2004, 3D Cadastre, PhD thesis, 327 pp, TU Delft, the Netherlands

UNECE, 2004, Guidelines on Real Property Units and Identifiers, United Nations, New York and Geneva, 2004

UNECE, 1996, United Nations/Economic Commission for Europe, 'Land Administration Guidelines', Geneva, Switzerland, www.unece.org/env/hs/wpla/welcome

WG-CPI, 2006, Role of the cadastral parcel in INSPIRE and national SDIs with impacts on cadastre and land registry operations. Joint Working Group of EuroGeographics and the PCC (WG-CPI), Inventory document.

PCC, 2003: Common Principles on Cadastre in the European Union. Declaration, Rome, 3rd December 2003

Institut Géographique National (France): BD Parcellaire version 1.1 descriptif technique

Regione Emilia-Romagna: Data Base Topografico alle grandi scale (1:1.000 - 1:2.000 - 1:5.000)

Institute of Geodesy, Cartography and Remote Sensing (Hungary): Digital Base Map Standard

AdV: GeoInfoDok (Germany's AAA model)

Norwegian feature catalogue including a UML application schema for cadaster, including land parcels http://www.statkart.no/sosi/UMLfullmodell/Eiendom/Eiendom.htm

Australia and New Zealand Intergovernmental Committee on Surveying and Mapping Harmonised Data Model.

5.7 Transport networks

Definition:

(INSPIRE, 2007) 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 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 * and future revisions of that decision. * OJ L 228,9.9.1996, p.1. Decision as last amended by Decision No. 884/2004/EC (OJ L 167,30.4.2004, p.1. Corrigendum published in OJ L 201,7.6.2004,p.1).

Description:

The transport component should comprise an integrated transport network, and related features, that are seamless within each national border. In accordance with article 10.2 of the Directive, national transport networks may also be seamless at European level, i.e.connected at national borders. Transportation data includes topographic features related to transport by road, rail, water, and air. It is important that the features form networks where appropriate, and that links between different networks are established, i.e multi-modal nodes, especially at the local level, in order to satisfy the requirements for intelligent transport systems such as location based services (LBS) and telematics. The transport network should also reflect the transport flow to enable our navigation services. (INSPIRE IMS, 2003)

Route is a kind of "abstract" or invisible objects describing the spatial services offered within a transport system. Bus routes, ferry lines, scenic roads route, bicycle routes may be examples of route information. Commonly links or segments of a transport system is brought together to form a route, but may exist as separate feature data. It should be clarified if such data are included within this theme or if not, how one through the INSPIRE data and services can support such route information.

Scope, use examples:

- routing systems, traffic management
- environmental assessments,
- security,
- disaster and emergency management,
- social and economic planning, etc.
- Transport planning,
- Land use planning,
- Risk planning/management,

(INSPIRE IMS, 2003)

Community policies:

- Decision no. 1692/96/EC on Community guidelines for the development of trans-European transport network.

Important feature types and attributes:

for the road network:

Road link
- form of way (motorway, dual carriage way, single carriage way, slip road, …)
- functional road class (importance for traffic)
- road number
- road name
- condition of facility (disused, under construction, functional)
- Road surface (paved, unpaved)

Bridge, Tunnel

Road node
- form of node (junction, roundabout, ..)
- node number
- node name

for the water network:

Navigable channels (off-shore), navigable watercourses s (in-shore – rivers/canals)

Ferry link

Harbour

for the railway network:

Railway link
- railway type (e.g. high speed, tramway, …)
- condition of facility (disused, under construction, functional)
- railway gauge classification
- energy (electrified or not)

Bridge, tunnel

Railway station
- name
- condition of facility
- function (passengers, freight, both)

for the air transport:

Airport
- name
- ICAO identifier, IATA identifier

Heliport
- name

In view of navigation services, it might be useful to keep the navigation attributes on the road network (Direction of flow, Access restriction, Seasonal restriction, Speed limit, …).

Links and overlaps with other themes:

The main overlaps are:

- Hydrography as water network is both part of Hydrography and Transport
- Addresses: a road link may carry useful information about addresses.
- Land use, as roads is a category in land use data and land use plan data

Reference documents:

EuroRoadS: Specifications of core European road data (D6.5 v1.2)

EuroGeographics: EuroRegionalMap Specification and Data Catalogue v4.0

EuroGeographics: EuroGlobalMap (v3.1) data specification

DGIWG: Feature and Attribute Coding Catalog (FACC) v2.0
https://www.dgiwg.org/FAD/registers.jsp?register=DFDD

ISO/TC204 Transport Information and Control Systems (TICS):

ISO/TR 14825:1996 Geographic Data Files (GDF)

http://www.goodroute-eu.org/
https://www.reorient.org.uk/
http://www.factsonline.nl/

Several SDICs/LMOs from EU Member States or Regions have submitted specifications for topographic datasets that include transport networks. See categorised list of reference material, compiled by JRC, March 2007

5.8 Hydrography

Definition:

(INSPIRE, 2007) 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 *, and in the form of networks.
* OJ L 327,22.12.2000, p.1. Directive as amended by Decision No. 2455/2001/EC (OJ L 331, 15.12.2001, p.1.).

Description:

The theme 'Hydrography' covers the network of rivers, lakes and marine areas. The definition builds mainly on the uses cases from WFD and the Flood Directive. 'Static' features are in the 'Hydrography' theme, 'dynamic' features such as water levels are in related themes in Annex 3

It also includes the river basins. River basin, as defined in the Water Framework Directive, Art 2, annex I, ii, means the area of land from which all surface run-off flows through a sequence of streams, rivers and, possibly, lakes into the sea at a single river mouth, estuary or delta. Sub-basin means the area of land from which all surface run-off flows through a series of streams, rivers and, possibly, lakes to a particular point in a water course, normally a lake or a river confluence. (INSPIRE IMS, 2003)

Groundwater is also an important part of the hydrological cycle of water, but is treated under the Annex theme Geology.

Scope, use examples:

Hydrography data is being used in: (INSPIRE IMS, 2003)

- Water navigation / transport routes
- Tourism environmental
- Assessment and monitoring in estimation of water resources,
- Assessment of flow patterns of particles and pollutants, pollution monitoring,
- Wastewater cleaning estimation,
- Species migration and biodiversity assessment, the hydrological elements being habitats.
- Inland fisheries management.
- Hazardous waste disposal sites.
- Land use planning/ management,
- Recreation planning and management,
- Transport routes,
- Water supply

Water catchments are used in assessment of water flow and flooding, flow of contaminants, erosion monitoring. Catchments are used to create WFD River Basin Management Districts, but does not have full correspondence in boundaries. (INSPIRE IMS, 2003)

Community policies:

- Directive 200/60/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, OJ L 327, 22.12.2000, p.1
- Flood Risk management; Flood Prevention, protection and mitigation. Communication from the Commission of the European Communities, COM(2004)472 final, Brussels, 12.07.2004

The **Water Framework Directive (2000/60/EC)** – "WFD" - was adopted by the European Parliament and of the Council in 2000 and establishes a framework for Community action in the field of water policy and has since then been incorporated in the legislation of Member States. It requires that inland and coastal waters within defined river basin districts must reach at least good status by 2015 and defines how this should be achieved through the establishment of environmental objectives and ecological targets.

Article 5 defines the responsibility for each Member State to define the characteristics of the river basin district, review of the environmental impact of human activity and economic analysis of water use.

Article 8 defines the responsibility for Member States to establish programmes for the monitoring of water status in order to establish a coherent and comprehensive overview of water status within each river basin district.

The implementation of the WFD requires the handling of spatial data both for the preparation of the River Basin Management Plans and for the reporting to the Commission. In the first case GIS techniques will be essential for the derivation of various information layers (e.g., on the characteristics of river basins and water bodies, on the chemical and ecological status of water bodies), while in the second case GIS will be the tool for the preparation and delivery of the GIS layers required for the reporting.

Important feature types and attributes:

Watercourse

- Name
- Hydrologic code (as required by WFD)
- Hydrologic persistence (perennial, intermittent)
- Hydrographic Origin Category (natural, man-made)
- Type (stream, canal, aqueduct, ditch, estuary, …, virtual)
- Position/ground
- Navigability

Lake, pond

- Name (if any)
- Hydrologic code (as required by WFD)
- Hydrologic persistence (perennial, intermittent)
- Hydrographic Origin Category (natural, man-made)

Other entities on water network, such as waterfall, sluice, lock, dam

Isolated water infrastructures, such as fountain, pumping station

River basin

- name
- hydrologic code (as required by WFD)
- hydrological level ("administrative importance")

Marine areas :

- category (transitional waters, coastal waters)
- name (if any)

- hydrologic code (as required by WFD)

Links and overlaps with other themes:

The main relations with other themes :

- Transportation - for water navigation (Annex I)
- Geographical Names - for names of water features
- Elevation - for geometric consistency and coastline
- Land cover - for wetlands, water bodies (Annex II)
- Geology – for aquifers
- Utility and governmental services – for water supply
- Environmental monitoring facilities
- Production and industrial facilities – for water abstraction facilities
- Agricultural and aquaculture facilities - specially for irrigation systems
- Area management/restriction/regulation zones and reporting units as some of these zones are related with hydrography
- Natural risk zones - for instance for flood risks
- Sea regions - concerning the limit between land and sea
- Oceanographic geographical features

Groundwater is by geologists commonly treated as a geological resource. Groundwater in aquifers mainly depends on the geological structure of the subsurface (rock type). Thus it is an integral, inseparable part of Geology. It is mentioned in the INSPIRE Annex as aquifers. However, as being part of the hydrological cycle, it is strongly related with the theme Hydrography as well. The current definition of Hydrography would accommodate groundwater bodies under “all other water bodies related to hydrographic elements”.

Reference documents:

SDIGER: Reference water common model (2005)

Common Implementation Strategy for the Water Framework Directive (2000/60/EC), *Guidance document no. 9* Implementing the Geographical Information System Elements (GIS) of the Water Framework Directive. URL: http://forum.europa.eu.int/irc/DownLoad/k0eHAOJ_mtGq7VjevHT5SFOiSIQRb4g4lbR-pMbj4IJBTp9eAgHVN0ZTmGzX5L_0FdM3IG6SBcLlBO76jEy4dc/Guidance%20No%209%20-%20GIS%20%28WG%203.1%29.pdf

Guidance document on Reporting under the Water Framework Directive

Stanli (Sweden): SS 63 70 08 Geographic information - Surface water systems - Conceptual model and Application schema

EuroGeographics: EuroRegionalMap Specification and Data Catalogue (v4.0)

EuroGeographics: EuroGlobalMap (v3.1) data specification

DGIWG: Feature and Attribute Coding Catalog (FACC) v2.0
https://www.dgiwg.org/FAD/registers.jsp?register=DFDD

EDMED - European Directory of Marine Environmental Datasets;
http://www.sea-search.net/edmed/welcome.html

Several SDICs/LMOs from EU Member States or Regions have submitted data specifications for topographic datasets that include hydrography. See categorized list of reference material, compiled by JRC, March 2007.

5.9 Protected sites

Definition:

(INSPIRE, 2007) Area designated or managed within a framework of international, Community and Member States' legislation to achieve specific conservation objectives.

Description:

Areas with certain protection targets defined by sectors. Many of the categories refer to conservation of nature, but could also refer to other objectives, e.g. fishing or forest resources, or cultural heritage objects or areas. Nature protection may be linked to certain landscapes, habitats or species. Protected areas may be located in both terrestrial, aquatic or marine environments. Protected sites differs from environmental founded classifications of natural or cultural resources and objects, as localisation, boundary and area of protected sites are based on formal, legal or administrative agreements/decisions.

Scope, use examples:

The theme refers to policies from Community and UN:

- Habitat Directive (1992) (Directive 92/43/EEC)
- Directive 79/409/EEC (Birds).
- World Heritage
- Ramsar Convention
- Barcelona Convention
- Helsinki Convention
- OSPAR Convention
- UN Geoparks

Habitat Directive sites. Sites designated under the Habitat directive (1992) (Directive 92/43/EEC) most sites registered as polygons. Coverage: All EU countries. Requested also by the Water Framework Directive: “areas designated for the protection of habitats or species where the maintenance or improvement of the status of water is an important factor in their protection, including relevant sites designated under Directive 92/43/EEC (habitats).

Birds Directive sites. Sites designated under the bird Directive (1979), most sites registered as polygons. Coverage: All EU countries.
Also requested by WFD: areas designated for the protection of habitats or species where the maintenance or improvement of the status of water is an important factor in their protection, including sites designated under Directive 79/409/EEC (Birds).

Habitat and Birds sites are mostly managed and reported under the Natura 2000 programme.

Other internationally designated sites Internationally designated areas may be found in European and national databases, such as locations for the Ramsar, World Heritage and Biosphere areas. The data may include the following designations: Biogenetic Reserves, European Diploma Biosphere Reserves, World Heritage Sites, Ramsar Convention Sites, Barcelona Convention Sites, Helsinki Convention Sites, OSPAR Convention sites.

Nationally designated sites (CDDA). The European inventory of nationally designated areas (CDDA) holds information about protected sites and about the national legislative instruments, which directly or indirectly create protected areas. The inventory began under the CORINE programme. It is now maintained for EEA by the European Topic Centre on Biological Diversity and is annually updated through EIONET.

Protected cultural heritage – land and sea Inspire definition of protected sites does not exclude man-made objects or other kinds of cultural heritage sites. Therefore areas or objects with formal protection status should be defined. Datasets exist with categories of cultural heritage sites on land territories and at sea. Be aware that objects and areas with formal protection may be only a small portion of a full set of cultural heritage sites, old houses, medival sites/constructions, ship wrecs or other cultural objects. When addressing conservation and management needs of an area, data sets representing both cultural and nature protection values will be relevant. Data about cultural heritage is commonly maintained by cultural heritage authorities.

Protected geological heritage – land and sea. Protected sites with geological, hydrogeological, geomorfological or mining interest with recognised scientific, educational and paisagistic interest.

Important feature types and attributes:

Protected site, area, point, line

- Classification system
- Category
- Id
- Name of area/site
- Description
- Reference to legal foundation/ agreement
- Date of establishment of protected site
- Date of modification of protected site
- Target of protection

Links and overlaps with other themes:

The objects, being administratively defined boundaries, may follow object boundaries in natural (e.g. forest stands) or man-made environments (e.g. roads), property boundaries, administrative boundaries of different kinds, coastline, rivers, thus link and overlap with many themes.

- Administrative units
- Cadastral parcels
- Hydrography - for instance: rivers, lakes, waterfalls can be classified as natural heritage or natural parks
- Elevation - particularly coastline
- Land cover
- Geology
- Land use (as protection often is seen as a kind of land use)
- Area management/restriction, regulation zones and reporting units
- Bio-geographical regions
- Habitats and biotopes
- Mineral Resources

Reference documents:

http://dd.eionet.eu.int/dataset.jsp?mode=view&ds_idf=CDDA

Ioannis Kannellopoulos (Editor, EC-JRC) with the support of GISIG and the contribution of the NATURE-GIS Partners: NATURE - GIS Guidelines: Data Infrastructure for Protected Areas

NATURA 2000: Identification & GIS Classification of Flora Habitants in Significant Reservation Areas: Greece

NATURA 2000: (App. D of) Standard Data Form Natura 2000

Geoparks: (http://www.unesco.org/science/earth/geoparks.shtml

Norwegian feature catalogue, section on cultural heritage and the preservation of natural resources, including UML-model. URL: http://www.statkart.no/sosi/UMLfullmodell/Kulturminner/Kulturminner.htm http://www.statkart.no/sosi/UML/Vern/Vern.htm (Model are in the process of being translated to English.

Several SDICs/LMOs from EU Member States or Regions have submitted data specifications for datasets that include protected sites. See categorized list of reference material, compiled by JRC, March 2007.

6 Annex II Themes

6.1 Elevation

Definition:

(INSPIRE, 2007) Digital elevation models for land, ice and ocean surfaces. Includes terrestrial elevation, bathymetry and shoreline.

Description:

The theme includes:

- Terrestrial elevation, generally represented as
  - the terrain data, ground surface topography, called Digital Terrain Model describing the threedimensional shape of the Earth's surface
  - the surface data, named Digital Elevation Model, including the three dimensional shape of every feature placed on the soil (buildings, bridges, trees, ...).
- Bathymetry, e.g. a gridded bottom model

The height will be according to a common vertical coordinate reference system. The current one is European Vertical Reference System 2000 (EVRS),) but EVRS 2007 is under development and might be taken into account or mentioned (cf. resolutions of the EUREF Symposium in London, 06-09 June 2007)

Scope, use examples:

- Modelling of land slides and avalanches, flooding vulnerability, risk to erosion, flow of water and pollutants, spread of air pollution, fires, noise, and biodiversity.
- Environmental applications
- Water supply
- Energy sector
- Agricultural and forestry
- Safety at sea,
- Location of valuable biodiversity sites in shallow waters,
- Location of sea resources and valuable sites for fish farming
- Understanding of flow pattern and chemical composition in water
- Assessment of location of pipelines at sea
- Production of orthoimagery.

Important feature types and attributes:

Core data :

DEM and/or DTM as regular grid, in different resolutions, for land and sea bottom.
TIN (Triangular Irregular Network)

Additional data:

Contour line and depth contour:

- altitude

Breakline

- category (crest, thalweg, other)

Spot height

- altitude
- category (summit, mountain pass, …)
- name

Sounding

- altitude

High and low water line

Links and overlaps with other themes:

The main relations with other themes are:

- Administrative boundaries: some boundaries may be defined as crests.
- Geographical Names: names of spot heights, e.g. mountain tops
- Hydrography: there is overlap for some features (coastline) and consistencies rules between the two themes, for instance: a river must flow in the thalwegs, a lake or a sea must have the same elevation for all surface points of the water body.
- Buildings, for 3-D models of urban areas

Reference documents:

EuroGeographics: EURODEM

Reference 3D; http//www.spotimage.fr/html/_54_743_773_.php

Several SDICs/LMOs from EU Member States or Regions have submitted data specifications for topographic datasets that include data on elevation. See categorized list of reference material, compiled by JRC, March 2007

6.2 Land cover

Definition:

(INSPIRE, 2007) Physical and biological cover of the earth's surface including artificial surfaces, agricultural areas, forests, (semi-)natural areas, wetlands, water bodies.

Description:

Land cover data is a physical or biological description of the earth surface. In this way it is different from the land use data (Annex III, theme number 4), dedicated to the description of the use of the Earth surface.

Land cover information has to be homogenous and comparable between different locations in Europe, based on the infrastructures for Land Cover information created by the Member States (if existing), and made available and maintained at the most appropriate level.

DG ENV among other DGs, together with 37 participating countries are financing and implementing the European multi-annual land cover database, within the framework of the GMES precursor Fast Track Service on Land Management and as the result of the users' requirements at national and European levels.

Scope, use examples:

Policies from the European Community and UN:

- International Framework Convention on Climate Change (Kyoto protocol)
- Convention on Long-range Transboundary Air Pollution
- European Regional Development Fund
- Water Framework Directive
- Thematic Strategy for Soil Protection
- Convention for Biological Diversity
- Greening the EU Common Agriculture Policy

Use examples by policy framework:

- Regional planning / ESDP, ESPON, Structural funds: assessing impacts of policy against regional development perspectives
- Implementation of Common Agricultural Policy: rural development (less favored areas), statutory management requirements (environment directives: e.g. Nitrate Directive, Habitat Directive; Water Framework Directive), agri-environmental measures
- Environmental policy / Habitat Directive: implementing biodiversity conventions, habitats and protected sites,
- Environmental policy / Water Framework Directive : integrated watershed analysis,
- Environmental policy / Air quality Directives, IPCC, UNFCCC): assessing air emission and air quality measures
- Transport policy / Common transport policy, SEA: strategic environmental assessment of Trans-European transport networks, transport and Environment Reporting Mechanism.

Examples of European/International classification schemes:

- CORINE (Coordination of Information on the Environment)
- LCCS (Land Cover Classification System)

Important feature types and attributes:

Example (based on CORINE, for illustrative purpose only):

- Artificial surfaces
  - Urban fabric
  - Industrial, commercial and transport units
  - Mine, dump and construction sites
  - Artificial, non-agricultural vegetated areas
- Agricultural areas
  - Arable land
  - Permanent crops
  - Pastures
  - Heterogeneous agricultural areas
- Forests
- semi-natural areas
  - Scrub and/or herbaceous vegetation associations
  - Open spaces with little or no vegetation
- Wetlands
  - Inland wetlands
  - Maritime wetlands
- Water bodies
  - Inland waters
  - Marine waters

Important attributes: Area, perimeter, Land cover type.

Links and overlaps with other themes:

A strong link exists with Orthoimagery, which are the major source for information on land cover.

Land cover is related with Land use.

Moreover, strong links exist with other INSPIRE themes that can be considered elements of land cover, such as:

- Transport Networks
- Hydrography
- Buildings
- Production and industrial facilities
- Agricultural and aquaculture facilities
- Oceanographic geographical features

Reference documents:

CORINE Land cover technical guide, 1994, Office for the Official Publications of the European Communities, Luxembourg.

CORINE Land Cover Technical guide, Addendum 2000, Technical Report N)40, Copenhagen, EEA, May 2000

FAO: Land Cover Classification System classification concepts and User Manual

GMES/OCS classification

Herold, Martin et al: International land cover harmonization initiative - GOFC-GOLD report 20. Global Terrestrial Observing System (GTOS) of the United Nations.

Herold, M., Latham, J. S., Di Gregorio, A. & C. C. Schmullius 2006. Evolving standards on land cover characterization, Journal of Land Use Science, 1, 2-4, 157-168.

IMAGE2000 and CLC2000, Products and methods. EUR 21757 EN; ISBN 92-894-9862-5

ISO 19144 “Geographic information - Classification Systems”

Latham, John et al: UN Global land cover network: an international framework for standardized development of land cover data. Global Terrestrial Observing System (GTOS) of the United Nations.

The Landcover Classification System LCCS. http://www.glcn-lccs.org/

Several SDICs/LMOs from EU Member States or Regions have submitted data specifications for datasets that include information on land cover. See categorized list of reference material, compiled by JRC, March 2007

6.3 Orthoimagery

Definition:

(INSPIRE, 2007) Geo-referenced image data of the Earth's surface, from either satellite or airborne sensors.

Description:

An orthoimage is a raster image that has been geometrically corrected ("orthorectified") to remove distortion caused by camera optics, camera tilt, and differences in elevation. Source is either satellite or air-borne sensors. Data is orthorectified to achieve an accuracy commensurate with a given topographic map equivalent.

Scope, use examples:

Airborne or spaceborne orthoimagery can be considered:

- for the for extraction, mapping and updating of specific features on the surface of the Earth(e.g. Transport network, Hydrography, Land cover, Geology)
- for the production of thematic information (e.g. Land use, Production and industrial facilities, Agricultural and aquacultural facilities)
- to provide a synoptic view of a given territory.
- for display as a backdrop to other data

(INSPIRE RDM, 2002)

Other applications include:

- the localisation of other thematic data
- the localisation of earth observation image data itself
- the quick georeferencing and delivery of recently acquired images (dedicated to natural or industrial hazards e.g.) to be co-localised with other thematic interest data (geology, soil, old maps...)
- the continuous updating of rapidly evolving Reference Data layers

Different data already exists or is planned in the near future for pan-Europe, e.g. aerial photos, SPOT, IRS P6 data (for IMAGE2006) and Landsat 7 ETM+ (for IMAGE2000).

Efforts are made at national, European and Global level to implement efficient methods for Earth observation. The '**Global Monitoring for Environment and Security' (GMES)** represents a concerted effort to bring data and information providers together with users, so they can better understand each other and make environmental and security-related information available to the people who need it through enhanced or new services. At the World Summit on Earth Observation in Washington in July 2003, the Group on Earth Observations (GEO) was established, with the goal of addressing the information requirement for the environment on a global scale. This work was completed in Brussels in February 2005 by the adoption of a 10 year implementation plan of an integrated **Global Earth Observation System of Systems (GEOSS)**.

Important feature types and attributes:

Usually, orthoimages are represented by a discrete rectified grid coverage. The coverage contains a set of values, i.e. the radiometric characteristic.

Overlaps and links with other themes:

- Elevation, because DEM is required for ortho-rectification
- Orthomages relate with many other themes in INSPIRE, as information can be extracted from orthoimages through computer analysis or visual interpretation

Reference documents:

IMAGE2000 and CLC2000, Products and methods EUR 21757 EN; ISBN 92-894-9862-5

Kay, S. et al, 2003: Guidelines for best practices and quality checking of ortho-imagery, JRC, Ispra

Institut Géographique National (France): BD Ortho version 2 descriptif de contenu

Institut Géographique National (France): Spécification de la composante orthophotographique du RGE

EuroGeographics: Report on Reference Data Sets and Feature types in Europe.

Agriculture and Fisheries Unit, JRC of the EC: Guidelines for Best Practice and Quality Checking of Ortho Imagery v2.5

Norwegian feature catalogue: http://www.statkart.no/sosi/UMLfullmodell/FotoOgBilde/FotoOgBilde.htm The model is in the process of being translated to English and will be available autumn 2007

6.4 Geology

Definition:

(INSPIRE, 2007) Geology characterised according to composition and structure. Includes bedrock, aquifers and geomorphology.

Description:

Geological information provides basic knowledge about the physical and chemical composition and the genesis of the underground, in particular on the properties of the rocks and sediments (age, petrography, genesis and tectonic elements, ...) and their structure.
NOTE: Experts from EuroGeosurveys will provide an improved version of the Description for the theme 'Geology' in 2008.

Scope, use examples:

Geological information, on-shore and off-shore, is the basis to locate distribution of natural resources such as ores, groundwater, oil, industrial minerals, aggregate materials and building stones. They may, albeit indirectly, warn about the danger of natural hazards, climatic change or supply information about suitable sites for land-fill, house-building or enhance aspects of tourism. They thus provide the basis for environmental planning and protection and support public-policy decision making. Thus, Geological data are the basis for understanding the earth and its processes.

Thus, geological Data are used in:

- Detecting geo-hazards,
- Locating natural mineral resources (oil, gas, gas hydrates, coal, ore, e.g. iron, copper or aluminium, sand, gravel, limestone etc.)
- Locating groundwater resources for drinking water supply
- Aid in depicting indicators for climatic change
- Aid in protecting ground water
- Ensuring the security of constructing buildings and infrastructures
- Ensuring the safe disposal of wastes
- Ensuring the safe construction of buildings and infrastructure
- Support for public decisions
- Providing crucial information for environmental planning
- Adding value to tourism information
- Providing crucial information for the interpretation of geophysical and geochemical data

Important feature types and attributes:

- Age (from ... to ... , as geological formations ages represent time spans rather than absolute times and name of periods)
- Rock type
    - Sedimentary Rocks
    - Igneous rocks
    - Metamorphic rocks
    - Anthropogenic deposits
    - Regolith (unconsolidated superficial formations, fractured/ weathered bedrock)
- Genetic aspects
- Tectonic aspects
- Regional names
- Metamorphism

Hydrogeological parameters of individual rock formations:

- aquifer type:
    - porous aquifers
    - fissured aquifers
    - karstic aquifers
- groundwater qualitative parameters
- groundwater quantitative parameters
- dynamic parameters (recharge/ discharge rates, groundwater flow rate and direction)
- aquifer vulnerability
- depth of the bedrock

- Geomorphological features (incl. sedimentation/erosion rates in coastal areas)

Overlaps and links with other themes:

The main relations with other themes:

- Soil
- Land use
- Hydrography
- Protected sites
- Area management/restriction/regulation zones & reporting units
- Natural risk zones
- Oceanographic geographical features
- Bio-geographical regions
- Habitats and biotopes
- Energy resources,
- Mineral resources,
- Environmental monitoring facilities,
- Sea regions

Groundwater held in aquifers is controlled by the physical properties and structure of the aquifer and its adjacent rocks. Groundwater is considered by geologists as a natural resource and it is thus an integral part of Geology.

Reference documents:

Asch, K. (2003): The 1: 5 Million International Geological Map of Europe and Adjacent Areas: Development and Implementation of a GIS-enabled Concept; Geologisches Jahrbuch; SA 3, BGR, Hannover (ed.); Schweitzerbart (Stuttgart), 190 p., 45 fig., 46 tab.

Asch, K. (2005): The 1: 5 Million International Geological Map of Europe and Adjacent Areas. Map. (BGR) Hannover.

BGR & UNESCO (1974 – ongoing): The 1 : 1.5 Million Internationale Hydrogeological Map of Europe (in 25 map sheets). BGR (Hannover)

Gilbrich, W.H. (2000): Internatioanle Hydrogeological Map of Europe. – Feature Article. Waterway No. 19 (Paris), 11 pp., 1 fig. 1 tab.;

Gillbrich, W.H., Krampe, K. & Winter, P. (2001): Internatioanle Hydrogeologischen Karte von Europa, 1 : 1 500 000. Bemerkungen zum Inhalt und Satnd der Bearbeitung.- Hydrologie und Wasserbewirtschaftung, 45, H.3, BFG (Koblenz) pp 122 – 125

Gradstein, F.M., Ogg, J.G., and Smith, A.G., Agterberg, F.P., Bleeker, W., Cooper, R.A., Davydov, V., Gibbard, P., Hinnov, L.A., House, M.R., Lourens, L., Luterbacher, H.P., McArthur, J., Melchin, M.J., Robb, L.J., Shergold, J., Villeneuve, M., Wardlaw, B.R., Ali, J., Brinkhuis, H., Hilgen, F.J., Hooker, J., Howarth, R.J., Knoll, A.H., Laskar, J., Monechi, S., Plumb, K.A., Powell, J., Raffi, I., Röhl, U., Sadler, P., Sanfilippo, A., Schmitz, B., Shackleton, N.J., Shields, G.A., Strauss, H., Van Dam, J., van Kolfschoten, T., Veizer, J., and Wilson, D., 2004. A Geologic Time Scale 2004. Cambridge University Press (Cambridge), p 589

International Commission on Stratigraphy (2006): International Stratigraphic Chart. http://www.stratigraphy.org/cheu.pdf

IUGS-SCMR ; 2004; Subcommission on the Systematics an Nomenclature of Metamorphic Rocks

Le Maitre, R W Streckeisen, A and 13 others. (2002) Igneous Rocks: A classification and glossary of terms. Recommendations of the International Subcommission on the systematics of igneous rocks. Cambridge University Press 2nd Edition 236 pp.

Streckeisen, A. L. (1976): To each plutonic rock its proper name.- Earth Sci. Rev., 12: 1-34.

Streckeisen, A. L. (1978): Classification and Nomenclature of Volcanic Rocks, Lamprophyres, Carbonitites and Melilitic Rocks.- IUGS Subcommission on the Systematics of Igneous Rocks. N. Jb. Miner. Abh., 141: 1-14.

Voges, A. et al. (1993): Geologische Karte der Bundesrepublik Deutschland. *(Map and GIS),* BGR (Hannover).

Suggested links:

The just started OneGeology project that will globally make available cross-boundary geological information at a 1 : 1 Million scale: www.\\onegeology.org

The Geological Survey of the Netherlands and Alterra, the Soil institute of the Netherlands, Integrated soil and geology information model:
http://dinolks04.nitg.tno.nl/dinoLks/lookAndFeelIMBOD/index.html
http://dinolks01.nitg.tno.nl/dinoLks/about/dataTypes/dataTypes.jsp

The Norwegian feature catalogue including a UML application schema for different types of geology, based upon Norwegian user requirements (as soon as links are available)
(links did not work as accessed 2007-11-19):
http://www.statkart.no/sosi/UMLfullmodell/GeologiGenerellDel.htm,
http://www.statkart.no/sosi/UMLfullmodell/Losmasse/Losmasse.htm,
http://www.statkart.no/sosi/UMLfullmodell/Rastoff/Rastoff.htm,
http://www.statkart.no/sosi/UMLfullmodell/Gfys/Gfys.htm,
http://www.statkart.no/sosi/UMLfullmodell/Gkjem/Gkjem.htm,
http://www.statkart.no/sosi/UMLfullmodell/Grotter/Grotter.htm
The models are in the process of being translated to English and will be available autumn 2007)

Shell Standard Legend
http://www.energistics.org/images/posc/esrc/Geology/esrc_geology_lithology_shell95.pdf

Shell GeophysicalML
http://www.energistics.org/posc/Geophysical__Reservoir_Standards.asp?SnID=1369808806

Projects executed by the European geological community that strive for cross-border access to and application of geological data
http://www.eEarth.eu
http://www.eWater.eu,
http://www.geomind.eu

http://www.posc.org/rescue/#FtPrnt

WITSML Version 1.3.1
WITSML (Geology) wellLog http://www.witsml.org/

From the reference material submitted by SDICs and LMOs, the following may be relevant to this theme:

Norwegian feature catalogue and standards

Geological knowledge and digital geologic mapping: hints derived from CARG activity (reference document submitted by MAGGIS)

Ministery of the Flemish Community - Natural Resources and Energy Devision, Water Devision, Geotechnics Devision: A view to subsoil of Flanders - http://dov.vlaanderen.be

UKHO/Ordnance Survey/ British Geological Survey: ICZMap - Data Research Project

7 Annex III Themes

7.1 Statistical units

Definition:

(INSPIRE, 2007) Units for dissemination or use of statistical information.

Description:

The theme statistical units must be seen as one of several thematic groups of administrative units, but may also include other area units (e.g. grids or watersheds) or points in point-based statistics (e.g. statistics on address level). The IMS paper (INSPIRE IMS, 2003) describes the following sub-grouping of administrative units

- official administrative units
- government management zones
- blocks, census and statistical districts
- civil security units
- environmental reporting and management units
- postal codes/ regions

Units for dissemination of statistical information can be viewed as spatial units; areas, lines or point objects used in reporting of information, in geographical analysis and in distribution systems for environmental and socio-economic information. "Use" can be interpreted as something else than "dissemination", as the words is connected with the word "or". The use may represent any use in the full cycle of establishment, aggregation, assessment and display of "statistical information". Statistical information can be defined as "any numerical representation of a phenomenon".

Scope, use examples:

Users of statistics express an increasing need for harmonisation in order to have comparable data across the European Union. In order to function, the internal market requires statistical standards applicable to the collection, transmission and publication of national and Community statistics so that all operators in the single market can be provided with comparable statistical data. In this context, classifications are an important tool for the collection, compilation and dissemination of comparable statistics. Regional statistics are a cornerstone of the European Statistical System. For many years European regional statistics have been collected, compiled and disseminated on the basis of a common regional classification, called ‘Nomenclature of territorial units for Statistics’ (NUTS). Clear rules for this classification system have been fixed in a legal framework (Regulation (EC) No 1059/2003). The NUTS classification serves as a harmonised system for applications at European and regional level, while it does not preclude the existence of other subdivisions and classifications.

The Nomenclature of Territorial Units for Statistics (NUTS) was established by the European Office for Statistics (EuroStat) in order to provide a single uniform breakdown of territorial units for the production of regional statistics for the European Union. NUTS excludes specific territorial units and local units in favour of regional units of a general nature. At a more detailed level, there are the districts and municipalities. These are called Local Administrative Units (LAU) and are not subject of the NUTS Regulation. At the top of the hierarchy are the individual member states of the EU, below that are NUTS levels 1 to 3, then LAU levels 1 and 2. NUTS regions do not necessarily match with the national administrative units.

There is a long tradition in collecting demographic and economic/activity statistics. All geographical levels are interesting, including municipal and intra-municipal levels. It is common to have statistics with geographical breakdown on country level, regional/ county level and municipal level. In some countries we also find information on census districts. The last decades some statistical offices have started producing demographic and socio-economic statistics in urban and rural areas with a reference to blocks of houses and to process this data within a GIS. In some countries, the methodology chosen refers to aggregation of point-based statistical information (address/households) on a grid (e.g. 1x1 km or 0.1x0.1 km).

Needed within local to national governments, settlement, urban and regional development, health and education planning, school enrolment planning, risks assessment. Of major importance to integrated analysis for sectors and regions. Necessary as geographical features also in environmental and social assessments, e.g. on estimates on exposure to pressures and on availability of services.

The present focus on eGovernment systems within all sectors and the general rapid changes towards including a spatial dimension in management activities and planning will mean that both points, areas and boundaries of different kind of regions become important, as there is an interest in almost any sector to aggregate information.

Statistical units can be used for collecting data (mostly spatial data at larger scales) as well as for aggregating or presenting data (at different scales for different purposes, for instance: at different statistical NUTS levels). Likewise administrative units the statistical units can be used to geo-reference data from different statistical fields, like demography and social statistics, economy, environment and natural resources.

Important feature types and attributes:

The definition in the Directive specifies the kinds of features relevant to demography: The definition includes the term "aggregated". Probably information in this theme does not refer to address level information, but aggregations presented as point based location may be relevant, e.g. of production activities in cities. Underneath is given examples of features. The most needed attribute is the unique ID, as this can be used for connecting attribute information. No thematic information should be part of data in this "statistical unit" theme.

administrative unit, e.g. from LAU2 level.

- Id

census districts

- Id

small area statistics "free" regionalisation

- Id

settlement – small settlement, village, block, township, town, city

- Id

Can also give population figures at other regional aggregations, e.g. on water catchment level, being done in assessments being part of WFD work.

Links and overlaps with other themes:

The datasets addressed in this theme may also be covered in other themes, either as overlapping geometry/ objects, or as a needed geometry for thematic presentations. Statistical units can be used as a basis for aggregation and presentation of choroplet maps for nearly any theme or sector-specific issue. The links given emphasis here are the most important ones linked mainly to the geometry of the statistical

units.

- Administrative units; closely linked to this theme, as both are kinds of a broader package of administratively defined boundaries and regions. Statistical units may be composed of, or coincide with administrative units. According to the NUTS regulation, the overlap with administrative units is on purpose, and meant to distinguish zones where coherent decision power enables one to elaborate policies.

- Population distribution/demography; the theme also includes similar geographical objects as the theme "statistical units", however the demography theme also include a multitude of thematic attribute information, this is absent in the "statistical unit" theme. One could say that the demography theme for some kinds of information and aggregation borrow/is based on object types from the "statistical unit" and "administrative unit" themes.

- Area management/restriction/regulation zones and reporting units. These can be sector specific and certain management zones. These include major common operational spatial units such as fire, police, ambulance, coastguard etc. Of very high value both in the sectors own operations and in cross-sector emergency operations, e.g. at occasions of natural and technological hazards, accidents where health, economy or ecology is affected. Such sector/management zones are commonly used as a basis for aggregation of economic, production or services information, could also be health information or other socio-economic information. Usually not used for biological information. The theme could overlap with "statistical unit", and the boundary between them should be clarified. Probably the statistical unit system should be defined only to include units/ systems made for a multipurpose use/ to be non-sector specific statistical unit system.

- Geographical grids: In many cases the geographical grid systems and grid cells functions as statistical units as statistical information is aggregated/displayed cell by cell, however as these are defined in a separate theme, they should not be included in the theme "statistical units".

- Human health and safety, the theme "statistical units" could be a basis component for aggregation and presentation of health related information.

Reference documents:

CSI-Piemonte: Descrizione della struttura del DB dello Stradario Unico della Regione Piemonte

International agreements on reporting of socio-economic statistics

Norwegian feature catalogue including a UML application schema for administrative and statistical units. URL: http://www.statkart.no/sosi/UMLfullmodell/ABAS/abas.htm The model will be available in english spring 2008.

Open Geospatial Consortium: Candidate OpenGIS® CityGML Implementation Specification (City Geography Markup Language), OGC document no. 07-062", "International Alliance for Interoperability (IAI): Industy Foundation Classes 2x3

Regional statistics at EuroStat (NUTS regions, GISCO database)

Regulation (EC) No 1059/2003 of the European Parliament and of the Council of 16 May 2003 on the establishment of a common classification system of territorial units for statistics (NUTS), OJ L 154, 21.06.2003, p.1

SIGMA-TER project (Italy): DBTI (DataBase Territoriale Integrato): modello dati.

Tandem project reports

7.2 Buildings

Definition:

(INSPIRE, 2007) Geographical location of buildings.

Description:

A building is a covered facility, usable for the protection of humans, animals, things or the production of economic goods. A building refers to any structure permanently constructed or erected on its site.
Information on location of buildings may be supplied as points or with the actual basic form of the building.

Usually buildings are part of cadastre. On the local level buildings are available within the large scale cadastral maps or cadastral data sets and are geometrically represented as surfaces

Most buildings can be identified (geocoded) by address (separate theme in INSPIRE).

Scope, use examples:

- Local planning and management
- Emergency and rescue operations
- Property agents
- Construction sector
- Taxation
- Environment (noise level, protection of cultural heritage sites, …)
- Census, statistics

Important feature types and attributes:

The feature type 'Building' may be described with:

- condition of facility (ruin, under construction, functional)
- function: industrial, commercial, agricultural, ….
- Height and/or number of floors
- size

and for specific buildings :

- nature (school, museum, church, hospital, …)
- name

Links and overlaps with other themes:

A strong link exists with:,

- Addresses
- Cadastral parcels

Buildings relate with themes :

- Land cover
- Land use
  - Utility and government services
  - Production and industrial facilities
  - Agricultural and aquaculture facilities.

Reference documents:

GiMoDig: Report on Global Schema

EuroGeographics: Report on Reference Data Sets and Feature types in Europe.

EuroGeographics: EuroRegionalMap (v4.0) data specification.

Several SDICs/LMOs from EU Member States or Regions have submitted data specifications for topographic or cadastral datasets that include data on buildings. See categorized list of reference material, compiled by JRC, March 2007

7.3 Soil

Definition:

(INSPIRE, 2007) 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.

Description:

The proposed Soil Framework Directive (COM(2006) 232 final), which aims at the establishment of a framework for the protection of soil, specifies in *Article 1* that soil is "the top layer of the earth's crust situated between the bedrock and the surface, excluding groundwater as defined in Article 2(2) of Directive 2000/60/EC of the European Parliament and of the Council". In the Communication from the Commission regarding the Thematic Strategy for Soil Protection (COM(2006)231 final), it is mentioned that "soil is generally defined as the top layer of the earth's crust, formed by mineral particles, organic matter, water, air and living organisms. It is the interface between earth, air and water and hosts most of the biosphere".

As soil formation is an extremely slow process, soil can be considered essentially as a non-renewable resource. Soil provides us with food, biomass and raw materials. It serves as a platform for human activities and landscape and as an archive of heritage and plays a central role as a habitat and gene pool. It stores, filters and transforms many substances, including water, nutrients and carbon. In fact, it is the biggest carbon store in the world. These functions must be protected because of both their socio-economic and environmental importance.

Soil is an extremely complex and variable medium. Over 320 major soil types have been identified in Europe and within each there are enormous variations in physical, chemical and biological properties. Soil's structure plays a major role in determining its ability to perform its functions. Any damage to its structure also damages other environmental media and ecosystems.

Soil is subject to a series of degradation processes or threats. These include erosion, decline in organic matter, local and diffuse contamination, sealing, compaction, decline in biodiversity, salinisation, floods and landslides. A combination of some of these threats can ultimately lead arid or sub-arid climatic conditions to desertification."

Typically, **soil** is **characterized** on the basis of soil profile descriptions, analysed by taking samples from genetic horizons or depth classes, and classified according to national or international nomenclature. Soil maps contain the borders of typical combinations of soil development factors of the target mapping scale. There is no internationally defined aggregation scheme between the various map scales.

The collection of soil information can be broadly classified into three categories:

a) **Soil mapping**, enabling to identify areas of land for management purposes.
b) **Soil inventories**, providing a one-off assessment of soil conditions and/or properties at a point in time, and **soil monitoring**, providing a series of assessments showing how soil conditions and/or properties change over time.
c) **Soil thematic mapping**

(a) Soil maps

The general aim of soil mapping is to provide a spatial representation and description of the soils of continents, countries, regions, farms, or any area of land of interest. It involves identifying the different types of soils that occur, collecting data on their nature, properties and potential use, and recording this information on maps and in geographic information systems and derived media.

(b) Soil inventories and soil monitoring

Soil inventories (predominantly based on “soil profiles”) provide information on the soil condition. It can be introduced to soil maps as attribute (semantic) data describing soil properties. Soil monitoring in national or Europe-wide grid systems, or in stratified sampling regimes, is designed to provide information about how soils are changing with time (see also INSPIRE Theme ‘Environmental Monitoring Facilities’). Geochemical surveys also gather soil information and are specifically targeted to provide information on natural background values and on overimposed anthropic pollution.

(c) Thematic data/risk maps in soil protection and environmental reporting
The general adoption of GIS technology and the creation of databases of georeferenced soil information have allowed a number of new types of assessments producing more policy relevant information than the basic soil maps. For example, modelling approaches using the existing soil inventories allow deriving information like soil erosion risk, organic matter content, diffuse contamination, soil compaction, salinisation, etc.

Scope, use examples:

Soil maps: soil maps have been prepared for regional and national environmental assessment and reporting in **overview scales**, involving the scales 1:5,000,000 (Europe), 1:1,000,000 (Europe, countries), and 1:250,000 (countries, regions). On the basis of the work conducted by the European Soil Bureau Network (ESBN), the soil classification has been agreed to be the World Reference Base for Soil Resources (WRB) (FAO 2006). All three scales are used within the context of the European Soil Information System (EUSIS). Manuals have been developed by the European Soil Bureau Network to improve harmonized soil mapping in overview scales (Finke et al. 2001; Lambert et al. 2001).

In contrast to overview scales, **basic soil data/soil maps** are available throughout Europe (countries, regions) at different larger scales (scale > 1:50,000) and are using different classification systems, mapping reference dates, and map legends. They are the results of extensive national and regional soil surveys performed in the past 50 years, mostly for agricultural purposes (see also Jones et al. 2005). In order to facilitate comparability of these data, harmonization methods are needed which refer national nomenclatures to WRB (FAO 2006a, b).

Soil monitoring: There are only few examples in Europe at national or regional level of fully operational soil monitoring systems. Many of the national systems have performed only one observation in time, and therefore cannot be considered as fully operational systems. Van-Camp et al. (2004) conclude that a minimum set of common parameters to be monitored by the existing soil monitoring systems at national level still need to be selected. The same holds true for standardised methods and procedures. More information can be received in the review of existing soil monitoring systems by Huber et al. (2001), updated but unpublished by EEA/ETC-TE (2003). A recent update on existing soil monitoring schemes is found in Morvan et al. (2007, submitted). The FP6 ENVASSO project (www.envasso.com) develops an extensive manual with Procedures and Protocols for soil monitoring in Europe, to be available by the beginning of 2008.

For Europe as a whole, two main soil inventory activities are established: (1) the Geochemical Atlas of Europe provides information about the regional pattern and background values for 60 elements in the topsoil (Salminen et al. 2006). (2) The forest soil condition monitoring, conducted by the ICP Forests network (16x16 km grid; 1990-1995; see also Vanmechelen et al. 1995) has recently been repeated in the frame of the Forest Focus demonstration project BioSoil.
Thematic data: In order to facilitate the application of the soil data (i.e. to estimate integrative parameters difficult to measure, and to estimate the susceptibility of the soil to pressures), the European Soil Bureau Network (ESBN) developed a set of pedotransfer rules, available as a separate method compilation which comes with the 1:1,000,000 European Soil Database (Van Ranst et al. 1995; ESBN 1998). At national level, such rules and functions also exist, the most comprehensive compilation is found in Ad-hoc-AG Boden (2000).

Important feature types and attributes:

The basic scheme for soil data relies on soil profiles or soil cores. Depending on the respective soil nomenclature, macro-morphological characteristics of soil profiles or soil cores are described. Samples are taken for genetic horizons or depth classes, and analysed for soil chemical, soil biological and soil physical properties. Using this information, soil is classified in order to compare and describe different sites. The type of data in soil data bases varies greatly, between soil maps and resolutions, and between projects. As an example, within the Soil Geographical Data Base for Europe 1:1,000,000, soil information is provided for soil typological units (STU). At this geographical representation, it is technically not feasible to delineate each STU. Therefore STU's are grouped into Soil Mapping Units (SMU) to form soil associations. The criteria for soil groupings and SMU delineation have taken into account the functioning of pedological systems within the landscape. STU's characterize distinct soil types that have been identified and described by attributes (variables) specifying the nature and properties of the soils, for example the texture, the moisture regime, the stoniness, etc.

The mapping concept at a scale of 1:250,000 (as described in the Manual of Procedures, Finke et al. 2001) is slightly different in nature and distinguishes soil bodies and soilscapes. A soil body represents a portion of land with imprecisely known geographical limits. It describes a three-dimensional entity in a soil continuum using the WRB soil classification (FAO 1998), parent material, depth to obstacle for roots and dominant surface texture. Similar to the STU, the soil body thus contains the relevant attributes describing the soil. The soilscape is delineated at the 1:250,000 scale and groups the soil bodies.

The European Soil Regions Map 1:5,000,000 represents the regionally restricted part of the soil cover characterized by climate type and parent material (Finke et al. 2001).

Examples for feature types and attributes in European soil maps:

Soil Geographical Data Base for Europe 1:250,000	soil body soilscape	- soil attributes for genetic horizons of one or more **soil profiles** characterizing a soil body - dominant soil - major landform - regional slope - relief intensity - wetness index - dominant land use, etc.
Soil Geographical Data Base for Europe 1:1,000,000	soil mapping unit (SMU) and soil typological unit (STU)	- dominant soil - co-dominant soil - limitation to agricultural use - soil code - presence of an impermeable layer - dominant parent material - obstacle to roots - slope class - textural change - textural class - land use - presence, type of an existing water management system - soil water regime class - elevation above sea level, etc.

In addition, each mapping unit can be described based on additional soil properties received from described and/or analyzed soil profiles for the dominating and/or associated soil types.

Perspective for the collection and harmonzation of soil data at European level: the GRID approach:

The European Soil Database (ESDB), covering EU-25 has been developed jointly with European partners and is the only harmonized coverage of digital soil information for Europe. It is the result of a complex and time-consuming undertaking, due to the vast heterogeneity of soil data in countries. In the light of updates to such a database and of collecting data in relation to the upcoming Soil Framework Directive, simplification is needed through a more suitable technical framework. One idea is to conduct reporting of soil data on the basis of a hierarchical system of grids (or rasters) with a common point of origin and a standardized location and size of grid cells. This system constitutes a suitable framework for the building of a nested European system of soil data and facilitates interoperability through a common coordinate reference system, a unique grid coding system, a set of detailed and standardized metadata and an exchangeable and open format. It will lay the basis for a multi-scale European Soil Information System (MEUSIS), a system whereby soil data produced at a certain scale can easily be integrated or compared with soil data produced at another scale, provided that the rules for representation of the data are equal at all scales. In order to achieve this, a common standard for the collection of harmonized soil information is going to be developed and implemented. It should be stressed that, in order to provide soil data in grid format, country data providers most likely will need to process their original soil data, held in traditional vector-based soil databases, in order to fit a grid. The final result of MEUSIS developments will be the existence of a harmonized soil information system for Europe which will streamline better the flow of information from the data producer at a local or regional scale to the data users at higher scales (National, European and Global scales).

Overlaps and links with other themes

- Protected sites; area management/restriction/regulation zones and reporting units; habitats and biotopes; species distribution:
  soil conditions can be indirect delineation criteria (wet soils in combination with a specific vegetation type; soil conditions affecting historic land use, etc.)
- Elevation: important factor to soil formation
- Land cover, Land use, agricultural and aquacultural facilities: anthropogenic factors affecting the soil condition
- Geology: parent material is major soil forming factor; with regard to hydrogeology, soil physical characteristics control seepage water and run-off
- Environmental monitoring facilities: soil monitoring systems
- Natural risk zones: relevant in soil protection policies (landslides, floods); can cause important soil loss; soil condition (e.g. clay content) affects the susceptibility and severity of degradative processes
- Atmospheric conditions; meteorological geographical features: important site factor; controls soil processes
- Bio-geographical regions: regional stratification of soil forming conditions; used in soil mapping and soil information application

Reference documents:

Soil Data Specification and manuals

ESBN [European Soil Bureau, Scientific Committee] (1998). Georeferenced Soil Database for Europe: Manual of Procedures Version 1.0. EUR 18092 EN 184pp. (1998). Office for Official Publications of the European Communities, Luxembourg.

Finke, P., R. Hartwich, R. Dudal, J. Ibàñez, M. Jamagne, D. King, L. Montanarella and N. Yassoglou (2001) Georeferenced Soil Database for Europe: Manual of Procedures Version 1.1. European Soil Bureau, Scientific Committee. EUR 18092 EN 184 pp. Office for Official Publications of the European Communities, Luxembourg.

FSEP [Forest Soil Expert Panel] and FSCC [Forest Soil Coordinating Centre] (2003). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests. Part IIIa - Sampling and Analysis of soil. Upgrade of the 4th edition of the ICP Forests manual. Version 4.0. UN/ECE Convention on Long-Range Transboundary Air Pollution Effects on Forests. Ghent, 2003.

Lambert, J.J., J. Daroussin, M. Eimberck, M. Jamagne, D. King and C. Le Bas (2001). Instructions Guide for the elaboration of the soil geographical database of Eurasia and Mediterranean countries at 1:1 million scale, Version 4.0. Office of the Official Publications of the European Communities, EUR 20422 EN, Luxembourg.

UN/ECE ICP Forests (1994). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests. Hamburg, Prague, 1994.

Norwegian feature catalogue including a UML application schema for addresses (in the process of being translated to English):
http://www.statkart.no/sosi/UMLfullmodell/Jordsmonn/Jordsmonn.htm

Soil Classification (international)

FAO (1998): World Reference Base for Soil Resources. – World Soil Resources Reports 84, ISSN 0532-0488, 88 p., Food and Agriculture Organization of the United Nations, Rome, 1998.

FAO (Food and Agriculture Organization of the United Nations) (2006a): World reference base for soil resources 2006 - A framework for international classification, correlation and communication. World Soil Resources Reports 103. Food and Agriculture Organization of the United Nations, Rome, 2006.

FAO (Food and Agriculture Organization of the United Nations) (2006b): Guidelines for soil description, 4th ed. Rome.

Relevant reviews at European level:

Dobos, E., F. Carré, T. Hengl, H.I. Reuter and G. Toth (2006). Digital soil mapping as a support to the production of functional maps. European Soil Bureau Network: Digital Soil Mapping Working Group. EUR 22123 EN (2005). 68 pp. Office for Official Publications of the European Communities, Luxembourg.

Eckelmann, W., R. Baritz, S. Bialousz, F. Carre, B. Jones, M. Kibblewhite, J. Kozak, C. Le Bas, G. Toth, G. Varallyay, M. Yli Halla and M. Zupan (2005). Common Criteria for Risk Area Identification according to Soil Threats. Soil Information Working Group (SIWG) European Soil Bureau Network (ESBN). EUR 22185 EN, Office for Official Publications of the European Communities, Luxembourg.

Ad-hoc-AG Boden (coordination V. Hennings, 2000). Methodendokumentation Bodenkunde. Auswertungsmethoden zur Beurteilung der Empfindlichkeit und Belastbarkeit von Böden. - 2. Aufl., Geologisches Jahrbuch, SG 1; Hannover. [*Method documentation soil science: evaluation methods to assess the vulnerability and stress resistance of soils]*

Huber, S., A. Freudenschuss, and U. Staerk (2001). European Soil Monitoring and Assessment Framework. EIONET workshop proceedings. EEA Technical Report 67 (2001). 52 pp. European Environment Agency, Kopenhagen.

Jones, R.J.A., Houskova, B., Montanarella, L. and P. Bullock (2005). Soil Resources of Europe: including Neighbouring Countries. European Soil Bureau Research Report No. 9, EUR 20559 EN (2005). 350 pp. Office for Official Publications of the European Communities, Luxembourg.

Morvan, X., N.P.A. Saby, D. Arrouays, C. Le Bas, R.J.A. Jones, F.G.A. Verheijen, P.H. Bellamy, M. Stephens and M.G. Kibblewhite (2007, submitted). Soil monitoring in Europe: a review of

existing systems and requirements of harmonization. Science of the Total Environment (2007, submitted).

Salminen R. et al. (2006). Geochemical Atlas of Europe (edited and printed by the Geological Survey of Finland). http://www.gtk.fi/publ/foregsatlas/.

Van-Camp, L., B. Bujarrabal, A.R. Gentile, R.J.A. Jones, L. Montanarella and C. Olazabal (2004). Reports of the technical working groups established under the soil thematic strategy for soil protection Volume 5 Monitoring. EUR 21319 EN/5. Luxembourg: Office for Official Publications of the European Communities.

Vanmechelen, L., Groenemans, R. and E. van Ranst (eds) (1997). Forest Soil Condition in Europe - Results of a Large-Scale Soil Survey. – Forest Soil Co-ordinating Centre, University of Gent, EC - UN/ECE, Brussels, Geneva.

Van Ranst, E., L. Vanmechelen, A.J. Thomasson, J. Daroussin, J.M. Hollis, R.J.A. Jones, M. Jamagne and D. King. 1995. Elaboration of an extended knowledge database to interpret the 1:1,000,000 EU soil map for environmental purposes. In: King, D., R.J.A. Jones and A.J. Thomasson (eds.). European land information systems for agro-environmental monitoring, pp. 71-84. Office for Official Publications of the European Communities, Luxembourg.

Soil Information Systems:

European Soil Information System (EUSIS), a framework for the integration of European soil data at various scales (for more information see documents at eusoils.jrc.it)

Soil Resources of Europe, Second edition, R.J.A. Jones, B. Houskova, P. Bullock and L. Montanarella. EUR 20559 EN (2005).

Baritz, R. and E. Eberhardt (2007). Data base design and selection. FP6-Environmental Assessment of Soils for Monitoring (ENVASSO). Contract No. 022713. Final report. Hannover, 2007 (submitted). www.envasso.com

Heineke H.J., W. Eckelmann, A.J. Thomasson, R.J.A. Jones, L. Montanarella and B. Buckley (eds.) (1998). Land Information Systems: Developments for planning the sustainable use of land resources. EUR 17729 EN. 546 pp. Office for Official Publications of the European Communities, Luxembourg.

King D., R.J.A. Jones and A.J. Thomasson (eds.) (1995). European Land Information Systems for Agro-environmental Monitoring. EUR 16232 EN. 284 pp. Office for the Official Publications of the European Communities, Luxembourg.

Examples for fully operational national soil information systems:

Austrian Soil Information System (BORIS):
http://www.umweltbundesamt.at/umweltschutz/boden/boris/

French national soil information system (DONESOL): http://gissol.fr/programme/programmes.php

Sectoral soil information system of the BGR (FISBo BGR):
http://www.bgr.bund.de/cln_030/nn_454934/DE/Themen/Boden/boden__node.html__nnn=true

Land information system (LandIS):
http://www.silsoe.cranfield.ac.uk/nsri/services/cf/gateway/ooi/intro.cfm .

From the reference material submitted by SDICs and LMOs, the following may be relevant to this theme:

Ad-hoc-AG Boden (2005). Bodenkundliche Kartieranleitung [*German soil mapping guide*]. 5. edition, 438 p., E. Schweizerbart'sche Verlagsbuchhandlung, Stuffgart. 2005.

Regione Emilia-Romagna: Capitolato tecnico – Realizzazione della terza edizione della carta e del database dell'uso del suolo della Regione Emilia-Romagna

Statkart Norway: http://www.statkart.no/sosi/UMLfullmodell/Jordsmonn/Jordsmonn.htm (feature catalogue including a UML application schema for soil. The model is based upon Norwegian user requirements)

SIKP, The Netherlands: http://www.sikb.nl/ (SIKB-protocol 0101, version 5.0.0 for the digital exchange of soil data)

Other:

ISO TC 190 (Soil Quality), SC 1 (Evaluation Criteria, Terminology and Codification), WG 3 (Data codification and management). Work Item N 12 (Recording and exchange of soil related data) [*ongoing*].

7.4 Land use

Definition:

(INSPIRE, 2007) Territory characterised according to its current and future planned functional dimension or socio–economic purpose (e.g. residential, industrial, commercial, agricultural, forestry, recreational).

Description:

Land regulation is the general spatial planning tool at regional and local levels. Land use may be characterised as ordinary mapping of existing functions as an objective picture of the use and functions of a territory, but may also be plans characterising how land may be utilised at present and in the future.

There are two main land use definitions, a **functional** one and **sequential** one (Duhamel, 1998). The first of them defines land use as *the description of land in terms or its socio-economic purpose (agricultural, residential, forestry etc.)*. The second one describes land use as *a series of operations on land, carried out by humans, with the intention to obtain products and/or benefits through using land resources.*

Land use plans/ land user regulation

The land use plans regulate actual and future use of areas. The land use plans commonly have significant textual regulations to each area/ land category or specific areas. The land use plans are of varying detail; Municipal land use plans, detailed regulation plans for blocks or smaller areas within urban areas.

- Land use may be seen as divisions at a high level, e.g. distinguishing between private and state owned land. , e.g. at scale 1: 1 mill.
- Land use plans is commonly made at regional levels as kinds of master plans, e.g. covering the full extent of municipalities and being at the scale 1: 50.000
- Land regulation plans at detailed low level may cover populated areas or areas of specific economic or social interest. The plans may direct utilization level, the % of building coverage within areas, height regulations or functional regulations, and maps produced may have a detailed scale, e.g. 1: 5000.

It is a very diverse situation concerning land regulation/ land use plans as these spatial data commonly are based on national or regional legislation or other kinds of regulation. The documents/maps are frequently seen as legal documents, and the categories remain for decades as rights directing use land and property. Categories of land use follow such regulations. Furthermore, operational plans may for some areas be old and based on older legislation, and the nomenclature may have changed through time. Operational land use plans may be as old as 100 years or more. Also plans being proposed and being in a process or public/sectoral hearing can be relevant for dissemination in the infrastructure.

A common strategy to activate land use plans in a GIS is through the production of raster versions of land use plans. This is by some seen as a very good strategy, as the rasterisation makes a "copy" of the visual content, thus locking the content and accuracy for changes and misleading interpretation of the legal map documents. Some organisations have a strategy of first supplying raster versions of existing plans, and with a long term plan for establishment of vector versions.

Functional land use – according to socio-economic purpose

Functional areas within urban or rural areas may be mapped through fieldwork, register information or through modelling using socio-economic input data in a GIS.

The recommended classification of the land use phenomenon is based on the ISIC Rev.3 (International Standard Classification of All Economic Activities) classification drawn up by the United Nations (approved by the Statistical Commission in 1989) and recommended for use throughout the world. This classification is integrated in the sense that it ensures a full harmonization with another main branches of economic classifications: the classifications of products ICPC Central Product Classification) which are fundamental for foreign trade statistics, statistics of production and consumption, energy statistics, etc. The ISIC Rev. 3, it is important to state, is fully compatible with the EU NACE Rev. 1 (Nomenclature des Activités de la Communauté Européenne) system for the first two levels. (System replaced by 1.1.2008, see references).

The **ISIC system** is made of four levels of breakdown: 17 sections, 60 divisions, 159 groups and 292 classes. The 17 sections of the first level are characterizing main economic activities. These categories are:

SECTION A	Agriculture, Hunting and Forestry
SECTION B	Fishing
SECTION C	Mining and Quarrying
SECTION D	Manufacturing
SECTION E	Electricity, Gas and Water Supply
SECTION F	Construction
SECTION G	Wholesale and Retail Trade, Repair of motor vehicles, motorcycles and Personal and household goods
SECTION H	Hotels and Restaurants
SECTION I	Transport, Storage and Communication
SECTION J	Financial intermediation
SECTION K	Real estate, Renting and Business activities
SECTION L	Public Administration and Defence, Compulsory social security
SECTION M	Education
SECTION N	Health and Social work
SECTION O	Other Community, Social and Personal Service Activities
SECTION P	Private Households with Employed Persons
SECTION Q	Extra-territorial Organizations and Bodies

Scope, use examples:

Many of the management and planning activities at local level require detailed data. Proper location, the geographical position, is important. The level of accuracy needed in location varies, the need for (and will to produce) accurate data being higher in urban or built-up areas and lower in rural and natural/semi-natural environments. Similarly, interest in frequent updating decreases with distance from central areas. The detailed area planning covers both land and sea/coastal areas.

Land Use is important for impact assessment and monitoring of implementation of policies and legal instruments for sustainable management of the environment, like Natura2000.

Policies:
6EAP, EIA guidelines. Several policies and strategies give highlight the value of regional approaches with integrated land/area management, such as the Integrated Coastal Zone Management, Communication on planning and environment, Water Framework Directive and the Communication on risk prevention.

Environmental Impact Assessments (EIAs) for projects and Strategic Environmental Assessment (SEAs) for policies, plans and programmes ensure that significant environmental impacts are identified, assessed and taken into account in decision-making process to which the public can participate.

Important feature types and attributes:

Kinds of features depend on kind of land use and land use plan. A representation of a land use plan may be structured as a layered dataset.

- boundary of plan/regulation
- land use category area
- land use regulation area
- land use restriction area
- elements within a plan (road boundaries, building boundaries, forest/agricultural land boundaries etc)

Important attributes

- land use category
- land use regulation category
- land use restriction category
- present/existing or proposed/planned/future
- legal reference
- date of entry into force
- link to text regulations for each area

Links and overlaps with other themes:

- Cadastral parcels
- Hydrography
- Transport networks
- Protected sites
- Land cover
- Buildings
- Human health and safety
- Utility and governmental services
- Production and industrial facilities
- Agricultural and aquacultural facilities
- Population distribution – demography
- Area management/restriction/regulation zones and reporting units
- Natural risk zones
- Habitats and biotopes
- Energy resources
- Mineral resources

Reference documents:

Christophe Duhamel (1998) First approximation of a reference land use classification, Report to the FAO

CNIG: Annexe 5 – Liste des données géographiques de référence en domaine littoral (France)

CORINE as a European Land Use nomenclature (e.g. urban sprawl MOLAND).

Council Regulation (EEC) no. 3037/90 concerning the statistical classification of economic activities in the European Community (NACE rev.1) is repealed by Regulation (EC) no. 1893/2006 of the European Parliament and of the Council of 20 December 2006 establishing the statistical classification of economic

activities NACE revision 2 and amending Council Regulation (EEC) No 3037/90 as well as certain EC Regulations on specific statistical domains. (NACE rev. 2) This Regulation shall apply from 1 January 2008. As a consequence NACE rev.1 as well as ISIC Rev. 3 is not applicable from 1 January 2008 onwards.

EuroGeographics: EuroRegionalMap Specification 4.0 and Data Catalogue

INTESA-GIS: 1n1007_1-2 - Specifiche per la realizzazione dei data base topografici di interesse generale. Il catalogo degli oggetti (v.3_3). (Italy)

Nomenclature statistique des Activités économiques dans la Communauté Européenne (NACE), revision 1.1, at : http://www.fifoost.org/database/nace/index_en.php

Norwegian feature catalogue including different chapters and UML models for land use planning/masterplan, land cover (with a land use component) See URLs: http://www.statkart.no/sosi/UMLfullmodell/Plan/Plan.htm, http://www.statkart.no/sosi/UMLfullmodell/Markslag/Markslag.htm

RAVI:NEN3610 by “Ministry of Housing, Spatial Planning and Environment (VROM), Information model Land use plans (Informatiemodel Ruimtelijke Ordening), 2006, http://www.helpdeskdurp.nl/files/412/deelpublicatie_6_.pdf”

United Nations, International Standard Industrial Classification (ISIC), Rev. 3, at: http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=2

7.5 Human health and safety

Definition:

(INSPIRE, 2007) 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.

Description:

A descriptive approach to human health and safety will focus on the

- descriptive geographical distribution of diseases, wellbeing of humans or other health and safety qualities showing geographical patterns, may also include probability descriptions.
- causes and elements affecting health
- wellbeing of humans, including quality of the human environment
- safety issues, behaviour linked to safety
- health care services

To illustrate kinds of geographical information which can be included in this INSPIRE theme, some examples on medical statistics and medical geography can be given:

General statistics on health - change over time

- **mortality** – the number of death in relation to a total population over a given period of time
- **life expectancy** – the average number of years newborn children may expect to live if death subsequently occurs in accordance with the mortality for each age group of the population within this period. Life expectancy may also be estimated as the expected remaining time of life at any particular age.
- **Morbidity**: incidence of disease in relation to a total population over a given period of time. Morbidity can be described by many different indicators:
    - incidences: the number of new cases in relation to a total population over a given period of time
    - cumulative incidences: the total number of new cases for a longer period of time, e.g. several years, in relation to a total population
    - prevalence: the total number of cases registered in a population at a given time in relation to a total population
    - rate, age-specific rate, age-adjusted rate.

Relevant material on geographical patterns of health is comparison of the major sources of death or illness at different points in time. This can, for instance, illustrate epidemiological transitions, with a fall in infant mortality and infectious disease and a rise in degenerative diseases.

Incidence data on specific diseases or other health issues

Incidences overviews can be split by male/females, age, region or rural-urban sub-division, and data may give opportunities to depict trends over time. Examples which can be treated geographically:

- **Kinds of diseases and illnesses**: coronary heart disease, stroke, infant mortality, mortality related to cancer, morbidity overview, cardiovascular diseases, musculo-sceletal diseases, mental health problems, injuries, sexually transmitted diseases, infectious diseases.
- **Cancer incidence in particular**: Cancer comprises a variety of types with different geographical patterns. Incidence data from pubic registers material on age-specific trends, gender variations in a geographical context, incident rates and survival rates: Cancer of the tongue, mouth, throat,

stomach, colon, rectum, lunge, prostate, kidney, urinary bladder, malignant melanoma, lymphatic cancer.

Causes of poor or good health – risk factors - exposures

The theme may also include focus on the causes of poor (or good) health. For the purpose of INSPIRE it is convenient to define health in an environmental context, viewing health as a result of an interplay between three factors, man as a biological organism, habitat and behaviour - the human organism's ability to withstand chemical, physical, biological, psychological or social stresses.

- Firstly, it can provide clues about the causes of disease. Although examples of geographical studies leading to basic new knowledge about disease causation are rare, geographical disease patterns may generate hypotheses about causes which can be followed up using other approaches, or suggestions from other research approaches can be tested geographically.
- Secondly, such information can be useful in the planning of strategies for health promotion.
- Thirdly, knowledge about geographical variations in different aspects of health can be useful in health care planning.

Geographical distribution over exposure elements may help understanding links between exposure and health or illness. A causation analysis should include the following two concepts: **Risk factor**: factor which is known to increase the risk of a disease or other problems: **Exposure**: to be exposed to a risk factor:

- Exposure to chemical agents in the environment, in air, water, food and soil, has been implicated in numerous adverse effects on humans from cancer to birth effects. E.g. geochemical geographical data may be used in analysis of exposure.
- Among exposures which have been shown to be carcinogenic the following can be mentioned; radioactive and ultraviolet radiation, some chemicals, stimulants such as alcohol and nicotine, food and some occupational factors.
- Two groups of hazardous chemicals – heavy metals and persistent organic pollutants (POPs) are currently receiving particular attention. Further attention should also be given to CMR (cancerogenic, mutagenic and reprotoxic chemicals), PBT (persistent, bioaccumulative, toxic chemicals) and vPvB (very persistent and very bioaccumulative substances), which are substances of special concern according to REACH. Exposure to heavy metals has been linked with developmental retardation various cancers and kidney damage. Exposure with gold and lead has also been associated with the development of auto-immunity. Growing evidence that POPs have serious human health effects.
- Exposure to GMOs in the environment, in air, water, food and soil is currently receiving particular attention since it may potentially cause adverse effects on human health and the environment.

Human well-being:
Human wellbeing may be linked to environmental stress, e.g. noise, heavy traffic, pollution, it may also be reflected in statistics on rates negative wellbeing, e.g. psychiatric problems, alcohol-related causes of illness, social problems or death, health problems or death by traffic accidents, injuries or death by other accidents, suicide in general or firearm suicide as a particular case.

Security
Security may contain issues like peoples' own experience or perception of their security situation, be linked to rates of a long range of indicators e.g. crime rates, or be probability maps for e.g. crime.

Health services
Health services may be interpreted as part of the theme health, as their occurrences and quality in closely linked to health and wellbeing. The issues may reflect public health services in a geographical context, - distribution of e.g. hospitals and similar institutions, medical laboratories or institutions for rehabilitation purposes. Details may be given on distribution, rates, and quality parameters about doctors, nurses, physiotherapists or other practitioners. It may also include services in the form of ambulance services, ambulance regions and other kinds of emergency management systems, where use of GIS have proved

to improve performances. Peoples own health care of themselves and their families - by their next of kin – is another important service not commonly being registered.

Scope, use examples:

- Important aspects on health in the 6EAP, followed by the health communication. High concern for the citizen. (INSPIRE IMS, 2003)
- Health planning and management
- Monitoring of marine foods or marine algal blooms that could cause harm to human health
- Research on causes of illness and death: Through medical geography and geographical epidemiology different health issues can be analysed in a geographical context.
- Emergency management
- Security management: Over the last decade the criminal justice community has begun to reap the valuable analytic benefits of geographic information systems (GIS) technology. The powerful technology enhances the ability of researchers and practitioners to identify hot spots, analyse spatial patterns of crime and criminal behaviour, and to share disparate data sets across jurisdictional boundaries.

Important feature types and attributes:

Geographical grid systems, administrative units and statistical units
Data on rates of a variety of heath related issues may be linked to geographical grid systems (grids), administrative units and statistical units. The use implies a linkage between health-related attribute information with geometry on grids, administrative or statistical units. It is important that these data with different regional breakdown have stable and know IDs (identifiers). Detailed geographical information on total population, gender and age is crucial in geographical mapping of health. There are no particular health attributes that should be mentioned, the topic is so vast that this would not make sense. For details on minimum requirements on features and attributes, see these themes.

Distribution area/ observation area/ observation point
Point or area localisation showing any kind of health or security related observation, e.g. diseases like malaria, potential human epidemics/risks as avian flue, distribution or crime incidences. Important attributes being kind of incidence, date of observation, sources of observation. The existing material does not allow a more specific outline relevant features and attributes.

Location of health care institution
Sector-specific management regions – e.g. health care/management regions/ambulance regions.

Sector-specific management region

- sector
- sub-sector
- management activity type
- responsible organisation
- year of verification

Risk factors being used in causation assessments may be linked to a series of features treated as other themes. There may be quality information about the human environment, stress and pollution data not treated in other themes relevant in as input element in analyses covered by the theme Human health and safety. It should be assessed if these are to be brought into this topic, such as for instance noise level zones.

Links and overlaps with other themes:

- Geographical grid systems
- Administrative units
- Geology (geochemistry)
- Statistical units
- Soil
- Utility and government services
- Environmental monitoring facilities
- Area management / reporting units
- Atmospheric conditions
- Meteorological geographical features

Reference documents:

Aase, A. & Storm-Furru, I, 1996: National atlas for Norway - health. Nasjonalatlas for Norge – Helse. Norwegian Mapping Authority.

Atlas of mortality in Europe: Subnational patterns, 1980/1981 and 1990/1991: http://www.euro.who.int/InformationSources/Publications/Catalogue/20010911_22

Atlas of United States mortality: http://www.cdc.gov/nchs/products/pubs/pubd/other/atlas/atlas.htm

Avian flu feed for Google Earth (.kmz)

Classification/Nomenclature: The international system for coding diagnoses (International classification of diseases (ICD) for diseases, injuries and causes of death makes comparison between different countries possible. This system is revised on a regular basis.

Cliff AD, Hagget P 1988: Atlas of Disease Distribution, Analytic approaches to Epidemiological Data. Oxford.Blackwell Reference 1988

Eurosurveillance 2005;10 (10): 051027

http://gamapserver.who.int/mapLibrary/
http://gamapserver.who.int/mapLibrary/Files/Maps/EMRO_endemic.png

http://www.ij-healthgeographics.com/,
http://www.ij-healthgeographics.com/content/pdf/1476-072X-4-22.pdf

http://www.ij-healthgeographics.com/content/pdf/1476-072X-4-22.pdf

Mapping and analysis for public safety

Medical Geography

Owe Lofman pp117-132 Att anvenda GIS før analyser av helsa – ohelsa, sjukdomar och deras determinanter, (to use gis for analysis of health – unhealthy, illness and their determinants) In: Melinder K, Schærstrøm Statens folkhelsoinstitut www.fhi.se, 2005: Platsen, individen og folkhalsen – teorier, metoder og tolkningar - epidemiologiska data på kartan: sjuklighet och exponering - en oversikt.

Web GIS in practice III: creating a simple interactive map of England's Strategic Health Authorities using Google Maps API, Google Earth KML, and MSN Virtual Earth Map Control

World health organisation – public health mapping and gis map library

www.zorgatlas.nl

7.6 Utility and Government services

Definition:

(INSPIRE, 2007) 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.

Description:

A very broad INSPIRE theme including different kinds of objects:

Utility services/networks: Physical construction for transport of defined products: These may include pipelines for transport of oil, gas, water, sewage or other pipelines. Transmission lines may include electrical, phone, cable-TV or other networks. Transmission lines for both land and at sea/water (bottom) is important. All kinds of transmission systems have nodes and are linked to facilities for production and treatment of different kinds of products. Despite being heavily interlinked, the themes in INSPIRE are treated separately – the production and treatment facilties are treated mainly in the theme production and industrial facilities. Transmission systems may be of different kinds;

- **Oil and gas pipelines**: Major lines from oil and gas fields/extraction areas and storage sites. Important production and treatment facilities of such resources is linked to a such a transport network, such as nuclear power stations, power stations, transformer stations and oil tanks. GISCO, Energy/ industry authorities, Companies
- **Water pipelines**: Location of water pipelines – large and local network. Large transmission lines are of interest here. Linked to production facilities for water for consumption/processes. Irrigation lines treated separately under agricultural facilities. Water supply institutions, Utilities/ health
- **Sewage pipelines**: Sewage network, linked to sewerage facilities. Major lines of interest here. Utilities
- **Transmission lines- electrical**: Data set showing larger transmission lines for electricity, both at land and sea. The location of lines is important knowledge for the energy sector itself, land use planners, construction, fisheries for sea cables. Parts of the information important in low flight hindrance databases. Large: national energy/industry institutions. Local authorities, Companies
- **Transmission lines-phone/ data/cable-TV**: Location of phone/ data: Rough data needed in land planning. Important transmission nodes, e.g. antennas, may be seen as part of the network. The cables placement can conflict other natural resource utilization activities, e.g. fisheries. Technical data accuracy for local level Companies

Rough pipeline and utility service databases exist at European level, e.g. GISCO database with scale 1: 1.000.000. Data within countries is non-homogenous. There are examples of national portals warning on construction, distributing maps/data on location of pipelines. At local and regional level the responsibility of government offices or different operators/ firms. In some countries there are national portals for information about cables etc in construction work.

Waste treatment facilities and waste storage:
It is important to identify the environmental protection facilities with unique identifiers. The data component category coincides with economic/statistical categories (NACE/SERIEE). Location by geographical point, by address or in some cases as area.

- **Controlled waste treatment sites for non-hazardous waste at land:** geographical location of official or regulated facilities for waste treatment and storage; Included in the spatial component category "environmental protection facilities"
  - storage sites at land - landfills
  - incinerators
  - other treatment facilities

  Information on kind of treatment, kind of substances treated, capacity, percentage biodegradable waste, energy recovery from incinerators and landfills

- **Controlled waste treatment facilities for hazardous waste at land:** geographical location of official or regulated facilities for treatment and storage of hazardous waste; Included in the spatial component category "environmental protection facilities". Reported according to SEVESO II Directive. Distinction between
  - thermal treatment,
  - landfills
  - nuclear waste treatment and storage
  - and other treatment for hazardous waste (e.g. chemical),
  - other treatment facilities

  Information about kind of treatment, kind of substances treated, capacity (and potential risks).

- **Regulated areas for dumping of waste at sea:** Areas at sea for dumping of waste, e.g. ships, oil drilling platforms, industrial waste, military waste. OSPAR Permits on marine dumping. Reporting per contracting party and site (?) waste category, number of permits issued, tonnes licensed and contracting party. Important in environmental management and management of biological resources at sea. . Submission of data for the Annual OSPAR Report on Dumping of wastes at Sea from OSPAR Convention for the protection of the marine environment of the north-east Atlantic. The anticipated delivery authorities could be sea management/ marine/ waste/ environmental authorities, OSPAR. Included in the spatial data component "area regulation".

  Does also include nuclear waste. Example is Russian dumping sites: Official sources states a total of 0.45 PBq of liquid radioactive material has been dumped in the Barents Sea and 0.32 PBq in the Kara Sea. Most of the solid radioactive waste has been dumped along the east coast of Novaja Zemlya and the open Kara Sea. Some material on existing sites and amounts are available.

- **Illegal or non-controlled dumping of waste - sea and land.** Illegal landfills/"wildfills" on land areas are common, but policies are directed to reduce the number of such storage of waste. It is important in local waste management and pollution control to locate such illegal land fills, in order to carry out targeted actions. Non-controlled areas at sea where waste is recorded is also important, this can be shipwrecks, industrial waste, military waste, cars. OSPAR Permits on marine dumping.

- **Mining waste:** Mining waste is a special kind of waste. The residues from mining can contain a low content of metals or minerals not being economically extractable, but leaching can cause contamination of soil and water. The tailings of mining activities are usually located near the site of extraction. In management and assessment of mining waste there are needs for spatial data such as location of mines and tailings, water catchments, river network, water and sea, soil.

- **Sewage sludge: generation, sewage pipelines network and sewage treatment facilities:** Is treated as a group here:
    - Sewerage/wastewater treatment facilities, Information on capacity, kind of treatment, category of recipient.
    - Sewage networks treated under the data component: utilities.
    - Sewage sludge spread to agricultural lands - regulated "permission zones"
    - Sewage sludge spread - agricultural lands and soil deposits suitability mapping

Environmental. protection facilities
The theme does also include a specific kind of facilities: Environmental protection facilities include a series communal or private facilities of sewage/ wastewater treatment sites, waste treatment facilities (e.g. incineration , landfills), anti-noise constructions facilities, protection facilities against natural hazards (slide walls, flood walls etc). It is important to identify the environmental protection facilities with unique identifiers. The data component category coincides with economic/statistical categories (NACE/SERIEE). Location by geographical point, by address or in some cases as area.

Examples

- **Waste treatment and disposal site - hazardous waste:** Waste treatment plants location for hazardous waste. Major distinction between hazardous and non-hazardous waste. Distinction between thermal treatment, landfills and other treatment for hazardous waste (chemical/ radioactive),. incineration, landfills and other treatment for non-hazardous waste. Information about kind of treatment, kind of substances treated, capacity (and potential risks). Waste Directive (Directive 75/442/EEC), Mining Waste Directive (Directive 2006/21/EC), SEVESO II, WFD, MS to DG ENV
- **Sewage/ wastewater treatment site:** Wastewater treatment facilities, Information on capacity, kind of treatment, category of recipient. Sewage networks treated under the data component: utilities. WFD, MS to DG ENV, local authorities. Facilities defined in Directive 91/271/ECC (urban waste water) / industrial waste may be part of this general category of Sewage/wastewater treatment site.

Natural hazards protection facilities: Any kind of facilities or constructions protecting against natural hazards, e.g. land slide walls, flood walls etc). Hydrographic services, civil security, local authorities.

- **Anti-noise constructions:** Constructions/walls or other facilities for limiting the spread of noise from road, rail and air traffic, industrial or other noise. For industrial includes modification at the source. Workplace protection excluded. 6EAP

Administrative and social governmental services such as public administrations, civil protection, sites, schools, hospitals. The kinds of sites are commonly presented in governmental and municipal portals and map system as "point of interest"-data, and may be point-based location of a variety of categories of municipal and governmental services and social infrastructure.

- police stations,
- fire fighter stations
- hospitals
- health care centres
- care centres for the elderly
- schools and kindergartens
- renovation/ waste delivery sites
- government and municipal offices

Scope and use examples:

Land use planning. Risk planning/ management. Foreseen development of Seveso II Directive to treat transmission lines as possible technological hazards, the Seveso Directive is of major importance in regulating management of risk. Access to utility data as needed in environmental impact assessment, to be carried out when planning of larger transmission lines for electricity or pipelines. Existing and planning transmission lines should be available for general land use planning. Detailed network data needed in construction.

Information about environmental protection facilities is to be used in evaluation of policies, indicator development and generally on reporting of environmental issues. Statistics linked to the protection facilities can be linked to a location. There is a need for such information if spatial analysis of anthropogenic pressure on river basins. At local level important in land use planning, management of water, coastal areas, natural and technological risks.

Administrative and governmental service information is being used by the citizen and public information systems, in government and municipal management actions and in planning. The navigation databases used in cars commonly include such information.

Community policies:

A community Strategy for Waste Management was initially adopted by the European Commission in 1989 followed by the 1996 Review of the Community Strategy for Waste Management. The 6 Environmental Action plan is the latest document from the Community, with expected developments on “Thematic strategy on the Sustainable Use of Natural Resources”.

Waste management is linked to two issues: preventing waste generation and sustainable management of waste: re-use and recovery (recycling), optimisation of final disposal and regulation of transport. The 6EAP gives a high priority to waste prevention, and to achieving a de-coupling of resource use from economic growth through significantly improved resource efficiency, dematerialisation of the economy and waste prevention. Other policy areas are linked to waste policies, e.g. policies on climate change, air, urban, soil and water (WFD).

- Seveso II, EIS Environmental Impact Assessment, Waste, EAP

Important feature types and attributes:

Objects in networks could both include transmission lines and nodes being pump stations etc. Major production and treatment sites is treated in the theme Production and industrial facilities.

Pipeline – oil, gas, heat

- category of content
- segment id
- capacity, max
- average volume
- diameter
- pressure regime
- construction system
- date of construction
- responsible organization

Sewage system network

- segment id
- capacity, max
- average volume
- construction system, including e.g. material used for building the network (cast iron, cement …)
- altitude
- date of construction
- responsible organization

Water supply system network

- segment id
- capacity, max
- average volume
- construction system, including e.g. material used for building the network (cast iron, cement …)
- date of construction
- responsible organization

Electricity transmission lines

- segment id
- capacity, max
- average volume
- construction system
- date of construction
- responsible organization

Transmission network for different kind of data/ signals

- segment id
- category of object (feature type) e.g. antennas, base-stations, relay-antennas, cables etc
- category of data/signal, e.g. radio, data, mobile, TV
- date of construction
- responsible organization

Environmental protection facility

- category of object (feature type)
- type of treatment/service
- description, capacity, construction etc
- name
- date of construction
- responsible organization

Public/governmental services/ facility (point)

- category of service/facility
- name
- Id
- information
- link to web site

If measurement values are to be given, a registration attribute may be added, with information in sub-attributes such as

- registration authority
- registration regime
- registration parameter
- value

- registration date, time

Overlaps and links with other themes

Water supply and sewage might overlap with themes

- Hydrography
- Buildings
- Land use
- Environmental monitoring facilities (like treatment plants/pumping stations)
- Production and industrial facilities
- Energy resources

Reference documents:

CSI – Piemonte: SIRI Conceptual Schema

European Commission: Mining Waste Directive (Directive 2006/21/EC)

European Commission: Urban Waste Water Directive (Directive 91/271/ECC)

European Commission: Waste Directive (Directive 75/442/EEC)

INTESA-GIS: 1n1007_1-2 - Specifiche per la realizzazione dei data base topografici di interesse generale. Il catalogo degli oggetti (v.3_3). (Italy)

LabNets: Subsoil network Laboratory: Mapping specifications of the technological networks.

Norwegian feature catalogue and standards, incluing UML models. Contain Utility. Oil and gas pipelines are described in the Petroleum model. URL:
http://www.statkart.no/sosi/UMLfullmodell/Ledningsnett/Ledningsnett.htm,
http://www.statkart.no/sosi/UMLfullmodell/Petroleum/Petroleum.htm English version by spring 2008.

RAVI: NEN3610 - Basic scheme for geo-information - Terms, definitions, relations and general rules for the interchange of information of spatial objects related to the earth's surface (The Netherlands)

Regione Emilia-Romagna: Data Base Topografico alle grandi scale (1:1.000 - 1:2.000 - 1:5.000)

CSI – Piemonte: SIRI Conceptual Schema

7.7 Environmental monitoring facilities

Definition:

(INSPIRE, 2007) 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.

Description:

Environmental monitoring facilities are facilities for observations and measurements of emissions, status and effects of environmental media (e.g. air, forest, marine water) and/or other environmental aspects (e.g. biodiversity, human health. The concept of monitoring may relate to systematic and hierarchical structures, including monitoring networks, monitoring stations, monitoring site and subsites. The monitoring sites may be permanently located at a site or can be temporal, only used for a certain time. Continuous moving monitoring facilities, e.g. on ships, may be a kind of monitoring facility. Monitoring sites in the form of locations and areas can be reported as georeferenced points, lines and polygons. In cases where data are classified or confidential, aggregation to grids may be a possibility. It is problematic that the definition of the theme refers to the kinds of delivery organisations to supply data, as the INSPIRE Directive in specific paragraphs defines for which organisations the directive is valid.

Scope, use examples:

Many different conventions, directives, scientific monitoring programmes and other agreements direct monitoring and the flow of monitoring information linked to the monitoring sites. At present different institutions use different data models and definitions. INSPIRE includes a more general model of monitoring sites.

Examples:

- **Meteorological stations:**: Includes both recording of weather conditions and climatological information. The information may include simple information on precipitation, temperature, but also stations with additional info on snow cover, humidity etc. Important in many kinds of environmental assessment. Different organisations, e.g. ECOMET, may provide data, commonly real-time, from National Meteorological and Hydrological Services. The category "meteorological station" may also be defined as point location for climatological information, such as general attributes and additional information on max/min monthly temp/precipitation, wind speed, solar radiation, atmospheric pressure relative humidity, potential evapotranspiration, cloud cover. An example is the network of European climatological stations, long-term mean monthly and mean annual values of ca. 19 meteorological attributes exist for up to 4773 stations, while more common variables (rainfall, temp) exist for ca. 10.000 stations.
- **Air quality monitoring stations** Site location of monitoring site and stations for registration of air quality, hazardous substances (ozone), other pollutants. INSPIRE/ CAFÉ
- **Water monitoring stations** The Water Framework Directive is presenting different kinds of monitoring sites.
    - surface water monitoring stations
    - drinking water abstraction (investigative station, operational station)
    - groundwater monitoring stations (Groundwater Level Station, OperationalGWstation, SurveillanceGWstation)

  Stations may be e.g. hydrometric (water quantity, flow and level only stations), chemical water quality, biological water quality.

- **Phenological observation points:** sites where observations of phenological networks are performed (European phenological network EPN)
- **Marine environment monitoring stations**: Sea based monitoring facilities for measurement of ocean and sea bottom parameters and pollution (e.g. heavy metals, oils spills). May be linked to national and international conventions and agreements, e.g. OSPAR convention. HELCOM reporting obligation, may serve as an example: It regulates: monitoring sites in the Baltic Sea, and requires registration and reporting on eutrophication, pollution by metals, pollution by toxic substances, water quality and water pollution. Different frequencies**.** Coverage: Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russian Federation, Sweden. See HELCOM reporting obligation from Convention on the Protection of the Marine Environment of the Baltic Sea Area, 1992 (Helsinki Convention, revised in 1992).
- **Soil monitoring sites:** monitoring of trends in chemical conditions of soils
- **Magnetic field intensity observation stations**
- **Bathing site**: Compliance to the Bathing Water Quality Directive 76/160/EEC: Coastal and Fresh Water Zones: Data reported are on the quality of bathing waters (coastal and freshwater zones) as per Directive 76/160/EEC on Bathing Water Quality. Parameters for which compliance is calculated include: total coliforms, faecal coliforms, mineral oils, surface-active substances and phenols. The information is submitted to the Commission by the Member Countries and is made available as country reports on the web site of DG Environment. Source: DG Environment.
- **Other water related monitoring** defined in: Fish Water Directive (78/659/EEC) and Directive 76/464/EEC - Water pollution by discharges of certain dangerous substances.
- **GMO monitoring sites and areas**: Directive 2001/18/EC, Annex VII (http://ec.europa.eu/environment/biotechnology/pdf/dec2002_811.pdf) stipulates that monitoring and reporting on the deliberate release of GMOs are carried out in the environment. Examples of elements to be monitored are a) effects on non-target organisms (including development of resistance in wild relatives) or pest organisms, change in the host range or in the dispersal of pest organisms and viruses, development of new viruses; b) dispersal, establishment and persistence into non-target environments or ecosystems; c) out-crossing with sexually compatible wild relatives in natural populations; d) unintended changes in the basic behaviour of the organism, for example, changes in reproduction; e) changes in biodiversity (e.g. in number or composition of species). The monitoring design (sites and areas) must be indicated. It includes agricultural fields where the crop is commercially grown as well as surrounding habitats.

Important feature types and attributes:

The theme is wide and different communities may have different models for defining monitoring facility. An example of possible general content is given underneath. The theme may be possible to subdivide into sub-themes, allowing different fields to define their core sets of characteristics. Extensions to defined data models, feature types or attributes may be done at defined intervals of time.

Registration/monitoring site

- registration authority
- registration regime
- measurement methodology
- registration parameter
- parameter units
- parameter value
- registration date, time

Links and overlaps with other themes:

Environmental facilities may be buildings or located to existing facilities, industry etc. The theme may thus overlap with INSPIRE themes such as

- Hydrography
- Protected sites
- Orthoimagery
- Geology
- Buildings
- Soil
- Human health and safety
- Production and industrial facilities,
- Agriculture and aquaculture facilities
- Utility and government services
- Natural Risk Zones
- Atmospheric conditions
- Meteorological geographical features
- Oceanographic geographical features
- Sea Regions

Reference documents:

Convention on the Protection of the Marine Environment of the Baltic Sea Area, 1992 (Helsinki Convention, revised in 1992)

CSI – Piemonte: SIRI - Conceptual Schema

Directive 76/160/EEC - Bathing Water Quality Directive: Coastal and Fresh Water Zones

Directive 76/464/EEC - Water pollution by discharges of certain dangerous substances.

Directive 78/659/EEC - Fish Water Directive

Directive 2001/18/EC, Annex VII (http://ec.europa.eu/environment/biotechnology/pdf/dec2002_811.pdf) on the deliberate release of GMOs into the environment

Directive 2006/118/EC - Groundwater Protection Directive

Norwegian feature catalogue and standards

"Soils protection" Directive proposal (COM(2006)0232)

Water Framework Directive: (2000/60/EC), annex V – 1.3, VII – 4: surface water monitoring network in the river basin management plan.

7.8 Production and industrial facilities

Definition:

(INSPIRE, 2007) Industrial production sites, including installations covered by Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control * and water abstraction facilities, mining, storage sites.

* OJ L 257, 10.10.1996, p.26 Directive as last amended by Regulation (EC) No 1882/2003

Description:

Location of production industry, mines, waste/disposal sites and energy production facilities. Concerning industry these may be chemical, hydrocarbons (oil-gas), mines or any other industry. Usage of PRTR categories as common nomenclature for such facilities is relevant as it comprises a very broad set relevant industrial activities. The categorisation may be mapped to other international categorisation systems like NACE, SERIEE or ISIC.

The definition mentions also water abstraction, mining and storage sites. The latter may be storage sites for different kinds of "products" needed as input in industrial/production processes, or may be seen as storage sites for real products and also form "waste" from the production process.

The theme production and industrial facilities" must be seen as one of several thematic groups of "facilities" such as

- utility and government services
- environmental monitoring facilities
- agriculture and aquaculture facilities

The IMS paper (INSPIRE IMS, 2003) contained a different sub-grouping of utilities and facilities with the groups transmission lines and pipelines, environmental protection facilities, production facilities, industry, agricultural facilities, trade and service facilities. The first and last in the IMS is not mentioned as separate themes in the draft Directive text, neither is the environmental protection facility. Two new themes have been introduced: "Utility and governmental services" and "Environmental monitoring facilities".

The definition includes a reference to the IPPC directive. IPPC Directive (Directive 96/61/EC) describes the European Emission Register (EPER) in Art 15 (3). This Directive and the clauses have been affected, as the PRTR Regulation (Regulation (EG) Nr. 166/2006 of 18.01.2006) has become effective. This Regulation establishes an integrated pollutant release and transfer register at Community level (PRTR) - and it deletes (among others) Art. 15 (3) of the IPPC Directive.

Kinds of production/industry facilities:

Industrial sites: Agglomerations and individual localisation of major industry, including chemical, hydrocarbon refineries, forestry, fisheries etc. Id on firm/site. SEVESO II

Nuclear installation location: Will be used as a reference point for discharges from Nuclear Installations. Reporting on each production unit: Submission of data for the Annual Report on Liquid Discharges from Nuclear Installations from OSPAR Convention for the protection of the marine environment of the North-East Atlantic Ocean. This is a legal obligation for the following nations: Belgium, Denmark, France, Germany, Norway, Portugal, Spain, Sweden, Switzerland, the Netherlands, and United Kingdom. Not necessarily reporting on geographical location, but unit name/address or other id could link information to a geographical location. OSPAR/ HELCOM

Energy resource extraction and production site: Localisation of energy production sites for production of heat, electricity, oil and gas. The sites may include extraction sites, e.g. for oil and gas (platforms), hydropower stations, nuclear power plants, The sites also includes the distribution facilities for energy, storage sites, but not the network (See data component utilities).

Mines: Individual localisation of mines or generalised mining areas, including storage sites, landfills, sedimentation dams etc.

Scope, use examples:

Needed in modelling and assessment of pressures on the environment, in land use planning, in risk and hazards management. Needed at all geographical levels, from European to local. Needed for information to the pubic. Rough representation in a European dataset for some of the objects in GISCO. Also a geographical database in the EPER, with a map viewer with details about production site, see www.eper.eu.int

European Policies: 6EAP, IPPC, EPER, Ospar/Helcom, Seveso II,

Important feature types and attributes:

Facilities are described in several INSPIRE themes. Data models and attributes should as far as possible be harmonised between these themes.

The first thought of objects in this theme is point location of a production/ industry facility. However, many of the production facilities cover large areas, so that area objects should also be considered. In detailed mapping/ referencing building or delineation of other objects could be considered. In the IMS paper transmission lines and pipelines where included as kinds of "utilities and facilities". Transmission lines of different kinds could be viewed as linked objects to the "true" production/ industry facilities.

Production/ industry facility
- id
- name
- classification system
- classification of activity/ production , Nace-code
- volume of production, per component and time
- volume of emission, per component and time
- owner/ responsible
- emission permitted volume
- etc

Storage facility
- id
- name
- classification system
- class/type
- component, name and volume
- owner/ responsible organisation

Waste/disposal site
- id
- name
- classification system
- class/type
- component, name and volume
- owner/ responsible organisation

Antennas/transmission facilities for data/ signals

- id
- name
- class/type: category of object (feature type) e.g. antennas, base-stations, relay-antennas
- category of data/signal, e.g. radio, data, mobile, TV
- date of construction
- responsible organization

Links and overlaps with other themes:

The datasets addressed in this theme may overlap with other themes and borders between themes should be identified. Particular care towards

- Land use
- Agricultural and aquaculture facilities. Closely related
- Utility and government services; which includes utility facilities such as sewage, waste management, energy supply and water supply
- Environmental monitoring facilities. marginal link, when the monitoring facility is located at a production facility location

Links also to:

- Buildings
- Addresses
- Energy resources
- Mineral resources

Reference documents:

Directive 96/61/EC (IPPC) and water abstraction facilities, mining, storage

EPER database, European Pollution Emission register, reporting of different kinds of production

GISCO database, industry etc

INTESA GIS: 1n1007_1-2 - Specifiche per la realizzazione dei data base topografici di interesse generale. Il catalogo degli oggetti (v.3_3). (Italy)

Norwegian feature catalogue and standards

PRTR Regulation (Regulation (EG) Nr. 166/2006 of 18.01.2006)

PRTR, NACE and SERIEE classifications

RAVI: NEN3610 - Basic scheme for geo-information - Terms, definitions, relations and general rules for the interchange of information of spatial objects related to the earth's surface (The Netherlands)

Teleatlas database

Water framework directive: Directive 200/60/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, OJ L 327, 22.12.2000, p.1 (as this directive is based on a characterization of water bodies/catchment areas and pressure assessment based on emission from emitting production and industry facilities.

7.9 Agricultural and aquaculture facilities

Definition:

(INSPIRE, 2007) Farming equipment and production facilities (including irrigation systems, greenhouses and stables).

Description:

***Agricultural facilities**:* The farming facilities are constructions used in agricultural production. Agriculture is defined to include cropping of annual crops or perennials and rearing/ breeding of animals. Forestry in general is probably not included, but intensive forestry plantations on former fields may be included? Facilities can be classified according to the NACE1.1 used in official statistics when relevant. The ISIC system for classification of industrial sites may also be relevant. Examples of farming productions facilities are irrigation systems, greenhouses, stables, tanks and pipelines. The definition of a facility should be clarified, e.g. if facilities such as wall systems for prevention of erosion, channel systems used in irrigation, terrace systems used for fruit production are constructions outside the scope of a "facility".

Aquaculture facilities: Productions and treatment facilities for fish, mussels, seaweed and other kinds of aquaculture. Aquaculture does only include permanent or semi-permanent systems for breeding of the organisms, and does not include locations for catching animals or plants in their natural environment. Aquaculture facilities may exist both in marine waters, inland water environments and as terrestrial production systems.

Scope, use examples:

Important in local land use planning and agricultural and water management, also of interest to the public, Environmental Impact Assessment, as input to identify resources/facilities under threat in crisis management. In addition, important knowledge in a spatial follow-up of the spread of human or plant/animal diseases. Also relevant in the follow up of different Directives and policies: IPPC/EPER Register, the Seveso Directive, Emissions to water.

Important feature types and attributes:

Agricultural productions/treatment facility and aquaculture production/treatment facility may have an exact location of site (point, area). Objects may be spatially expressed as points, but where production area is substantial, area coverage may be relevant, e.g. greenhouse areas or mussels production sites at sea.

Documentation of the facilities' location may exist as coordinates or indirectly through the address, property or building. Use of GIS or web services may join theme databases and databases offering possibilities for indirect referencing.

Agricultural facility

- classification system
- kind of facility
- role of facility in production system
- kind of production
- quantity of production
- kind of emission, different substances
- quantity of emission, different substances

- system for disease control

Aquaculture facility

- classification system
- kind of facility
- role of facility in production system
- kind of production
- quantity of production
- kind of emission, different substances
- quantity of emission, different substances

Links and overlaps with other themes:

Links/Overlaps with:

- Buildings
- Addresses
- Hydrography (for irrigation systems).
- Land cover
- Land use
- Production and industrial facilities
- Environmental monitoring facilities. marginal link, when the monitoring facility is located at a agricultural or aquaculture facility

Reference documents:

EPER register

CNIG: Annexe 5 – Liste des données géographiques de référence en domaine littoral (France)

NACE1.1, classification of facilities

Norwegian feature catalogue includes UML application schema for fishery (aquaculture facilities). URL: http://www.statkart.no/sosi/UMLfullmodell/Fiskeri/Fiskeri.htm. English version spring 2008.

7.10 Population distribution – demography

Definition:

(INSPIRE, 2007) Geographical distribution of people, including population characteristics and activity levels, aggregated by grid, region, administrative unit or other analytical unit.

Description:

There is a long tradition in collecting demographic and economic/activity statistics. All geographical levels interested, includes municipal and intra-municipal levels. Common to have statistics with geographical breakdown on country level, regional/ county level and municipal level. In some countries also information on census districts. These last decades, the statistical offices have started producing demographic and socio-economic statistics in large urban areas with a reference to blocks of houses and to process these data with a GIS. In some countries, the methodology chosen refers to aggregation of location-based information (address/households) on a grid (e.g. 1x1 km or 0.1x0.1 km).

Includes a broad spectrum of information sources, such as regional statistics at EuroStat; other European and National data, Regional data and Local breakdowns. The theme may thematically be divided into several components. The Directive text points at broad groups of sub-themes

- population characteristics
- population/ human activity levels

Concerning population information, this will or can include total population, age: population figures for each year class or aggregated year classes (0-5, 6-15, 16-20, 21-30, 31-40, 41-50, 51-67, 68-80, over 81). It could also include gender, mortality, life expectancy, migration. Figures could be offered as yearly versions, one could also like to give information of changes over time, such as growth/reduction in population, e.g. last 2 years, last 5 years, last 10 years. It could also include details on average night and day figures for some of the components. The sub-theme of population could include socio-economic information about the population, such as number of households, rate of employment, education, income, households with children etc.

Themes relevant to local, regional and national statistics also includes topics such as resource exploitation, agricultural production and a variety of environmental themes. Concerning "activity levels" used in the definition of the theme, this is probably an inclusion of a theme being treated separately in the INSPIRE position paper – namely "economic activities/local statistics". Economic activities including production, consumption, stocks, income, employment: statistics referred to administrative units, grids, facilities, networks, addresses, monetary and physical units. Economic data on transport and traffic are classified here. In general, economic activities are described according to the NACE rev.1.1. The NACE is the official classification of economic activities in the European Union and covers all industries. Examples relating directly to the protection of the environment is given underneath:

- 23.30 (part) Processing of nuclear fuel
- 37.10 Recycling of metal waste and scrap
- 37.20 Recycling of non-metal waste and scrap
- 41.00 Collection, purification and distribution of water
- 51.57 Wholesale of waste and scrap
- 90.01 Collection and treatment of sewage
- 90.02 Collection and treatment of other waste
- 90.03 Sanitation, remediation and similar activities
- In other industries, Environmental protection activities and expenditure need additional data, as it is presented in the SERIEE handbook (CEPA), EuroStat 1994 (Version 2002).

Population distribution could also mean geographical aggregations of buildings into settlements, villages, townships, towns, cities. Data may be materialised as hierarchical settlement databases with details on population figures for geographical objects either **centre point location** or **area/settlement extent**. Population distribution may also be or functional or physical characterisation of built-up areas **within** a settlement area. One example of an overall functional zoning can be the distribution of CBD areas within a city (CBD=Central business district). Detailed area categorisation can be done, e.g. kind of apartment, flat, cooperative society, self-owned, house/villa, semi-detached house, terrace house, apartment block.

Disaggregating of statistics is a methodology for transforming data at a higher aggregation to lower aggregates based on models. The EEA European population base introduces a transformation of statistics from administrative regions to small grid cells by a model based on knowledge of population distribution – land cover. Figures are aggregated to grid cells, and may therefore be seen as within the definition of this theme.

Population censuses take place with a periodicity of e.g. 10 years. In between, administrative registers of civil state supply a regular flow of data used generally for presenting annual statistics. New trends in statistics will probably lead to abandon the national censuses of large countries for a rotating system based on regional censuses supplemented by a broader collection of data from administrative registers.

Scope, use examples:

The demand for local statistics has increased over time. For example, the national statistical offices commonly disseminate statistics by municipalities, blocks of houses or grids. The uses of local statistics are many, from the local, regional and national management of public services (education, health, environment, urban planning…) to the consulting companies in domains such as public works or market studies and the research in the socio-economic domain. Data themes of major importance are demography, production, economy, but also such as natural resources and a variety of environmental themes.

Needed within local to national governments, settlement and city development, health and education planning, school enrolment planning, risks assessment. Of major importance to integrated analysis for sectors or regions. Existing statistics covering long time series make demographic statistics an essential information. The present focus on eGovernment systems within all sectors and the general rapid changes towards including a spatial dimension in management activities and planning will probably boost the use of socio-economic data with a geographical reference. In order to prepare for the increasing user needs, it is expected that European and national providers disseminate information on relevant aggregation levels, with internationally agreed id's and on formats making it possible to link geometry and attributes.

Community policies: 6EAP, and all the policies in which the exposure of the population to a risk or harm is a concern as well as those where population increase or migration is a key driver.

Important feature types and attributes:

The definition in the Directive specifies kinds of features relevant to demography: The definition includes the term "aggregated". DT anticipates that non-aggregated data about population is excluded. Probably therefore information in this theme does not refer to address level or point based location, e.g. of production activities. The mentioned examples of aggregation are by grid, region, administrative unit or other analytical unit.

Underneath is given examples of features, important attributes, however, can be very diverse and is generally referred to as socio-economic attributes. . Different variables can be relevant for different aggregation levels.

administrative unit, e.g. from the LAU2 level.

- id
- socio-economic attributes as mentioned above

grid, e.g. 1x1 km, 100x100m

- id
- socio-economic attributes as mentioned above

census districts

- id
- socio-economic attributes as mentioned above

small area statistics "free" regionalisation

- id
- socio-economic attributes as mentioned above

settlement – small settlement, village, block, township, town, city

- id
- socio-economic attributes as mentioned above

physical region/area within settlement

- category

functional region/area within settlement

- category

Can also give population figures at other regional aggregations, e.g. on water catchment level, being done in assessments being part of WFD work.

Links and overlaps with other themes:

The thematic information in the form of attributes collections/tables can be linked to geometry datasets also addressed in other themes, such as geographical grid systems, administrative units and statistical units (census districts). Other themes may be more indirectly linked to the theme demography, as they can be used as an input parameter or geometry needed in the generation of an aggregated population dataset, such as the themes address, land cover and utility and government services

Reference documents:

Eurostat: Regional statistics

GISCO database

International agreements on reporting of socio-economic statistics

NACE rev.1.1.

Norwegian Mapping and Cadaster Authority: Feature catalogue and data product specification Norway

SERIEE handbook (CEPA) European commission/ EuroStat 2002: SERIEE: European System for the collection of economic information on the environment. Methods and nomenclature.

Statistics Norway database and map service:
http://statbank.ssb.no/statistikkbanken/default_fr.asp?PLanguage=1
http://statbank.ssb.no/map/pximap.asp?pxfile=2006549121611571561Kostra2KEKommune.px&TempPath=/statistikkbanken/temp/&language=1

Tandem project reports

7.11 Area management/restriction/regulation zones and reporting units

Definition:

(INSPIRE, 2007) 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.

Description:

A wide range of management areas both at European, national, regional and local levels. The themes and its feature types allow information content from any sector – e.g. environmental, transport, health, education, energy, fisheries, agriculture.

Sector-specific management areas contain information about management zones in sectors, not already being covered by the INSPIRE theme "Administrative units". Here only a few examples are given. These may include health care management regions, defence enrolement regions, school regions, fire fighter management regions, police responsibility regions, rescue operation regions, National and IMO adopted Traffic Separation Schemes (TSS) and Deep Water Routes, Military Practice Areas, Explosive Dumping Grounds etc.

Different regimens and regulations may be relevant, some examples are given;
- Safety at Sea - SOLAS - dissemination of data and information for safe navigation - NAVAREA commitments may be relevant to the specification process
River Basin Districts, management area for WFD, is not specifically being defined a subset of water catchments, and is therefore relevant to be defined as a separate management area. Sub-units for reporting under the Water Framework Directive is being discussed, but not yet decided. In the specification process care should be given to differences in definition, nature-based delineation relevant to water catchments, delineation based on administrative decisions conflicting nature-based catchment boundaries relevant for river management zones. WFD: art 2, annex I, ii): River basin district means the area of land and sea, made up of one or more neighbouring river basins together with their associated groundwater and coastal waters, which is identified under Article 3(1) as the main unit for management of river basins. WFD: Annex I, ii): Geographical coverage of the river basin district- the names of the main rivers within the river basin district together with a precise description of the boundaries of the river basin district. Anticipated sources: Environmental / hydrological institutions, Mandatory reporting from MC. The implementation of delineation in the countries may not reflect the nature-based definition in the WFD.

Scope, use examples:

These are major sector or thematic management areas being used primarily by the sector itself. Sector management and reporting areas are also widely being used in reporting and statistical presentations. In order to fulfil needs defined in EU policies, one should secure the flow of main sector management/ reporting units at the European level.

OSPAR reporting units at sea: General micro-scale data of management units at sea. Only a few region areas in Pan-Europe. Anticipated sources: OSPAR

Bio-geographic regions: Biogeographical regions: Europe is divided into eleven broad biogeographical zones. The data is a polygon data set with the major biogeographical regions. The boundaries should be considered to be ambiguous as they are generalisations that have been fit with political boundaries. Scale 1: 10 million.

Important feature types and attributes:

Management region

- sector
- sub-sector
- management activity type
- responsible organisation
- year of verification

Links and overlaps with other themes:

- Administrative units
- Transport networks
- Hydrography
- Geology
- Statistical units
- Land use
- Natural risk zones
- Sea regions
- Biogeographical units
- Mineral resources
- Energy resources

Reference documents:

CNIG: Annexe 5 – Liste des données géographiques de référence en domaine littoral (France)

INTESA GIS: 1n1007_1 - Specifications for producing general Topographic Data Base - Layers, Themes, Classes (Italy)

Norwegian Mapping and Cadaster Authority: Norwegian feature catalogue and standards

RAVI: NEN3610 - Basic scheme for geo-information - Terms, definitions, relations and general rules for the interchange of information of spatial objects related to the earth's surface (The Netherlands)

Regione Emilia-Romagna: Data Base Topografico alle grandi scale (1:1.000 - 1:2.000 - 1:5.000)

7.12 Natural risk zones

Definition:

(INSPIRE, 2007) 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.

Description:

"Natural risk zones" are zones where natural hazards areas intersect with highly populated areas and/or areas of particular environmental/ cultural/ economic value. Risk in this context is defined as: risk = hazard x probability of its occurrence x vulnerability of the exposed populations and of the environmental, cultural and economic assets in the zone considered.

Natural hazards are natural processes or phenomena occurring in the biosphere that may constitute a damaging event. Natural hazards can be classified by origin namely: geological, hydrometeorological or biological. Hazardous events can vary in magnitude or intensity, frequency, duration, area of extent, speed of onset, spatial dispersion and temporal spacing. An international definition on hazard is relevant in defining the theme. The internationally agreed terminology on disasters should be adopted in this document (UNISDR): Hazards is defined as a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydrometeorological and biological) or induced by human processes (environmental degradation and technological hazards). Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterised by its location, intensity, frequency and probability.

Geological hazards are natural earth processes or phenomena that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Geological hazard includes internal earth processes or tectonic origin, such as earthquakes, geological fault activity, tsunamis, volcanic activity and emissions as well as external processes such as mass movements: landslides, rockslides, rock falls or avalanches, surfaces collapses, expansive soils and debris or mud flows. Geological hazards can be single, sequential or combined in their origin and effects.

Hydrometeorological hazards are natural processes or phenomena of atmospheric, hydrological or oceanographic nature, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hydrometeorological hazards include: floods, debris and mud floods; tropical cyclones, storm surges, thunder/hailstorms, rain and wind storms, blizzards and other severe storms; drought, desertification, wildland fires, temperature extremes, sand or dust storms; permafrost and snow or ice avalanches. Hydrometeorological hazards can be single, sequential or combined in their origin and effects.

Many of the hazards are sudden in their nature. However, several categories of natural hazards with major impacts on civil security and on environmental/ cultural and economic assets are not sudden in nature. They may be permanent phenomena going unnoticed (e.g..: radon gas emanations, deficit or excess of elements in soils and water), or slow phenomena (slow ground motion). Technological hazards are commonly sudden failure of a construction or a process causing significant damage. Natural hazards have the potential to precipitate technological hazards. Usually continuous processes like pollution/emission is not classified as hazards. However, repeated emissions might be called hazards, e.g. large scale chemical, radiation or oil spills. Continuous pollution and other environmental problems may have an adverse effect also on the size and frequency of some kinds of natural hazards.

Knowledge about "Natural hazards areas" is important in the identification and delineation of risk zones. The natural hazards areas may reflect all atmospheric, meteorological, hydrologic, geological 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, shrinking and swelling soils, radon gas emanations, deficit or excess of trace elements in soils or water. Data and services are probably needed for both risk assessment and emergency situations Special warning services may be relevant.

Underneath is given examples of some important natural hazards, with information on occurrence: location and frequency and with some information on the datasets, coverage etc.

Areas prone to flooding by inland waters and lakes:
Areas flooded due to exceptional raise of water table in groundwater, rivers and lakes, affecting adjacent land or areas further away being at the same altitude or lower than the flooding water. Affecting housing and industrial sites, agricultural land, transport network, sewage systems, dams etc: Occurrence: Flat river plains, delta areas, valley bottoms and shorelines.

- Physical mapping of areas susceptible to flooding, line for highest recorded level, also division into zones with different susceptibility classes. Data needs: detailed elevation model and measurements in the field
- Areas with certain regulations/ restrictions for different land use/ resource use linked to flooding risk.
- Constructions for flood control
- Data set on restriction zones on land use/ building/ activities downstream reservoirs in case of reservoir brake-down
- Drainage capacity of ground and soil sealing areas with low drainage capacity

Areas prone to flooding by spring tide/ exceptional sea level rise

Areas prone to flooding due to exceptional raise of water table the sea and backwaters, affecting adjacent land or areas further away being at the same altitude or lower than the flooding water. Affecting housing and industrial sites, agricultural land, transport network, sewage systems, dams etc Occurrence: Flat coastal areas, areas lower than original sea level. Commonly harbours, trade areas etc.

Frequency: Floods, as storms, are among the most common natural disasters in Europe – with the effect of being of the most costly in terms of economy and insurance.

- Physical mapping of areas susceptible to flooding, line for highest recorded level, also division into zones with different susceptibility classes. Data needs: detailed elevation model and/or measurements in the field.
  - measures by radar satellites or air born equipment to measure water level
  - field measurement
- Constructions for flood control
- Areas with certain regulations/ restrictions for different land use/ resource use linked to flooding risk.

Earthquakes

Earthquakes are widespread in the EU and other European Countries. The most destructive events have occurred in the Mediterranean countries, particularly Greece and Italy, which are in the collision zone between the Eurasian and African crustal plates. Through the last three decades several thousand persons have died and injured, several hundred thousand became homeless in events in Greece and Italy. Data needed for getting overview and handling the hazard:

- date and time of occurence; - epicenter location, depth, with a liability index - Magnitude and type of magnitude used - Observations (local intensity (MSK 1964 standard) with a liability index) - Triggered effects - Fault
- Data needed for emergency/ rescue operations

Volcano eruptions:

A few active volcanoes exist in the EU and other European Countries. The activity is low and generally the threats are minimal compared to other natural hazards. Some destructive events have occurred in the Mediterranean countries, such as Italy over the past decades. Actions are usually coped with at the local level.

- It is difficult to outline important spatial data sets linked to volcano activities. There might exist maps on expected lava flow channels and restriction areas for certain activities.

Mud slides, land slides and quick (saline leached) clay soils slides:

- clay rich shrinking and swelling soils
- areas of unstable terrain, slide area divided into zones of different susceptibility classes
- borehole locations with further information on the salt content etc
- affected area if area is subject to slumping and landslip
- Areas with activity restrictions – which kinds of operations are allowed in order to prevent slides and which areas are not to be built on. Different countries have different threshold levels e.g. concerning slope degree on land used for buildings, the values depending on the ground condition (soil, clay, bedrock)

Areas prone to mountain blocks slides and stone slides:

Occurrence: Mountain block slides mostly in alpine environment with "young landscapes" where frost and water erosion is active, stone slides areas with steep slopes and loose material. Problems occur where land use includes settlements, infrastructure etc.

- Physical mapping of areas susceptible to land block slides divided into zones with different susceptibility classes. Based on mapping of bedrock structures.
- Physical mapping of areas susceptible to stone slides divided into zones with different susceptibility classes. Further info on kind of material. A rough assessment can be based on analysis of slope angle, slope length and rock stability.
- Anticipated affected areas followed by a land block slide; the stone masses themselves and following flooded areas.
- Areas with certain regulations/ restrictions for different land use/ resource use linked to land block slide risk and stone slide risk.
- Constructions for directing stone slides

Areas prone to snow slides - avalanches:

Occurrence: In areas with significant snow cover combined with steep slopes. Wind will affect the creation of snowdrifts.

- Physical mapping of areas susceptible to snow slides divided into zones with different susceptibility classes
- Areas with certain regulations/ restrictions for different land use/ resource use linked to snow slide risk.
- Constructions for directing slides

Areas susceptible to forest, bush and grassland fires

Areas susceptible to forest, bush and grassland fires can be analysed by using

- Satellite images
- Vegetation cover, composition and strata
- Elevation data
- Meteorological data, Precipitation, temperature, winds,

Areas of installations prone to storms/ wind damage

Occurrence: Unclear picture; seas, coastal areas and narrow valleys, but also other areas within the continent. In addition storms, as floods, are among the most common natural disasters in Europe – thus also being the most costly in terms of economy and insurance.

- Data sets. Areas with recorded extreme wind

Coastal erosion

Coastal erosion is an important and costly category of natural hazard of growing significance in a climate change context

Radon areas

Natural radiation from bedrocks and unconsolidated rocks are considered as natural risk zones due to a possible high radon concentration in indoor air.

Scope, use examples:

Recent local and trans-national disasters have demonstrated to the European Commission and the Member States of the European Union that data and services about natural hazards and risk zones are of paramount importance of efficient risk management. Every year European citizens experience the negative consequences of natural disasters caused by flooding, forest fires etc. This was one of the reasons why "Safety of the Citizen" has been selected as one of the main topics for future EU research and development activities within the JRC during the Fifth Framework Program. The enhanced 'risk and hazard' monitoring and coordination responsibilities of EU services Environment DG and Research DG underpin this trend. In addition European policies covering different thematic domains, planned or already in place are directly linked to Natural Hazards problems e.g. Agriculture and Forestry domain - Agriculture DG, Spatial planning domain - Regional Policy DG. Concerning technological hazards, the Seveso Directive is of major importance in regulating management of risk.

It is an aim to minimise risks by making the society more resistant to hazards, either by minimising threats or by regulation of land use and production activities susceptible to the hazards. Some areas are more prone to natural hazards than others. It is important to identify these areas and build up regulations for long term land and production management. Maps, spatial databases and online spatial services are being used actively to carry out such management. Risk analysis is the basis for all work on planning and living with natural and technological hazards. All areas may in some way or other be affected by natural hazards, and areas with certain kinds of human activity may be hit by technological hazards.

The different kinds of users for handling hazards may be grouped into four:

- reporting, trends and overall policy development , commonly at national and international level
- assessment of natural and technological risks – mapping of areas prone to be hit by hazards
- planning phase for securing public safety- long term regulation and management of land and activities
- disaster response and emergency operations

In order to perform these activities certain kinds of data and services are needed. It is essential with a well organised supply system. The different kinds of data and services to be used and handled in these kinds of actions can be

- satellite images and air photographs as orthophotos
- vector data sets with polygons and lines
- simple point information tables
- address information system handled in GIS data bases
- online and web services of different kinds offered to specific user communities or the public, from organisations such as meteorological or hydrological offices.

The issues will be further elaborated below.

Four different forms of usage are identified below, including an outline of their spatial data needs. Based on the data, different kinds of services may be developed and used.

- **Reporting, indicators, trends, overall policy development:** The needs for spatial data by this use is limited. Usually one will need reporting units such as countries, NUTS regions, or catchment areas. There will be some use of generalised versions of data sets to be used under the other use categories. Overall trends in frequency of natural hazards is for some of the phenomena linked to the environmental situation – climate change in particular and land cover changes in particular. Data needed for analysing links and dependencies are needed.
- **Susceptibility analysis, mapping and prediction:** Data sets describing and analysing the natural phenomena causing hazards, commonly detailed data with high accuracy is needed, such as measuring stations, detailed thematic mapping through fieldwork (e.g. specific aspects of soil and land cover) , air photo interpretation or remote sensing, analysis of detailed elevation models, water flow data linked to the river and lake network, meteorological and climate data, seismic activity mapping etc. Work is seen to be carried out by both local authorities, national mapping agencies, national thematic agencies or international organisations.
- **Physical and sector disaster-prevention planning:** Making disaster-resistant communities by long term physical and sector planning, usually carried out at local and regional level. The mapping carries of by thematic agencies as described over will is used and transformed into simplified data sets and planning documents showing areas of high risk and restriction zones at or around high risk areas. The delimitation of the restriction zones would need population data, land use plans etc.
- **Emergency operations/disaster response:** The emergency operations for both natural and technological hazards needs more or less the same kinds of data. In order to make emergency management a faster and more accurate means to reduce effects, data are needed in several parts of the operation;
    - Monitoring; continuous or real time situation reports, giving information on trends, direction etc. Using GNSS linked to detailed topographic map data,
    - Overview and identification of qualities at land and sea; persons, property, production activities, infrastructure and environmental qualities that can be affected by the hazard/ disaster. It is essential to access the extensiveness of the anticipated damage caused by natural and technological hazards. There is a need to know about population information at the lowest possible level, property information making it possible to identify owners of individual properties, address register for information purposes and identification, mapping of areas/ infrastructure affected, such as roads, rail, telecommunication lines, water, gas pipe lines, oil installation at sea, storage areas for hazardous substances, resources such as important groundwater bodies, other extraction points for water or other resources, land use, location of high value environmental areas (biodiversity, recreation, cultural heritage sites etc)
    - Location of resources needed to perform the operation; Infrastructure, road and rail capacity, water supply points, depot for emergency equipment (oil spill extraction boats, vehicles etc) location and capacity of hospitals, information to see vehicle information on location, allocating resources, deploying personnel. Included here is also the administrative boundaries for responsibility areas of different bodies involved in the operation.

Links and overlaps with other themes:

The broad field of natural risks may link and overlap may other themes, mostly concerning physical environment; Land use (land use plans may reflect risk zones), Elevation, Hydrography, Land cover, Geology, Environmental protection facilities, Meteorological geographical features, Oceanographic geographical features.

Reference documents:

Balestro, Gianni; Piana, Fabrizio: GIS technology as tool to bring out the role of geological interpretation in the assessment of geological hazard

CNIG: Annexe 5 – Liste des données géographiques de référence en domaine littoral (France)

Glade, Thomas; Malcom Anderson and Michael J. Crozier (editors): Landslide Hazard and Risk

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http://reports.eea.europa.eu/environmental_assessment_report_2003_10/en/kiev_chapt_10.pdf
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http://www.geohazards.no/
http://geohazards.cr.usgs.gov/
http://www.ngu.no/kart/skrednett/?lang=English

IGOS Geohazards Theme report, 2004;(with the support of the European Space Agency) - Terminology: Basic terms of disaster risk reduction developed by the UN International Strategy for Disaster Reduction, available here: http://www.unisdr.org/eng/library/lib-terminology-eng%20home.htm

Norwegian feature catalogue. definitions and UML application schema e.g. for landslide: http://www.statkart.no/sosi/UMLfullmodell/Skred/Skred.htm.

Oosterom, Peter van; Siyka Zlatanova and Elfriede M. Fendel (editors): Geo-information for Disaster Management

POSITION COMMUNE (CE) No 33/2006 arrêtée par le Conseil le 23 novembre 2006, Chapitre III art.6

Schmidt-Thomè, P (2006): Natural and Technological Hazards and Risks Affecting the Spatial Development of European Regions. Geological Survey of Finland, Special Paper 42. (Espoo), p. 167, fig. 35, tab. 56, maps 22

7.13 Atmospheric conditions

Definition:

(INSPIRE, 2007) Physical conditions in the atmosphere. Includes spatial data based on measurements, on models or on a combination thereof and includes measurement locations.

Description:

Historical versions of the theme definition are found in the INSPIRE IMS and Scoping papers:

- Spatial data reflecting the physical conditions of the air and atmosphere, either as isolines, grids or other spatial forms. These can be based on measurements or models. This could also include the measurement locations. (INSPIRE IMS, 2003)
- Physical conditions in the atmosphere, represented as lines, grids or points. Includes spatial data sets based on measurements, on models or on a combination thereof and includes measurement locations. (INSPIRE Scoping, 2004)

In order to place into context the range of spatial data types relevant to this theme, we consider the typical 'forecast cycle' of a national meteorological service (NMS). This will: (a) collect meteorological observations over (say) a six-hour interval, (b) 'assimilate' these into a numerical model to produce an estimate of the current atmospheric state, (c) use this analysis as the initial condition for a model forecast run forward in time (typically out to several days). Four broad types of data are involved at different phases of the cycle:

1. **Observations**: around 11000 surface stations globally make up the Global Observing System, reporting such atmospheric parameters as weather, cloud, temperature, humidity, wind, visibility, pressure. A subset of these stations make '*climate observations*' which include daily temperature minimum and maximum, sunshine hours, rainfall amount etc. In addition, around 1000 '*upper-air*' stations make radiosonde (free-rising balloon) observations of pressure, wind, temperature and humidity. Voluntary observing ship and drifting buoys make *marine observations* including sea surface temperature, and wave height and period. Several hundred thousand reports per day of pressure, winds and temperature are made from *aircraft observations*.
2. **Synoptic analysis**: Gridded wind, temperature, humidity, geopotential height, precipitation, etc. Also, 'sensible weather' elements (fronts, cloud, thunderstorm activity etc) will be analysed.
3. **Forecasts**: Numerous forecast products are produced operationally. A conventional weather forecast contains similar elements to the synoptic analysis.
4. **Climatological data**: Long-term time-series' of data (either observations or analyses) may be analysed statistically to create climatologies (e.g. 20th century decadal averages, seasonal/monthly minimum or maximum, etc.).

There is considerable overlap and ambiguity between the themes 'Atmospheric conditions' and 'Meteorological geographical features' – e.g. weather conditions ('Meteorological geographical features') including precipitation, temperature, wind etc. are precisely components of the atmospheric state ('Atmospheric conditions'). Numerous suggestions have been made by stakeholders to resolve this ambiguity. They include:

- merging the themes (it is impossible to amend the Directive, but it would be sensible to consider the themes jointly during data specification development)
- distinguishing 'field-based data' (*Atmospheric conditions*) from 'point-based data' (*Meteorological geographical features*)
- distinguishing 'time-series & near-real-time data' (*Atmospheric conditions*) from 'gridded climate data' (*Meteorological geographical features*)

- distinguishing 'climate data' (*Atmospheric conditions*) from 'observations and forecasts' (*Meteorological geographical features*)

To resolve the ambiguity between themes, we consider the *multi-level approach* to data needs assessment applied in the INSPIRE 'Environmental Thematic User Needs Position Paper' (2002). Data at *local or regional level* are often needed for management and policy implementation, while lower resolution ('smaller scale') data are often required for reporting and policy development/evaluation. The latter includes *summaries and integrated data products*.

The scope of 'Atmospheric conditions' thematic data should be limited to (six-hourly) synoptic analyses and forecasts (typically gridded model fields), climatological data, and other integrated and/or summary data.

Ambiguity remains in some areas. For instance, it is unclear whether the Directive definition should include air quality information (e.g. airborne particulates, atmospheric chemistry). Similarly, while marine observations are collected in support of meteorological forecasting, they include parameters associated with the oceanographic/sea themes. Certain physical parameters of the atmospheric boundary-layer could be associated either to the atmospheric or oceanographic themes. These ambiguities are referred to the TWG and will be informed also by Use Cases and User Requirements.

The WMO operates a dedicated network (the Global Telecommunications System) to distribute observations and data products. Data exchange is governed by WMO Resolution 40, which provides for free and unrestricted exchange of observational data 'essential' for forecast activities. 'Additional' nominated data and products may be provided with charge, while all data must be supplied free of charge (excluding costs of reproduction and delivery) for research and education. . The ECOMET Catalogue (http://www.meteo.oma.be/ECOMET/Categories_of_data_and_products.htm) provides a 'one-stop shop' index of both 'essential' and chargeable data and product offerings from European NMSs. A similar catalogue is available for the European Centre for Medium-range Weather Forecasting (ECMWF) (http://www.ecmwf.int/products/catalogue/).

Scope, use examples:

Used in environmental and security assessments, in assessment of climatic change etc. (INSPIRE IMS, 2003)

- For the ETC 'Renewable energy resources' data component, solar power estimation requires national, regional and local inventories on soar energy conditions (climate data); wind energy requires climatological wind measurements.
- The evaluation of 'natural and technological risk zones' (ETC) is based in part on climate data (e.g. rain, snow, wind)
- Wind/climate information is required to evaluate soil erosion (ETC)
- Wind information is required for advanced noise zone mapping (ETC)

Important feature types and attributes:

Four-dimensional (space+time) gridded coverage data, very large datasets; station-based or analysed climatological records.

Links and overlaps with other themes:

Overlap exist with:

- Meteorological geographical features
- Oceanographic geographical features and Sea regions (especially for physical parameters associated with the boundary-layer or atmosphere/ocean interface)
- Environmental monitoring facilities (meteorological and air quality observation stations)

Reference documents:

"WMO Reference Information for INSPIRE", available on CIRCA (http://forum.europa.eu.int/Members/irc/jrc/imaco2000/library?l=/drafting_folders/common_area)

"OGC Web Services and GML Modelling for Operational Meteorology", available on CIRCA (http://forum.europa.eu.int/Members/irc/jrc/imaco2000/library?l=/drafting_folders/data_specifications/reference_material/annex_iii/meteorological_geographi&vm=detailed&sb=Title)

"Climate Science Modelling Language (CSML)", available on CIRCA (http://forum.europa.eu.int/Members/irc/jrc/imaco2000/library?l=/drafting_folders/data_specifications/reference_material/annex_iii/atmospheric_conditions&vm=detailed&sb=Title)

"MarineXML position paper", available on CIRCA (http://forum.europa.eu.int/Members/irc/jrc/imaco2000/library?l=/drafting_folders/data_specifications/reference_material/annex_iii/atmospheric_conditions&vm=detailed&sb=Title)

HALO public documents: http://www.ecmwf.int/research/EU_projects/HALO/docs_public.html

From the other reference material submitted by SDICs and LMOs, the following may be relevant to this theme:

Link list to documents relating to: Framework for the WMO Information System (submitted by GRDC)

Ross, Gil: Introduction to WMO for INSPIRE

7.14 Meteorological geographical features

Definition:

(INSPIRE, 2007) Weather conditions and their measurements; precipitation, temperature, evapotranspiration, wind speed and direction.

Description:

Historical versions of the theme definition are found in the INSPIRE IMS and Scoping papers:

- Weather conditions and their measurements; precipitation, temperature, evapotranspiration, wind. (INSPIRE IMS, 2003)
- Weather conditions and their measurements; precipitation, temperature, evapotranspiration, wind speed and direction (INSPIRE Scoping, 2004)

In order to place into context the range of spatial data types relevant to this theme, we consider the typical 'forecast cycle' of a national meteorological service (NMS). This will: (a) collect meteorological observations over (say) a six-hour interval, (b) 'assimilate' these into a numerical model to produce an estimate of the current atmospheric state, (c) use this analysis as the initial condition for a model forecast run forward in time (typically out to several days). Four broad types of data are involved at different phases of the cycle:

1. **Observations**: around 11000 surface stations globally make up the Global Observing System, reporting such atmospheric parameters as weather, cloud, temperature, humidity, wind, visibility, pressure. A subset of these stations make '*climate observations*' which include daily temperature minimum and maximum, sunshine hours, rainfall amount etc. In addition, around 1000 '*upper-air*' stations make radiosonde (free-rising balloon) observations of pressure, wind, temperature and humidity. Voluntary observing ship and drifting buoys make *marine observations* including sea surface temperature, and wave height and period. Several hundred thousand reports per day of pressure, winds and temperature are made from *aircraft observations*.
2. **Synoptic analysis**: Gridded wind, temperature, humidity, geopotential height, precipitation, etc. Also, 'sensible weather' elements (fronts, cloud, thunderstorm activity etc) will be analysed.
3. **Forecasts**: Numerous forecast products are produced operationally. A conventional weather forecast contains similar elements to the synoptic analysis.
4. **Climatological data**: Long-term time-series' of data (either observations or analyses) may be analysed statistically to create climatologies (e.g. 20th century decadal averages, seasonal/monthly minimum or maximum, etc.).

There is considerable overlap and ambiguity between the themes 'Atmospheric conditions' and 'Meteorological geographical features' – e.g. weather conditions ('Meteorological geographical features') including precipitation, temperature, wind etc. are precisely components of the atmospheric state ('Atmospheric conditions'). Numerous suggestions have been made by stakeholders to resolve this ambiguity. They include:

- merging the themes (it is impossible to amend the Directive, but it would be sensible to consider the themes jointly during data specification development)
- distinguishing 'field-based data' (*Atmospheric conditions*) from 'point-based data' (*Meteorological geographical features*)
- distinguishing 'time-series & near-real-time data' (*Atmospheric conditions*) from 'gridded climate data' (*Meteorological geographical features*)

- distinguishing 'climate data' (*Atmospheric conditions*) from 'observations and forecasts' (*Meteorological geographical features*)

To resolve the ambiguity between themes, we consider the *multi-level approach* to data needs assessment applied in the INSPIRE 'Environmental Thematic User Needs Position Paper' (2002). Data at *local or regional level* are often needed for management and policy implementation, while lower resolution ('smaller scale') data are often required for reporting and policy development/evaluation. The latter includes *summaries and integrated data products*.

The scope of 'Meteorological geographical features' thematic data should be limited to local-level high-resolution (weather-related) data, typically observations.

- This includes synoptic observations from stations making up the WMO RA VI (European) Regional Basic Synoptic Network.

The WMO operates a dedicated network (the Global Telecommunications System) to distribute observations and data products. Data exchange is governed by WMO Resolution 40, which provides for free and unrestricted exchange of observational data 'essential' for forecast activities. 'Additional' nominated data and products may be provided with charge, while all data must be supplied free of charge (excluding costs of reproduction and delivery) for research and education. The ECOMET Catalogue (http://www.meteo.oma.be/ECOMET/Categories_of_data_and_products.htm) provides a 'one-stop shop' index of both 'essential' and chargeable data and product offerings from European NMSs. A similar catalogue is available for the European Centre for Medium-range Weather Forecasting (ECMWF) (http://www.ecmwf.int/products/catalogue/).

Scope, use examples:

Used by the environmental sector to predict natural hazards e.g. flooding, drought, forest fires. Also used by other sectors, e.g. water supply to estimate recharge, for forecasting agricultural performance, for giving meteorological forecasts to shipping etc (INSPIRE IMS, 2003).

- A range of meteorological observations is required in support of 'air and climate change' environmental policy implementation and management (ETC)
- A range of meteorological (e.g. rainfall, snow, temperature, winds) data is required for natural hazard prediction and monitoring – floods, avalanches, fires; and for the management of chemical and other hazardous events (ETC)

Important feature types and attributes:

Raw data organised by station (location, id)

Possibly high spatial resolution raw surface data, from remote sensing instrument at their best resolution

Links and overlaps with other themes:

Potential overlap with:

- Atmospheric conditions
- Oceanographic geographical features and Sea regions (especially for physical parameters associated with the boundary-layer or atmosphere/ocean interface)
- Environmental monitoring facilities (meteorological and air quality observation stations)

Reference documents:

Science Modelling Language' (CSML)", available on CIRCA (http://forum.europa.eu.int/Members/irc/jrc/imaco2000/library?l=/drafting_folders/data_specifications/reference_material/annex_iii/meteorological_geographi&vm=detailed&sb=Title)

"Marine XML", available on CIRCA (http://forum.europa.eu.int/Members/irc/jrc/imaco2000/library?l=/drafting_folders/data_specifications/reference_material/annex_iii/meteorological_geographi&vm=detailed&sb=Title)

"OGC Web Services and GML Modelling for Operational Meteorology", available on CIRCA (http://forum.europa.eu.int/Members/irc/jrc/imaco2000/library?l=/drafting_folders/data_specifications/reference_material/annex_iii/meteorological_geographi&vm=detailed&sb=Title)

"WMO Reference Information", available on CIRCA (http://forum.europa.eu.int/Members/irc/jrc/imaco2000/library?l=/drafting_folders/data_specifications/reference_material/annex_iii/meteorological_geographi&vm=detailed&sb=Title)

HALO public documents: http://www.ecmwf.int/research/EU_projects/HALO/docs_public.html

From the other reference material submitted by SDICs and LMOs, the following may be relevant to this theme:

Link list to documents relating to: Framework for the WMO Information System (submitted by GRDC)

Ross, Gil: Introduction to WMO for INSPIRE

7.15 Oceanographic geographical features

Definition:

(INSPIRE, 2007) Physical conditions of oceans (currents, salinity, wave heights, etc.).

Description:

Historical versions of the theme definition are found in the INSPIRE IMS and Scoping papers:

- The measurable physical conditions of oceans e.g. salinity, oxygen, other chemical components, currents. Representation e.g. as isolines, grids or other spatial organisation. Based on measurements directly or combined with models. (INSPIRE IMS, 2003)
- Physical conditions of oceans (e.g. currents, salinity, etc) represented as lines, grids or points. Includes spatial data sets based on measurements, on models or on a combination thereof and includes measurement locations (INSPIRE Scoping, 2004)

Both 'Oceanographic geographical features' and 'Sea-regions' are concerned with physical conditions of marine water-masses. (This is a similar overlap to that which exists for themes 7.13 "Atmospheric Conditions" and 7.14 "Meteorological geographical features".) To resolve the ambiguity, we consider the multi-level approach to data needs assessment applied in ETC. Data at local or regional level are often needed for management and policy implementation, while lower resolution ('smaller scale') data are often required for reporting and policy development/evaluation. The latter includes summaries and integrated data products.

We regard the theme "Oceanographic geographical features" as being concerned with the high seas and larger oceanic physical/dynamic structures.

Operational forecasting of ocean dynamic physical conditions – together with the prerequisite observations – are key elements of this theme (e.g. through the GMES Marine Core Service), with France and UK both running a operational facilities.

Relevant observational data include:

- remote-sensing of sea surface temperature, dynamic topography (by satellite altimeter), synthetic aperture radar winds, ocean colour (for primary productivity and sedimentation)
- drifting buoys – surface velocity, temperature, atmospheric pressure
- ships-of-opportunity and regular voluntary observing ships provide temperature (bathythermograph) profiles
- Argo floats provide temperature and salinity profiles

Scope, use examples:

Used in environmental assessments, sector resource exploitation. (INSPIRE IMS, 2003)

Important feature types and attributes:

Typically vertical profile or ocean surface data.

Forecast fields are large gridded four-dimensional (space+time) coverage data.

Links and overlaps with other themes:

Potential overlap with:

- Sea-regions
- Meteorological geographical features, Atmospheric conditions (e.g. very similar spatial object types, and also physical links through the boundary layer, and common observational regimes)
- Orthoimagery (since many oceanographic data come from satellite remote-sensing, e.g. ocean colour, sea-surface height, sea-surface temperature.)

Reference documents:

"Climate Science Modelling Language (CSML)", available on CIRCA (http://forum.europa.eu.int/Members/irc/jrc/imaco2000/library?l=/drafting_folders/data_specifications/reference_material/annex_iii/odeanographic&vm=detailed&sb=Title)

"Liste des données géographiques de référence en domaine littoral", available on CIRCA (http://forum.europa.eu.int/Members/irc/jrc/imaco2000/library?l=/drafting_folders/data_specifications/reference_material/annex_iii/odeanographic&vm=detailed&sb=Title)

"MarineXML position paper", available on CIRCA (http://forum.europa.eu.int/Members/irc/jrc/imaco2000/library?l=/drafting_folders/data_specifications/reference_material/annex_iii/odeanographic&vm=detailed&sb=Title)

Marine Metadata Interoperability: http://marinemetadata.org/

SeaDataNet FP6 project: http://www.seadatanet.org/

HALO public documents: http://www.ecmwf.int/research/EU_projects/HALO/docs_public.html (see particularly MERSEA)

French operational oceanography (http://www.mercator-ocean.fr/en)

UK operational oceanography (http://www.metoffice.com/research/ncof/foam/)

EuroGOOS (http://www.eurogoos.org/) is an association of agencies to further the development of operational oceanography within Europe including data management and pilot studies.

NATO 'Additional Military Layers'

From the other reference material submitted by SDICs and LMOs, the following may be relevant to this theme:

IHO Presentation Library for ECDIS (Publication S-52, Appendix 2, Annex A)

IHO: IHO Transfer Standard for digital Hydrographic Data (Publication S-57)

7.16 Sea regions

Definition:

(INSPIRE, 2007) Physical conditions of seas and saline water bodies divided into regions and sub-regions with common characteristics.

Description:

A historical version of the theme definition is found in the INSPIRE IMS paper:

- Seas and saline water bodies divided into regions and sub-regions. Each region with common characteristics, concerning water flow/ circulation, adjacent river catchments, bio-chemical or temperature of water, based on scientific criteria. Detailed information at regional level exist. (INSPIRE IMS, 2003)

Both 'Oceanographic geographical features' and 'Sea-regions' are concerned with physical conditions of marine water-masses. (This is a similar overlap to that which exists for themes 7.13 "Atmospheric Conditions" and 7.14 "Meteorological geographical features".) To resolve the ambiguity, we consider the multi-level approach to data needs assessment applied in ETC. Data at local or regional level are often needed for management and policy implementation, while lower resolution ('smaller scale') data are often required for reporting and policy development/evaluation. The latter includes summaries and integrated data products.

We regard the "Sea regions" theme as focussing on the local/regional level coastal zone.

Whereas 7.15 'Oceanographic geographical features' focuses on physical conditions and general circulation of offshore oceanic waters, the 'Sea regions' theme is concerned with marine features of the coastal zone – regions defined as 'transitional waters' and 'coastal waters' in the Water Framework Directive:

- transitional waters: bodies of surface water in the vicinity of river mouths which are partly saline in character as a result of their proximity to coastal waters but which are substantially influenced by freshwater flows
- coastal waters: surface water on the landward side of a line, every point of which is at a distance of one nautical mile on the seaward side from the nearest point of the baseline from which the breadth of territorial waters is measured, extending where appropriate up to the outer limit of transitional waters

The World Meteorological Organisation also has a geometry-based sea region classification, dividing the ocean into Marsden Squares.

Both biotic and physical parameters and indicators are important in the classification and delineation of sea regions. Physical data requirements for important indicators defined in the WFD and the Integrated Coastal Zone Management policy are outlined in the ETC paper. These include:

- nutrients (nitrate, phosphate and nitrogen: phosphorus ratio) by regional sea and water body type
- concentrations of hazardous substances and pollutants (incl. heavy metals, persistent organic pollutants)
- productivity indicators (incl. surface cholorophyll-a)
- biological classification of waters
- water masses/layers characterised by bulk temperature and salinity properties
- polar area features (incl. pack ice)
- wind (climatological and meteorological)

- benthic parameters (sediment, benthic communities/habitats)
- sea level
- chemical species and concentrations
- physical characteristics (incl. temperature, salinity)
- currents (including surface currents)
- tidal zones
- waves

Scope, use examples:

Water Framework Directive: The WFD classes of surface saline water bodies, transitional waters, coastal waters to some extent coincide with sea regions, but have boundaries based on administrative/ reporting criteria, not scientific definitions. (INSPIRE IMS, 2003)

The Integrated Coastal Zone Management (ICZM) policy is an EU integrated strategy for coastal zone management. Key areas of action for ICZM are environmental impact assessment, coastal land planning, habitat management and pollution control. The Working Group on Indicators and Data has determined a set of indicators of sustainable development of the coastal zone, including sea-level rise and extreme weather conditions.

Important feature types and attributes:

- point measurements of physico-chemical properties
- biological surveys
- meteorological and climate measurements (time-varying)
- tidal timeseries and currents

Links and overlaps with other themes:

Potential overlap with:

- Oceanographic geographical features
- Meteorological geographical features, Atmospheric conditions (e.g. very similar spatial object types, and also physical links through the boundary layer, and common observational regimes)

Reference documents:

ICZM policy documents (see DG-ENV http://europa.eu.int/comm/environment/iczm/home.htm)

Water Framework Directive policy documents (see DG-ENV http://europa.eu.int/comm/environment/water/water-framework/index_en.html)

IHO S-57, S-100 data models: http://www.iho.int/PUBLICATIONS/Publications_E.htm#S57, http://www.iho.int/COMMITTEES/CHRIS/TSMAD/S-100_Info_Paper.pdf

EUSEASED online metadatabase on seabed sediment samples and core as well as on seismic profiles (http://www.eu-seased.net/welcome_flash.html)

EUROSION project: http://www.eurosion.org

From the reference material submitted by SDICs and LMOs, the following may be relevant to this theme:

IHO Presentation Library for ECDIS (Publication S-52, Appendix 2, Annex A)

Norwegian feature catalogue and standards

7.17 Bio-geographical regions

Definition:

(INSPIRE, 2007) Areas of relatively homogeneous ecological conditions with common characteristics.

Description:

Data component description:
Bio-geographical regions show the extent of areas with common characteristics, usually based on climatic, topographic and geobotanical information. Thus the bio-geographical regions show areas with relatively homogeneous ecological conditions. Included in this theme is vegetation map data. The determination of structure and composition of the vegetation is based essentially on stands of ecosystems and their correlation with particular site conditions, commonly based on plant-sociological classification. Vegetation can be mapped either as actual/existing or potential vegetation cover. The classification of potential vegetation depicts the potential distribution of the main natural plant communities. The mapping is based essentially on remaining stands of natural or near-natural ecosystems corresponding to the actual climatic and edaphic conditions. Several high-level data exists for Pan-European level, large-scale data with fragmented systems, resolution and coverage.

Once produced, the bio-geographical data and potential vegetation map data potential vegetation maps are relatively stable and regarded as reference data/maps. Mapping of existing vegetation at local level needs to be updated to depict changes in vegetation.

- **Nomenclature:** The high-level and pan-European data follow agreed nomenclatures. Concerning local and regional data, there exist a broad variety of nomenclatures, e.g. in vegetation mapping.
- **Span in accuracy**: Bio-geographical regional data commonly small-scale data, e.g. in 1: 1 mill or smaller. Vegetation data are commonly more detailed, at local level medium precision data, 1: 50.000 or better. Common scales used are 1:25.000 and 1: 10.000.
- **Clarification about definition, boundary to other INSPIRE themes:** Boundary between land cover and bio-geographical regions.

Scope, use examples:

The data are used for comparisons and assessments of biodiversity and conservation, at international, national even regional levels. Data in the form of detailed data are being used in land management and local land use planning. The European Bio-geographical regions are used for Natura 2000 national proposals validations, which are performed for whole regions.

Knowledge about the extent of local and regional biogeographical regions, e.g. in the form of vegetation maps, may be used to identify climatic, topographic or geological characteristics, as there is a correcation between certain species and such factors. Looking at geology, it is one of the important factors conditioning biodiversity, either directly (moss, lichen, plants directly developing on bare, weathering rock) or indirectly, via soil and the geology derived major and trace elements it contains. Vegetal biotopes are quite frequently strictly correlated to the existence of subjacent acidic, calcareous or ferro-magnesian (basaltic, ophiolitic for instance) rocks. There are even very element specific plants such as Armeria maritima ssp. halleri that is one of the few plants that develops on zinc reach soils, making it a very useful indicator for oxydised zinc deposits exploration in Western europe. The survey of vegetal communities is a precious tool for geological mapping. Geobotany is a scientific speciality (see for instance: http://www.cstars.ucdavis.edu/papers/html/ustinetal1998b/).

Vegetation – potential vegetation

- Classification system/ nomenclature
- Name of class
- Code of class
- Date of last verification
- Source

Example data:

- **Bio-geographical regions** Europe is divided into eleven broad biog-eographical zones. The data is a polygon data set with the major bio-geographical regions. The boundaries should be considered to be ambiguous as they are generalisations that have been fit with political boundaries. Scale 1: 10 mill
- **Potential vegetation** The determination of structure and composition of the potential natural vegetation is based essentially on remaining stands of natural or near-natural ecosystems and their correlation with particular site conditions. The classification of natural (potential) vegetation depicts the potential distribution of the main natural plant communities corresponding to the actual climatic and edaphic conditions. Harmonised pan-European data exists, scattered data with a variety of classification systems exist at lower levels. Coverage: Pan-European: Existing dataset in small scale.
- **Ecological regions** Digital Map of European Ecological Regions The Digital Map of European Ecological Regions DMEER- delineates and describes ecological distinct areas in Europe, on the basis of updated knowledge of climatic, topographic and geobotanical European data, together with the judgement of a large team of experts from several European nature related Institutions and the WWF. The objective of the map of ecological regions in Europe is to show the extent of areas with relatively homogeneous ecological conditions, within which, comparisons and assessments of different expressions of biodiversity are meaningful. Coverage: Pan-European: Existing dataset in small scale.
- The bio-geographical regions for the European Seas are not finally agreed on. To date various models from the EEA, ICES and OSPAR/HELCOM are discussed and have to be added after designation.

Important feature types and attributes:

Bio-geographical/ ecological region

- Classification system/ nomenclature
- Name of class
- Code of class
- Date of last verification
- Source

Links and overlaps with other themes:

Bio-geographical regions may link with biodiversity themes such as the INSPIRE themes Species distribution, and Habitats and biotopes, but may also link to the themes Land cover, Geology, Soil, Mineral resources and Area management/ restriction/ regulation zones and reporting units.

Reference documents:

CNIG: Annexe 5 – Liste des données géographiques de référence en domaine littoral (France)

European Biogeographical regions
http://dataservice.eea.eu.int/dataservice/metadetails.asp?id=308

European Community Biodiversity Clearing House Mechanism
http://biodiversity-chm.eea.eu.int/

Geobotany: http://www.cstars.ucdavis.edu/papers/html/ustinetal1998b

http://www.plant-talk.org/country/europe.html

Karte der natürlichen Vegetation Europas/Map of the Natural Vegetation of Europe. U. Bohn, G. Gollub, H. Hettwer, Z. Neuhäuslová, T. Raus, H. Schlüter & H. Weber. 2004. Landwirtschaftsverlag, Münster. Interactive CD-ROM at scale of 1:2,500,000 with explanatory text (in German and English), legend and maps. The project headed by the Bundesamt für Naturschutz, Germany, started in 1979 with more than 100 participating scientists from 31 European countries.

LÖBF: OSIRIS-Datenmodell (Germany)

NATURE-GIS Guidelines: Data Infrastructure for Protected Areas. Edtor: Ioannis Kannellopoulos (EC – JRC) with the support of GISIG and the contribution of the NATURE-GIS Partners.

Norwegian feature catalogue and standards

O. Polunin & M. Walters. 1985: A guide to the vegetation of Britain and Europe.. Pp. 238. Oxford University Press.

The Diversity of European Vegetation. An overview of phytosociological alliances and their relationships to EUNIS habitats. J.S. Rodwell, J.H.J. Schaminée, L. Mucina, S. Pignatti, J. Dring & D. Moss. 2002. EC-LNV. Report EC-LNV nr 2002/054, Wageningen.

Vegetation Mitteleuropas mit den Alpen in ökologischer, dynamischer und historischer Sicht. H. Ellenberg, 5th edition, 1996. Ulmer, Stuttgart. [Standard work on the vegetation of central Europe but also of value elsewhere; earlier version is available in English from Cambridge University Press as 'Vegetation Ecology of Central Europe' (1988)]

Végétation du Continent Européen. P Ozenda. 1994. Pp. 271. Delachaux et Niestlé, Switzerland.

7.18 Habitats and biotopes

Definition:

(INSPIRE, 2007) 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.

Description:

The "Habitats and biotopes" category of spatial data defined in the INSPIRE Directive is one of several themes in a wider grouping of biological organisms and biological communities - biodiversity. Includes habitats and biotopes as areas and their boundaries. Common to all spatial data that falls under this category is characterisation of the distribution of geographical areas being functional areas for living organisms, biotopes being the spatial and biotic environment of a biotic community/biocoenosis, while habitats being the spatial environment of specific species.

Both climatic, geological, chemical and biological conditions affect distribution of species and communities, thus distribution and conditions of habitats and biotopes. Some species have strict specific requirements to the environment, while others are accepting broad ranges in environmental conditions. Thus biotopes and habitats may vary broadly between different organisms. Some species changes biotopes throughout the year, by changes in seasons or due to migration. Some biotopes/habitats are depending on management, e.g. all kinds of cultural landscapes. Time series in mapping may be used to identify changes in biotopes/habitats.

Description of living areas for any kind of biota, usually used as a term for describing areas used by zoo-biota. Habitats commonly follow geobotanical/ bio-geographical regions/ vegetation types. In rough terms land cover classes and vegetation classes represent terrestrial habitats. Habitats can also be described at more detailed levels e.g. hedgerows, creeks etc. At sea differences in temperature, salinity, current, depth, topography, seabed geology or sediment conditions may form different habitats. Habitats and biotopes data can be made both by mapping in the field, remote sensing and aerial photography interpretation or modelling.

Different documents and communities follow different definitions for habitats and biotopes. An example is the Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora. EUNIS has been developed as an international nomenclature for habitats. Different countries or communities have different classification systems. There may be difficulties in mapping accurately certain habitat classes between national nomenclatures and also between national and European nomenclatures. To find common European definitions and nomenclatures need to take into account both national systems and the different definitions used by international communities.

Habitats and biotopes does only include areas represented by natural boundaries and classified according to their ecological or physical condition. Habitats and biotopes being designated as protected sites is not included, they fall under another category of INSPIRE themes, namely "Protected sites", as these represent administrative area regulation and not ecologically founded boundaries.

The terms natural or semi-natural needs clarification, artificial landscapes being habitats (cultural landscapes like town areas, cultivated land, orchards, pastures etc) may be defined to be out of the scope of the theme.

Scope, use examples:

Assessment of changes in landscape and effects of wildlife and plant life. Linked to Habitats Directive. The habitats designated to the Directive are mentioned in the “area regulation” data component.

A selection of valuable habitats have been designated according to the Habitats and Birds Directives. In the marine environment a selection of valuable habitats have also been designated according to the OSPAR and HELCOM conventions.

Is being documented and used for identifying biotic diversity within areas or countries, both geographical distribution, variety and representation frequency. It is being used for planning of protection and management of biodiversity in natural, semi-natural and artificial environments. Users are both governments, professional environmental organisations, but also the practical land and resource managers being farmers or fishermen. Wide variety of different classification systems and levels of detail in mapping.

- Scale: An indication of common mapping scales: from 1: 5000 to 1: 1.000.000
- Community policies: 6EAP, Habitats and Birds Directive, CAP.
- Initiatives: NATURA2000, The RAMSAR database, CORINE biotopes and others.

Example data:

Biotope sites: Areas of ecological/ biodiversity interest areas, recorded under the Natura programme. Sites of special ecological interest in Nature conservation recorded whether protected or not.

> **Attributes:** site surface statistics, habitat data, mammals, birds, amphibians, fish, invertebrate, plant, Site designation status
> **Coverage:** EU Countries and Phare Countries, Finish date collection 1995. Updates?

Important feature types and attributes:

Biotope (area)

- Classification/Nomenclature system
- Category hierarchy level
- Category name
- Category code
- Mapping date: verification date
- Species or typical species found in the biotope
- Site description

Habitat (area)

- Classification/Nomenclature system
- Category hierarchy level
- Category name
- Category code
- Mapping date: verification date
- Species/species group to which the habitat refer
- Site description

Nomenclature should as far as possible follow internationally agreements.

Links and overlaps with other themes:

Habitats and Biotopes may link with biodiversity themes such as the INSPIRE themes Bio-geographical regions and Species distribution, but may also link to the themes Land cover, Land use, Geology, Soil and Mineral Resources.

Reference documents:

CNIG: Annexe 5 – Liste des données géographiques de référence en domaine littoral (France)

EUNIS, http://eunis.eea.eu.int/

Habitat classification system: http://eunis.eea.eu.int/upload/EUNIS_2004_report.pdf

Habitat types: http://eunis.eea.eu.int/upload/EUNIS_2004_list.pdf

LÖBF: OSIRIS-Datenmodell (Germany)

Marine Landscape reference documents at BALANCE web-site http://www.balance-eu.org/

NATURA 2000: Identification & GIS Classification of Flora Habitants in Significant Reservation Areas (Greece)

NATURE-GIS Guidelines: Data Infrastructure for Protected Areas. Edtor: Ioannis Kannellopoulos (EC – JRC) with the support of GISIG and the contribution of the NATURE-GIS Partners.

Norwegian feature catalogue contain specification and UML model for biological diversity. URL: http://www.statkart.no/sosi/UMLfullmodell/Bioma/Bioma.htm

Rote Liste der gefährdeten Biotoptypen Deutschlands" (Riecken et al. 2006, Naturschutz und Biologische Vielfalt 34

7.19 Species distribution

Definition:

(INSPIRE, 2007) Geographical distribution of occurrence of animal and plant species aggregated by grid, region, administrative unit or other analytical unit.

Description:

Pan-European, national or local mapping initiatives, resulting in spatial data for species in terrestrial and marine environments, e.g. for birds, insects, mammals, amphibians, reptiles, fish or vascular plants.

Clarification:

- The definition in INSPIRE Directive proposal does not include individual observations or other point based data, but focuses on aggregated versions of data about geographical distribution of species. Aggregation can be at any level of resolution, e.g. in geographical grid systems divided into 100x100 meter grid or 50x50km grid cells. Possibly also point-based observations and isolines generation between observations should be accepted and included in INSPIRE. Possibly these can be defined as options in the "other analytical unit". Aggregation may also be interpreted not only as space-based aggregation, but time-based aggregation as well.
- Only species are mentioned in the INSPIRE definition. But earlier INSPIRE documents (INPIRE IMS, 2003) mentions both species or species grouped e.g. to families.

Scope, use examples:

Different initiatives aim to get a full coverage of up to date species distribution data at a Pan-European scale, for a major set of mammals, birds, mammals and reptiles, vascular plants, together with similar data for a selection of other organisms important as indicators on environmental quality of air, inland waters, marine environment, soil, habitats.

Digital data sets can be used for conservation and statistical analysis, as the base of research in ecology and biodiversity, applied to the conservation and management of nature. In biodiversity assessment it is essential to have information on species distribution, quantities, development through time. Needed for Natura 2000. Is being documented in sciences and used for identifying biotic diversity within biotic regions or countries, both geographical distribution, changes over time, combination of species in communities and co-variance with environmental factors and ecological qualities. It is being used for planning of protection and management of biodiversity in natural, semi-natural and artificial environments. Users are both governments, professional environmental organisations, but also the practical land and resource managers such as farmers or fishermen. It is of high relevance to commercial exploitation of economic natural resources such as animals and plants living in natural and semi-natural environments, e.g. fisheries of specific species, both in marine and inland waters, hunting, forestry and sea weed harvesting.

The EU's principal instruments for nature conservation are the Birds Directive (1979) and the Habitats Directive (1992). Both Directives are leading to the establishment of the Natura 2000 network of sites.

Variety of different classification systems and levels of detail in mapping.

- Taxonomic references shall respect to the GBIF taxonomic reference. Different EU regulation should refer to this system, but existing EU directives refer to different taxonomic systems.
- Scale: An indication of common mapping scales: from 1: 5000 to 1: 10.000.000
- Community policies: 6EAP, Habitats and Birds Directive, CAP, Fisheries policies etc.

- Initiatives: NATURA2000, OSPAR convention, GBIF, Flora Europaea etc.

Example data:

- **Bird species distribution data:** Distribution of species by grid. Data sets on 440 different breeding birds in Europe have been compiled. Each breeding bird is classified according to its breeding status within 50 km grid squares. European Ornithological Atlas Committee. Mapping the breeding distribution of those European species, obtained through field work.

  Attribute information: presence and absence of each species, possible/probable/conformed/breeding, estimate of number of pairs in square, census period, square identity, survey completeness, altitude, observers, and comments.
  Coverage: Pan-European

- **Plant species distribution data:** A data set containing information upon the presence of plant species in grid squares across Europe.
  Attribute information: species found in each 50 km square, native occurrence, introduction, status unknown, probably extinct, record uncertain
  Coverage: Pan-European. It has taken 25 years to map 20 % of European Vascular plants. By 1999 there were plans of how to speed up the process.

- **Amphibian and reptile species distribution:** Species distribution in 50 km grid squares.
  Attribute information: coded latin name, date of sightings, regular presence of siting, the presence of the species.
  Coverage: Pan-European. Complete for Western Europe, incomplete for East. Europe (?)

- **Fauna Europaea:** A database containing information upon the presence of fauna species in particular states in Europe. Data collected in the most European countries and published in form of web site with the mapping capabilities. Fauna Europaea references differ regulation 865/2006 which is legally binding and founded on the international CITES agreement.
  Coverage: Pan-European

Important feature types and attributes:

Grid cell or area
- Classification system
- Family, scientific name, vernacular name
- Species, scientific name, vernacular name
- Verification date of presence in grid cell/ area
- Period present throughout the year in grid cell or area, (e.g. by start-end dates, listing months, season)
- Function: A sites function for a species, (e.g. migratory, breeding, resting or mating locality)
- Status: threatened, extinct, etc. (IUCN-category)
- Reference to source

Observation point
- Classification system
- Family, scientific name, vernacular name
- Species, scientific name, vernacular name
- Verification date of presence at location
- Period?
- Function?
- Status: threatened, extinct, etc. (IUCN-category)

- Reference to source
- Observation method

Classification/Nomenclature:

- EUNIS. http://eunis.eea.eu.int/
- GBIF, species in general,
- CITES convention,
- FAO system for classification of fishery resources, 3letter code :HER= herring, CAP= ….
- Coding-System for Status has to be defined. The coding system for different species (groups) differs from each other. IUCN classification system for status may be considered.

Links and overlaps with other themes:

- Geographical grid systems
- Habitats and Biotopes
- Biogeographical regions
- Protected sites: Species may sometimes only be registered within certain locations such as protected sites.

Reference documents:

Atlas Flora Europaea: http://www.fmnh.helsinki.fi/english/botany/afe/
http://www.biologie.uni-hamburg.de/b-online/ibc99/IDB/afe.html

Atlas of amphibians and reptiles in Europe: http://www.mnhn.fr/publication/spn/cpn29.html

Common European Chorological Grid Reference System (CGRS) :
http://dataservice.eea.eu.int/dataservice/metadetails.asp?id=625

Eunis: species: http://eunis.eea.eu.int/species.jsp

Eunis taxonomy: http://eunis.eea.eu.int/species-taxonomic-browser.jsp

EuroMed, Fauna Europae, at: http://www.euromed.org.uk/

European Reference grids. Proceedings and recommendations. Proposal for a European Grid Coding System. IES/JRC. http://eusoils.jrc.it/projects/alpsis/Docs/ref_grid_sh_proc_draft.pdf

Fauna Europea data base, at: http://www.faunaeur.org/

Global Biodiversity Information Facility www.gbif.org

LÖBF: OSIRIS-Datenmodell (Germany)

Natura 2000 Interpretation manual.

NATURA 2000: Identification & GIS Classification of Flora Habitants in Significant Reservation Areas: Greece

NATURE-GIS Guidelines: Data Infrastructure for Protected Areas. Editor: Ioannis Kannellopoulos (EC – JRC) with the support of GISIG and the contribution of the NATURE-GIS Partners.

Norwegian feature catalogue contain specification and UML model for biological diversity. URL: http://www.statkart.no/sosi/UMLfullmodell/Bioma/Bioma.htm

7.20 Energy resources

Definition:

(INSPIRE, 2007) Energy resources including hydrocarbons, hydropower, bio-energy, solar, wind, etc., where relevant including depth/height information on the extent of the resource.

Description:

Pan-European, national or local initiatives on mapping occur, resulting from governmental initiatives or private interests. There is a main distinction between fossil fuels and renewable energy resources. The concept of energy resources provides focus to the resource aspect and the extent/distribution of the resources. Thus, the technical constructions for abstraction, transport and treatment are not covered by this theme. However they are to a large extent covered in other themes, such as production and industrial facilities. Energy use, e.g. petrol consumption, is not covered by this theme. Licence areas, permission areas or planning areas linked to energy resource exploitation is covered by the theme "Area management/restriction/regulation zones and reporting areas".

The term resource can be problematic to define, the quantification and thus location of a resource is depending on the technical and economic situation. Resource aspects should not only be restricted to the resources under utilisation, but should also include un-utilised resources.

Fossil fuel resources include

- Oil accumulation: hydrocarbot fields, petroleum volumes
- Natural gas accumulations, including solid methane clathrates
- Coal, lignite or peat deposits
- Uranium ore deposits

For these resources the nature, location and 3D geometry of the deposit (= geological resource) of the deposit, the nature of the economic energy carrier and the size of the reserves at a point in time are key attributes.

The different kinds of renewable energy resources may include:

- **Hydropower:** Water resources especially mapped according to energy potential. Commonly undertaken in the MS, carried out by governmental bodies or private firms.
- **Bio-energy resources:** Forest resources, “scrap” forest, cereals or agricultural residues can be used for energy purposes, e.g. in the form of firewood or biodiesel. The resources or supply is sometimes being estimated and mapped.
- **Wind energy:** Country inventories of wind energy is being done in areas where wind is being utilised or planned utilised. Estimated by wind measurement together with topographical information. Example: http://www.nve.no/vindatlas/
- **Geothermal energy:** The Earth's natural heat flow is of high interest as a renewable and clean energy source. Mapping of the resource can be available or relevant at local, regional or national levels. A Pan-European Atlas was published in 2002 by the EC (see reference materials). Geothermal energy systems use the natural heat of the subsoil by utilising warm groundwater from surficial deposits for direct heating or electricity generation (open system). Alternatively, shallow geothermal flows are exploited by ground source heat pumps (closed system). Common heat sources in bedrock or subsoil may be utilized - a circulation of an antifreeze solution in collector hoses which are lowered into relatively shallow boreholes bedrock or circulation of ground water from deep boreholes in bedrock. Heat pumps are suitable, too, for example for extraction of heat from air, rivers, seas and artificial components**.**

- **Solar power and resources:** In order to reduce the need for extra heating solar conditions at local sites are important to bring into account in local planning. National, regional and local inventories on solar energy conditions is needed, relating to heating needs. Systems for storing solar heat is found at some locations. Solar resources may also be used in electricity production, through the use of solar cell technology (silicium cells). Air-based heat pumps can use solar energy stored in the air.
- **Other energy resources such as waves, currents etc.:** The different kinds of renewable energy resources is long. The list above is only giving some examples.

The quantification of the resources may be aggregated or detailed. The detailed information is to a large extent private business information. This includes for instance data about the internal structure of geological structures within oil fields. Within the INSPIRE context the data in question will mainly be aggregation and overview data. However, for public planning purposes at the local level detailed information about some of the renewable energy resources may be relevant.

The geographical representation of the resources (objects) may be different in different scales. In the mapping and exploitation of the resources 2-d (ordinary maps) and 3-d geographical data are being used. Resources may be mapped by natural boundaries. Aggregated or overview information can be referring to grid cells in a geographical grid system, administrative units/areas, statistical units/areas or points.

Scope, use examples:

Digital energy resource data can be used in different settings

- in management of resources and exploitation activities
- in EU policy development and regional policies
- in strategic work and resources planning
- in land use and urban planning
- in environmental impact assessments
- as input-data in assessments of state of the environment, e.g. modelling of future emissions, pressure and sustainability

Important feature types and attributes:

Some energy resources, such as oil or hydropower can be localised quite distinctly, while other resources, such as solar resources or wind resources based on point measurements are modelled/interpolated into "continuous" area and 3D-objects,

Energy resource object (2D or 3D-volumes)

- resource type (oil, gas, wind,..)
- name (place/location name)
- id
- quantifitation
    - volume
    - date of quantification

Water catchment area
- id
- average runoff

Administrative/ statistical unit
- resource type (oil, gas, wind…)
- quantification
    - amount
    - date of quantification

Grid cell
- resource type (oil, gas..)
- name
- id
- quantifitation
    - volume
    - date of quantification

Links and overlaps with other themes:

- Grids
- Administrative units
- Geology
- Statistical units
- Hydrography
- Soil (e.g. coal, peat)
- Land use
- Production and industrial facilities, area management/ restriction/regulation and reporting units
- Oceanographical geographical features
- Mineral resources

Reference documents:

Energistics , Formerly, the Petrotechnical Open Standards Consortium (POSC), The mission of Energistics is to deliver to the upstream oil and gas industry the means to produce, deploy and maintain common information and data standards. http://www.energistics.org/posc/Overview.asp?SnID=912544453 (formerly http://www.posc.org and http://w3.posc.org/xxxx)

Geowissenschaftliche Karten der Bundesrepublik Deutschland, 1 : 2 000 000 – Kohlereviere, Hannover 2006 / Geoscientific MAps of te hFEderal Republic of Germany, 1 : 2 000 000 – Coal Mining Districts

http://www.esa.int/esaEO/SEM9BL3VQUD_economy_0.html

http://www.esa.int/esaEO/SEMM8L3VQUD_economy_0.html

http://gis2.rrc.state.tx.us/public/

http://www.ppdm.org/standards/model/

http://www.etpsmr.org/ to the reference documents

Hurter, S. & Haenel, R. (2002): Atlas of Geothermal Resources in Europe. - 93pp, 88 plates, ISBN 92-828-0999-4, CG-NA-17-811-EN-C; Luxemburg (Office for Official Publications of the European Communities)

INSPIRE IMS: Implementation Strategy Issues - Data requirements. 2003.

INSPIRE position paper: Environmental and thematic data. 2002.

INSPIRE scoping paper, 2004.

Norwegian feature catalogue, specification and data model on oil/gas: URL:
http://www.statkart.no/sosi/UMLfullmodell/Petroleum/Petroleum.htm

PRODML (Production XML) Standards for Production Optimization: This standard is currently used by over 60 E&P companies, service industries and governmental agencies. http://www.prodml.org/ http://www.energistics.org/posc/Production_Stds.asp?SnID=1369808806

The Dutch Mining Act, Mining Decree and Mining Regulations. May be of use for the EU community of Energy Regulating authorities. Operators must obtain a variety of permits for oil and gas exploration and production. Summary of the permitting procedures, including an overview of pertinent legislative articles and different reports standards required:
http://dinolks01.nitg.tno.nl/dinoLks/NLOGPortal.jsp
http://dinolks01.nitg.tno.nl/dinoLks/delfstoffen/index.html

Wagner H, Tiess G, Nielsen K, Solar S, Hamor T, Ike P, Vervoort A, Espi JA, Agiountantis Z, Koziol W, Bauer V, 2005: Minerals planning policies and supply practices in Europe. Montanuniversität Leoben (At)

Wellsite Information Transfer Standard Markup Language WITSML: Developed by the WITSML project, an oil industry initiative sponsored by BP and Statoil, and later by Shell, as a new standard for drilling information transfer This standard is currently used by over 60 E&P companies, service industries and governmental agencies. http://www.witsml.org/

7.21 Mineral resources

Definition:

(INSPIRE, 2007) Mineral resources including metal ores, industrial minerals, etc., where relevant including depth/height information on the extent of the resource.

Description:

The mineral resources data theme refers to the description of natural concentrations of very diverse minerals of potential or proven economic interest. Important attributes are the nature, genesis, location, extent/distribution of these resources. The economic and technical data related to the location of areas licensed for exploration or mining, to the exploitation of deposits, transport, treatment and waste disposal are not covered by this theme. However, storing of material near mines and quarries is necessary. Knowledge how the constituents affect the surroundings is of importance, e.g. leakage from sulphides etc. They are to a large extent covered in other themes, such as production and industrial facilities. Energy minerals such as coal, uranium, oil and gas are excluded in this theme, as they are found in theme "energy resources". Exploration licence areas and areas permitted for mining are covered by the theme "Area management/restriction/regulation zones and reporting areas".

Mineral resources data refers to:

- **Anomalies:** locations where background concentrations of potentially valuable elements in soils, stream sediments or rocks onshore or offshore exceed the normal background values expected given the local geological context. Such maps are widely used in mineral exploration. Attributes are location, chemical elements, nature of the sampled element (s), analytical value(s);
- **Occurrences:** points or areas where concentrations of a given mineral (s) are observed but without a proven economic potential. Attributes are location, nature of the mineral(s), analytical data, nature of the host rock, geometry/ morphology of the observed occurrence(s)
- **Deposits:** areas bearing mineral concentrations with economic potential. Attributes are detailed below

A mineral resource encompasses all quantities of mineral resources, discovered and undiscovered, that are contained in, or have been produced from, naturally occurring accumulations on or within the earth's crust.

Resource information is generally available for deposits held by companies listed on the Western stock markets, as they face reporting obligations. National legislation also influences the detail of data publicly available. Detailed data or data related to some rare metals deposits with high-technology applications, may be difficult to obtain considered to be of economic/ private interest and therefore, problematic to distribute.

The mineral resources sector is divided in a number of segments, differentiated by the technologies involved in exploration and mining, the markets and the nature of the exploited material(s):

- Metal mining (non-energy metallic ores, uranium pertaining to the energy sector);
- Industrial minerals;
- Construction minerals and rocks; e.g. natural stone (dimension stone), sand and gravel and crushed bedrock aggregates
- Ornamental stones;
- Precious and semi-precious stones.

The description of the three first categories is included in the European Commission (DG Enterprise) document listed among the reference documents (Box 1 provides a comprehensive definition). The definitions included in that document should to be adhered to, in order to promote consistency of the semantics used in EC documents. Ornamental stones are all those rocks that are used for ornamental purposes inside and outside of constructions (marble, granite, labradorite, syenite …). Precious and semi-precious minerals are used for jewelry (an overlap exists with the ornamental stones segment some colourful semi-precious minerals being used for both jewelry and decoration).

Scope, use examples:

The use and potential of geographical data about mineral resources will depend very much on scale and detail of available information. Digital geographical information about mineral resources is used:

- for the management of resources and exploitation activities
- for the promotion of private sector investment
- in land use planning
- in environmental impact assessments
- as a basis for local, regional, national and EU policy making
- as input-data in assessments of state of the environment, e.g. modelling pressure and sustainability

Pan-European, national or local data acquisition and mapping initiatives are pursued by Geological Survey organizations. Mining companies, mostly belonging to the private sector, produce mostly confidential high resolution maps of very limited prospective or mining areas.

Important feature types and attributes:

Depending on the segment only some of these attributes are of relevance

- Localisation of each ore/mineral deposit,
- Name of each deposit
- Nature of the principal constituent of the deposit, defined by its economic value/ potential
- Nature of the secondary constituent(s) of the deposit, defined by its/ their economic value/ potential
- Geological properties, mechanical behaviour, quality aspects
- Tonnage and grade of the resource in the ground + reserves in the ground + the part of the reserves already extracted (reserves are that part of the resource that are technically exploitable under current economic conditions)
- Tonnage of the principal constituent (s) of the deposit included in the resource and reserves
- Average grade of the principal constituent (s) of the deposit
- Ore type and origin of the mineralization (hydrothermal, magmatic, sedimentary [alluvial, marine, glacial …], skarn …)
- Granulometry (in case of sand and gravel)
- Harmful constituents, radiation
- Usage of occurrence
- Age of the mineralization: oldest and youngest documented ages
- Age of the host rock: oldest and youngest documented ages
- Geometry of the deposit, including depth and extension of the mineralisation at given cut-off grades
- Nature of the related alteration of the host rock (if existent)
- Status of the deposit

Generalised or aggregated information about mineral resources may be found as geographical data with grid cells or administrative regions resolution.

Links and overlaps with other themes:

- Geology, the mineral resources being industrial geology
- Land use
- Soil
- Production and industrial facilities
- Area management/restriction/regulation zones and reporting units
- Oceanographical geographical features,
- Energy resources

Reference documents:

EU Non-Energy Extractive Industry - Sustainable Development Indicators 2001-2003 – Accessible online: http://ec.europa.eu/enterprise/steel/non-energy-extractive-industry/sd-indicators.htm

GeoSciML: model of mineral occurrences (https://www.seegrid.csiro.au/twiki/bin/view/Main/WebHome)

http://www.bgs.ac.uk/mineralsuk/digital_maps/home.html
http://www.bgs.ac.uk/mineralsuk/minequar/industrial/home.html
http://www.bgs.ac.uk/mineralsuk/digital_maps/maps/home.html
http://www.bgs.ac.uk/geoindex/
http://www.bgs.ac.uk/scripts/geoportal/home.cfm

http://www.etpsmr.org/

Industrial Mineral Resources Map of Great Britain

INSPIRE position paper: Environmental and thematic data. 2002

Karte der Oberflächennahen Rohstoffe der Bundesrepublik Deutschland, 1 : 200 000, BGR (Hannover) / Map of the Near-Surface Mineral Resources of Germany 1 : 200 000, BGR (Hannover)

Metallogenic and environmental GIS of Central Europe: http://giseurope.brgm.fr/ European Commission (DG Enterprise):

Mineral resources of Norway: http://www.ngu.no/kart/mineralressurser/
http://www.ngu.no/kart/grus%5Fpukk/

Mineral resources www.sgu.se/sgu/en/service/kart-tjanst_start_e.html

Norwegian feature catalogue and data model on mineral resources.:
http://www.statkart.no/sosi/UMLfullmodell/Rastoff/Rastoff.htm

TNO The Geological Survey of the Netherlands and The Ministry of Transport, Public Works and Water Management together with the provinces developed this standards as the basis for its National Geoscientific Database on Mineral mining : http://dinolks01.nitg.tno.nl/dinoLks/delfstoffen/index.html

Wagner H, Tiess G, Nielsen K, Solar S, Hamor T, Ike P, Vervoort A, Espi JA, Agiountantis Z, Koziol W, Bauer V, 2005: Minerals planning policies and supply practices in Europe. Montanuniversität Leoben (At)