INSPIRE
Infrastructure for Spatial Information in Europe

D2.8.III.12 Data Specification on Natural Risk Zones – Draft Guidelines

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Change Log

Version	Changed Sections	Changes made
2.9		Use Cases Removed relationship with other INSPIRE themes tables. Change to the Risk/ Hazard Classification Codelist The modelling of multi-hazard (via multiplicity) has been removed from the model Exposed Elements are modelled in a different way and linked to a hazard as well as a risk The Floods Example application schema has been moved to the Annex as an example only Theme specific Metadata elements have been selected Determination methods have been overhauled along with document referencing Annex B contains a mapping between featuretypes used in the Floods Directive and feature types used in the Natural Risk Zones data specification Use Cases have been significantly clarified

Foreword
How to read the document?

This document describes the *"INSPIRE data specification on Natural Risk Zones – Guidelines"* version 2.9 as developed by the Thematic Working Group (TWG) *Natural Risk Zones* using both natural and a conceptual schema language.

The data specification is based on a common template used for all data specifications and has been harmonised using the experience from the development of the Annex I data specifications.

This document provides guidelines for the implementation of the provisions laid down in the draft Implementing Rule for spatial data sets and services of the INSPIRE Directive.

This document includes two executive summaries that provide a quick overview of the INSPIRE data specification process in general, and the content of the data specification on *Natural Risk Zones* in particular. We highly recommend that managers, decision makers, and all those new to the INSPIRE process and/or information modelling should read these executive summaries first.

The UML diagrams (in Chapter 5) offer a rapid way to see the main elements of the specifications and their relationships. The definition of the spatial object types, attributes, and relationships are included in the Feature Catalogue (also in Chapter 5). People having thematic expertise but not familiar with UML can fully understand the content of the data model focusing on the Feature Catalogue. Users might also find the Feature Catalogue especially useful to check if it contains the data necessary for the applications that they run. The technical details are expected to be of prime interest to those organisations that are/will be responsible for implementing INSPIRE within the field of *Natural Risk Zones.*

The technical provisions and the underlying concepts are often illustrated by examples. Smaller examples are within the text of the specification, while longer explanatory examples and descriptions of selected use cases are attached in the annexes.

In order to distinguish the INSPIRE spatial data themes from the spatial object types, the INSPIRE spatial data themes are written in *italics.*

The document will be publicly available as a 'non-paper'. It does not represent an official position of the European Commission, and as such cannot be invoked in the context of legal procedures.

Interoperability of Spatial Data Sets and Services – General Executive Summary

The challenges regarding the lack of availability, quality, organisation, accessibility, and sharing of spatial information are common to a large number of policies and activities and are experienced across the various levels of public authority in Europe. In order to solve these problems it is necessary to take measures of coordination between the users and providers of spatial information. The Directive 2007/2/EC of the European Parliament and of the Council adopted on 14 March 2007 aims at establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) for environmental policies, or policies and activities that have an impact on the environment.

INSPIRE will be based on the infrastructures for spatial information that are created and maintained by the Member States. To support the establishment of a European infrastructure, Implementing Rules addressing the following components of the infrastructure are being specified: metadata, interoperability of spatial data themes (as described in Annexes I, II, III of the Directive) and spatial data services, network services and technologies, data and service sharing, and monitoring and reporting procedures.

INSPIRE does not require collection of new data. However, after the period specified in the Directive[1] Member States have to make their data available according to the Implementing Rules.

Interoperability in INSPIRE means the possibility to combine spatial data and services from different sources across the European Community in a consistent way without involving specific efforts of humans or machines. It is important to note that "interoperability" is understood as providing access to spatial data sets through network services, typically via Internet. Interoperability may be achieved by either changing (harmonising) and storing existing data sets or transforming them via services for publication in the INSPIRE infrastructure. It is expected that users will spend less time and efforts on understanding and integrating data when they build their applications based on data delivered within INSPIRE.

In order to benefit from the endeavours of international standardisation bodies and organisations established under international law their standards and technical means have been utilised and referenced, whenever possible.

To facilitate the implementation of INSPIRE, it is important that all stakeholders have the opportunity to participate in specification and development. For this reason, the Commission has put in place a consensus building process involving data users, and providers together with representatives of industry, research and government. These stakeholders, organised through Spatial Data Interest Communities (SDIC) and Legally Mandated Organisations (LMO)[2], have provided reference materials, participated in the user requirement and technical[3] surveys, proposed experts for the Data Specification Drafting Team[4] and Thematic Working Groups[5] and participated in the public stakeholder

[1] For all 34 Annex I,II and III data themes: within two years of the adoption of the corresponding Implementing Rules for newly collected and extensively restructured data and within 5 years for other data in electronic format still in use

[2] The current status of registered SDICs/LMOs is available via INSPIRE website: *http://inspire.jrc.ec.europa.eu/index.cfm/pageid/42*

[3] Surveys on unique identifiers and usage of the elements of the spatial and temporal schema,

[4] The Data Specification Drafting Team has been composed of experts from Austria, Belgium, Czech Republic, France, Germany, Greece, Italy, Netherlands, Norway, Poland, Switzerland, UK, and the European Environmental Agency

[5] The Thematic Working Groups of Annex II and III themes have been composed of experts from Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Netherlands, Norway, Poland, Romania, Slovakia, Spain, Sweden, Switzerland, Turkey, UK, the European Commission, and the European Environmental Agency

consultations on draft versions of the data specifications. These consultations covered expert reviews as well as feasibility and fitness-for-purpose testing of the data specifications[6].

This open and participatory approach was successfully used during the development of the data specification on Annex I data themes as well as during the preparation of the Implementing Rule on Interoperability of Spatial Data Sets and Services[7] for Annex I spatial data themes.,

The development framework elaborated by the Data Specification Drafting Team aims at keeping the data specifications of the different themes coherent. It summarises the methodology to be used for the data specifications and provides a coherent set of requirements and recommendations to achieve interoperability. The pillars of the framework are five technical documents:

- The Definition of Annex Themes and Scope[8] describes in greater detail the spatial data themes defined in the Directive, and thus provides a sound starting point for the thematic aspects of the data specification development.

- The Generic Conceptual Model[9] defines the elements necessary for interoperability and data harmonisation including cross-theme issues. It specifies requirements and recommendations with regard to data specification elements of common use, like the spatial and temporal schema, unique identifier management, object referencing, a generic network model, some common code lists, etc. Those requirements of the Generic Conceptual Model that are directly implementable will be included in the Implementing Rule on Interoperability of Spatial Data Sets and Services.

- The Methodology for the Development of Data Specifications[10] defines a repeatable methodology. It describes how to arrive from user requirements to a data specification through a number of steps including use-case development, initial specification development and analysis of analogies and gaps for further specification refinement.

- The "Guidelines for the Encoding of Spatial Data"[11] defines how geographic information can be encoded to enable transfer processes between the systems of the data providers in the Member States. Even though it does not specify a mandatory encoding rule it sets GML (ISO 19136) as the default encoding for INSPIRE.

- The "Guidelines for the use of Observations & Measurements and Sensor Web Enablement-related standards in INSPIRE Annex II and III data specification development" provides guidelines on how the "Observations and Measurements" standard (ISO 19156) is to be used within INSPIRE.

The structure of the data specifications is based on the "ISO 19131 Geographic information - Data product specifications" standard. They include the technical documentation of the application schema, the spatial object types with their properties, and other specifics of the spatial data themes using natural language as well as a formal conceptual schema language[12].

A consolidated model repository, feature concept dictionary, and glossary are being maintained to support the consistent specification development and potential further reuse of specification elements. The consolidated model consists of the harmonised models of the relevant standards from the ISO

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[6] For Annex II+III, the consultation phase lasted from 20 June to 21 October 2011.
[7] Commission Regulation (EU) No 1089/2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services, published in the Official Journal of the European Union on 8th of December 2010.
[8] *http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/DataSpecifications/D2.3_Definition_of_Annex_Themes_and_scope_v3.0.pdf*
[9] *http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/DataSpecifications/D2.5_v3.3.pdf*
[10] *http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/DataSpecifications/D2.6_v3.0.pdf*
[11] *http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/DataSpecifications/D2.7_v3.2.pdf*
[12] UML – Unified Modelling Language

19100 series, the INSPIRE Generic Conceptual Model, and the application schemas[13] developed for each spatial data theme. The multilingual INSPIRE Feature Concept Dictionary contains the definition and description of the INSPIRE themes together with the definition of the spatial object types present in the specification. The INSPIRE Glossary defines all the terms (beyond the spatial object types) necessary for understanding the INSPIRE documentation including the terminology of other components (metadata, network services, data sharing, and monitoring).

By listing a number of requirements and making the necessary recommendations, the data specifications enable full system interoperability across the Member States, within the scope of the application areas targeted by the Directive. Once finalised (version 3.0), the data specifications are published as technical guidelines and provide the basis for the content of the Implementing Rule on Interoperability of Spatial Data Sets and Services[14]. The content of the Implementing Rule is extracted from the data specifications keeping in mind short- and medium-term feasibility as well as cost-benefit considerations. The requirements included in the Implementing Rule will be legally binding for the Member States according to the timeline specified in the INSPIRE Directive.

In addition to providing a basis for the interoperability of spatial data in INSPIRE, the data specification development framework and the thematic data specifications can be reused in other environments at local, regional, national and global level contributing to improvements in the coherence and interoperability of data in spatial data infrastructures.

[13] Conceptual models related to specific areas (e.g. INSPIRE themes)

[14] In the case of the Annex II+III data specifications, the extracted requirements will be used to formulate an amendment to the existing Implementing Rule.

Natural Risk Zones – Executive Summary

INSPIRE Directive (2007/2/EC) defines Natural Risk Zones theme as: "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."

Version 2.9 of the data specification presents some further refinement of this definition and scope and provides implementation guidelines through a UML model that will be the basis for the Implementing Rules.

This specification is the work of the Natural Risk Zones thematic working group. A multinational team of experts volunteered from the community of SDICs (Spatial Data Interest Communities) and LMOs (Legally Mandated Organisations) of INSPIRE.

This version has been compiled using reference material submitted by SDICs and LMOs and the responses to a user requirements survey. The team themselves have had to draw on their own expertise and that of their organisations and other groups to develop agreed use cases in a selection of areas pertinent to Natural Risk Zones. It also incorporates the responses to nearly 400 comments received during the public consultation of summer 2011.

The scope of the Natural Risk Zones data specification is potentially very large and chapter 2 of this report develops a scope for the work. Natural Risk Zones also involves significant engagement with other thematic areas from INSPIRE. This involvement stems from the nature of hazard, exposure, vulnerability and risk as defined later in this document. Several other thematic areas will input attributes vital to understanding the nature of hazard, yet others are vital in the understanding of exposure. In working on the scope of the Natural Risk Zones theme five use cases were created; Floods, Risk Manager, French Landslide, Forest Fire and Earthquake. These use cases are listed in Annex C and detail the links to other INSPIRE thematic areas.

The approach taken to model Natural Risk Zones is generic in its treatment of each of hazard, exposure, vulnerability and risk, with a core model, whilst allowing extensibility to be more specific where possible and required. Flood risk is significantly more precisely defined than other hazards, due in part to the development of the Floods Directive (2007/60/EC). In version 2.9 of the specification we have been able to demonstrate the extensibility of the model, providing an example of how the core model could be extended with an application schema specifically targeted at floods in Annex C.

One of the main purposes of hazard and risk maps is to inform in a clear way thus supporting effective communication between modellers, data providers, policy makers and the citizen. We hope that this data specification can play a part in making this communication better.

Acknowledgements

Many individuals and organisations have contributed to the development of these Guidelines.

The Thematic Working Group Natural Risk Zones (TWG-NZ) included:
Matthew Harrison (TWG Facilitator), Florian Thomas (TWG Editor), José I. Barredo, Venco Bojilov, Andrea Camia, Raquel Canet Castella, Otakar Cerba, George Exadaktylos, Cristiano Giovando, Miguel Llorente Isidro, Manuela Pfeiffer, Robert Tomas (European Commission contact point).

Other contributors to the INSPIRE data specifications are the Drafting Team Data Specifications, the JRC data specifications team and the INSPIRE stakeholders - Spatial Data Interested Communities (SDICs) or Legally Mandated Organisations (LMOs).

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Table of contents

1 Scope

This document specifies a harmonised data specification for the spatial data theme *Natural Risk Zones* as defined in Annex III of the INSPIRE Directive.

This data specification provides the basis for the drafting of Implementing Rules according to Article 7 (1) of the INSPIRE Directive [Directive 2007/2/EC]. The entire data specification will be published as implementation guidelines accompanying these Implementing Rules.

2 Overview

2.1 Name

INSPIRE data specification for the theme Natural Risk Zones.

2.2 Informal description

Definition:
Below is the definition of Natural Risk Zones as provided by the INSPIRE Directive.

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. [Directive 2007/2/EC]

As predicted by the Data Specification Drafting Team, in light of Annex I and the greater detail that a dedicated Annex II or III Thematic Working Group can enter into, this is here updated using the latest research and experience available.

[Directive 2007/2/EC]

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 Exposure x Vulnerability

of human health, the environmental, cultural and economic assets in the zone considered.

In general there should be a clear distinction between “hazard” and “risk”.

The definition of each of these terms in the risk function almost has a discipline of their own. For the purposes of the INSPIRE natural risk zones thematic working group we have decided to adopt the existing, yet specific definitions below.

Risk
Risk is the combination of the consequences of an event (hazard) and the associated likelihood/probability of its occurrence. (ISO 31010)

Comment: This definition closely follows the definition of the ISO/IEC Guide 73. The word "risk" has two distinctive connotations: in popular usage the emphasis is usually placed on the concept of chance or possibility, such as in "the risk of an accident"; whereas in technical settings the emphasis is usually placed on the consequences, in terms of "potential losses" for some particular cause, place and period. It can be noted that people do not necessarily share the same perceptions of the significance and underlying causes of different risks.(UNISDR 2009)

Hazard

A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. (UNISDR 2009)

Comment: The hazards of concern to disaster risk reduction as stated in footnote 3 of the Hyogo Framework are "… hazards of natural origin and related environmental and technological hazards and risks." Such hazards arise from a variety of geological, meteorological, hydrological, oceanic, biological, and technological sources, sometimes acting in combination. In technical settings, hazards are described quantitatively by the likely frequency of occurrence of different intensities for different areas, as determined from historical data or scientific analysis.(UNISDR2009)

Remark: Technological hazards are out of scope for this data (cf. page 12).

Exposure

People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses. (UNISDR 2009)

Vulnerability

The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.(UNISDR 2009)

Comment: There are many aspects of vulnerability, arising from various physical, social, economic, and environmental factors. Examples may include poor design and construction of buildings, inadequate protection of assets, lack of public information and awareness, limited official recognition of risks and preparedness measures, and disregard for wise environmental management. Vulnerability varies significantly within a community and over time. This definition identifies vulnerability as a characteristic of the element of interest (community, system or asset) which is independent of its exposure. However, in common use the word is often used more broadly to include the element's exposure. UNISDR (2009).

One of the reasons for the difficulty in terminology is that the language of risk has developed across a broad range of disciplines, including those beyond the scope of this thematic working group, including financial risk, disaster management etc. Diagram 1 attempts to demonstrate the relationship between the various concepts defined above in a spatial context.

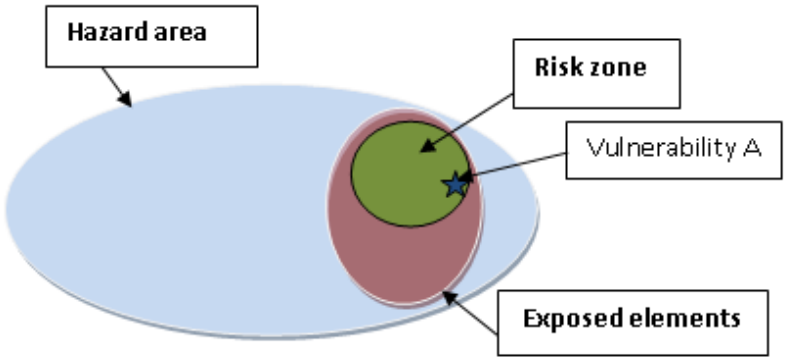


Diagram 1. Diagram depicting the main concepts in the natural risk zones model

R = H * E * V

This leads to the expression of risk in terms such as:

Every year there is a 1% chance of having 5 houses destroyed due to floods of a given magnitude

Or on average, five houses are destroyed every year due to forest fire of a given magnitude

Some of the confusion arises from the differing use of language when both specialists and non-specialists are talking about the concept of risk. Vulnerability and exposure are the terms most frequently interchanged. The terms used in the model follow the UNISDR2009 definitions and more recently the “Risk Assessment and Mapping Guidelines for Disaster Management” document of the Council of the European Union.

In the insurance industry risks are referred to using the term “Perils”.. This sector are large users of Public Sector hazard, risk and vulnerability Information and are a significant part of an international risk management framework that will, we hope, benefit from this data specification whilst bearing in mind that INSPIRE Directive first applies to data-holding public authorities. Work is continuing elsewhere in the Commission regarding updating “Proposal for a Directive of the European Parliament and of the Council on the taking-up and pursuit of the business of Insurance and Reinsurance - Solvency II {SEC(2007) 870} {SEC(2007) 871} /* COM/2007/0361 final - COD 2007/0143 */” known as Solvency II. This will have implications for the Insurance industry regarding provision of insurance for perils and this data specification should align with the proposals where possible.

As another example of the wider use of Natural Risk Zones information, in the EU the Structural Eurocodes or Eurocodes are the current building standards for Europe and they are published by the

European Committee for Standardization. Eurocode 1, for example, considers fire action on building structures, whereas Eurocode 8 refers to earthquake resistant buildings. So, it is important always to associate "vulnerability" assessment of building structures with the application or not of Eurocodes. In order to make an assessment as of whether an "exposed" engineering structure (asset) is also "vulnerable" and "how vulnerable (i.e. a damage assessment) it is" against a given hazard class (e.g. flood, fire, landslide etc) one should know the design and construction (or retrofitting) characteristics of this particular structure as well as if this design (retrofitting) is based on some standards or codes of practice. For example if a building or retaining wall etc is made from fire resistant materials, then it is not vulnerable at large extent to a fire, or if a building is earthquake resistant, it is not expected to suffer serious damages in an earthquake, unlike another building that is old and has been constructed without special consideration to earthquakes.

Thematic Working Group Scope

The data and information that are included in this data specification takes as one starting point the existence of the delineation of a hazard area. For some hazards, especially meteorological hazards (e.g. storms) it's not possible to delineate concrete hazard areas as occurrence depends on complex respectively chaotic meteorological conditions. Source data for each hazard are mostly in scope of other TWG's, e.g. fault lines as a source for earthquakes (TWG GE). As a consequence, this data specification does not include the modelling of the processes and scientific models that were used in the identification of hazard areas.

The data specification includes discussion of natural hazards caused by natural phenomena only, not technological hazards. It is anticipated that some technological hazards could precipitate natural hazards (and *vice versa*), in which case the model is likely to remain valid as causative factors are not modelled. It is also true that the core of the model may be valid for the modelling of other risks beyond the scope of the Natural Risk Zones specification. The model hasn't been designed with these in mind but may be useful in these circumstances.

In the real world, hazards can be single, sequential or combined in their origin and effects. There are complexities in adequately modelling these circumstances that complicate the communication of good practice in modelling more simple hazard and risk relationships. Version 2.9 of the data model is not designed so that it could also operate in multi-risk circumstances.

The model will only include measured past events and modelled future events. It does not deal with real-time data respectively events as they are happening. This is the domain of monitoring and emergency response which is largely out of scope.

The core model is extensible in many directions, to cover many domains and in version 2.9 TWG NZ has included a Floods example of how that may be achieved. In annex B there is also a mapping of feature types between Natural Risk Zones data specification and the draft Floods Directive feature types.

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). These hazards are considered within scope.

The thematic working group believes that it is important for all potential users of natural risk zones information to know what hazard is causing a particular risk zone. It is important for the mitigation and management of the risk. There are few definitive sources of pan-European natural hazard classification and as a result the thematic working group have agreed on a very high level hazard type classification. One of the only existing examples maintained by re-insurer Munich Re and CRED (Centre of Research on the Epidemiology of Disasters). It has been agreed that this is not suitable for the INSPIRE data specification as it deals primarily with the collection of disaster information which is out of scope.

The thematic working group have developed a simple, high level classification that in the model is supplemented with a free text field and reference to provide greater detail. It is highly recommended that at member state level data providers add to the limited codelist provided in the model to list detailed hazard types. Whilst it is by no means exhaustive, the group feels that this approach is representative and by considering the hazards identified there, much of the range of hazards considered to be in scope will have been covered.

Exposed elements and links to other thematic working groups

Knowledge about elements exposed to the specific hazard is also of utmost importance. So assessment of the level of threat that a certain hazard (flood, landslide, forest fires, etc...) poses to life, health, property or environment should be conducted. Here, data and services about settlements, infrastructures, land use and many others will be needed and provided by the other Annex I, II and III thematic working groups. Examples of these would include but not be limited to: Buildings, Transport networks, Land use, Industrial and production facilities, Agricultural and Aqua-cultural facilities, Utility and government services.

The model uses an abstract feature type with an attribute that indicates a type of element- it could be a building, or economic or environmental for example. The way it is modelled aligns with similar abstract types in other thematic working groups.

Use examples

This section describes identified uses of spatial information about natural hazards and risks as requested by the interest groups that responded through User Requirement Survey. The Core-model covers identified overall approaches with the option to extend the model for specific hazards/risks.. Further, more detailed examples are given for floods, landslide, forest fire and earthquake in the annex.

The different kinds of users (for managing hazard and providing respectively publishing risk information) may be grouped into four:

- assessment of natural 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
- reporting, trends and overall policy development , commonly at national and international level
- disaster response and emergency operations

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.

- **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. GIS-layer with extents for hazard areas and risk zones should be carried out as result.
- **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 areas of thematic agencies are used and transformed into simplified data sets and planning documents showing areas/zones with different levels of risk and restriction zones at or around risk areas. The delimitation of the restriction zones would need population data, land use plans etc.

- **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.
- **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.

2.3 Normative References

[Directive 2007/2/EC] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)

[ISO 19107] EN ISO 19107:2005, Geographic Information – Spatial Schema

[ISO 19108] EN ISO 19108:2005, Geographic Information – Temporal Schema

[ISO 19108-c] ISO 19108:2002/Cor 1:2006, Geographic Information – Temporal Schema, Technical Corrigendum 1

[ISO 19111] EN ISO 19111:2007 Geographic information - Spatial referencing by coordinates (ISO 19111:2007)

[ISO 19113] EN ISO 19113:2005, Geographic Information – Quality principles

[ISO 19115] EN ISO 19115:2005, Geographic information – Metadata (ISO 19115:2003)

[ISO 19118] EN ISO 19118:2006, Geographic information – Encoding (ISO 19118:2005)

[ISO 19123] EN ISO 19123:2007, Geographic Information – Schema for coverage geometry and functions

[ISO 19135] EN ISO 19135:2007 Geographic information – Procedures for item registration (ISO 19135:2005)

[ISO 19138] ISO/TS 19138:2006, Geographic Information – Data quality measures

[ISO 19139] ISO/TS 19139:2007, Geographic information – Metadata – XML schema implementation

[OGC 06-103r3] Implementation Specification for Geographic Information - Simple feature access – Part 1: Common Architecture v1.2.0

NOTE This is an updated version of "EN ISO 19125-1:2006, Geographic information – Simple feature access – Part 1: Common architecture". A revision of the EN ISO standard has been proposed.

[Regulation 1205/2008/EC] Regulation 1205/2008/EC implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata

2.4 Terms and definitions

General terms and definitions helpful for understanding the INSPIRE data specification documents are defined in the INSPIRE Glossary[15].

(1) Risk
Risk is the combination of the consequences of an event (hazard) and the associated likelihood/probability of its occurrence. (ISO 31010).

EXAMPLE 10000 People will lose their potable water supply with a percentage likelihood due to earthquakes of magnitude 6 or above.

(2) Hazard
A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. (UNISDR 2009)

EXAMPLE Earthquake hazard.

(3) Exposure
People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses. (UNISDR 2009)

EXAMPLE A hospital is in the affected area

(4) Vulnerability
The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.(UNISDR 2009)

EXAMPLE Elderly residents

[15] The INSPIRE Glossary is available from http://inspire-registry.jrc.ec.europa.eu/registers/GLOSSARY

2.5 Symbols and abbreviations

None

2.6 Notation of requirements and recommendations

To make it easier to identify the mandatory requirements and the recommendations for spatial data sets in the text, they are highlighted and numbered.

IR Requirement X	Requirements that are reflected in the Implementing Rule on interoperability of spatial data sets and services are shown using this style.

TG Requirement X	Requirements that are not reflected in the Implementing Rule on interoperability of spatial data sets and services are shown using this style.

Recommendation X	Recommendations are shown using this style.

2.7 Conformance

TG Requirement 1	Any dataset claiming conformance with this INSPIRE data specification shall pass the requirements described in the abstract test suite presented in Annex A.

3 Specification scopes

This data specification does not distinguish different specification scopes, but just considers one general scope.

NOTE For more information on specification scopes, see [ISO 19131:2007], clause 8 and Annex D.

4 Identification information

NOTE Since the content of this chapter was redundant with the overview description (section 2) and executive summary, it has been decided that this chapter will be removed in v3.0.

5 Data content and structure

This data specification defines the following application schemas:

– The <ApplicationSchema1> application schema …

IR Requirement 1	Spatial data sets related to the theme Natural Risk Zones shall be made available using the spatial object types and data types specified in the following application schema(s): <ApplicationSchema1>, <ApplicationSchema2>, … These spatial object types and data types shall comply with the definitions and constraints and include the attributes and association roles defined in this section.

Recommendation 1	The reason for a void value should be provided where possible using a listed value from the VoidValueReason code list to indicate the reason for the missing value.

NOTE The application schema specifies requirements on the properties of each spatial object including its multiplicity, domain of valid values, constraints, etc. All properties have to be reported, if the relevant information is part of the data set. Most properties may be reported as "void", if the data set does not include relevant information. See the Generic Conceptual Model [DS-D2.5] for more details.

In addition to the application schemas listed in IR Requirement 1, additional application schemas have been defined for the theme *Natural Risk Zones*. These additional application schemas typically address requirements from specific (groups of) use cases and/or may be used to provide additional information. They are included in this specification in order to improve interoperability also for these additional aspects.

Recommendation 2	Additional and/or use case-specific information related to the theme *Natural Risk Zones* should be made available using the spatial object types and data types specified in the following application schema(s): <ApplicationSchema1>, <ApplicationSchema2>, … These spatial object types and data types should comply with the definitions and constraints and include the attributes and association roles defined in this section.

5.1 Basic notions

This section explains some of the basic notions used in the INSPIRE application schemas. These explanations are based on the GCM [DS-D2.5].

5.1.1 Stereotypes

In the application schemas in this sections several stereotypes are used that have been defined as part of a UML profile for use in INSPIRE [DS-D2.5]. These are explained in Table 1 below.

Table 1 – Stereotypes (adapted from [DS-D2.5])

Stereotype	Model element	Description
applicationSchema	Package	An INSPIRE application schema according to ISO 19109 and the Generic Conceptual Model.
leaf	Package	A package that is not an application schema and contains no packages.
featureType	Class	A spatial object type.
placeholder	Class	A class that acts as a placeholder for a class, typically a spatial object type, that will be specified in the future as part of another spatial data theme. The class should at least have a definition, but may otherwise have a preliminary or no specification (see section 5.1.2).
type	Class	A conceptual, abstract type that is not a spatial object type.
dataType	Class	A structured data type without identity.
union	Class	A structured data type without identity where exactly one of the properties of the type is present in any instance.
enumeration	Class	A fixed list of valid identifiers of named literal values. Attributes of an enumerated type may only take values from this list.
codeList	Class	A code list.
import	Dependency	The model elements of the supplier package are imported.
voidable	Attribute, association role	A voidable attribute or association role (see section 5.1.3).
lifeCycleInfo	Attribute, association role	If in an application schema a property is considered to be part of the life-cycle information of a spatial object type, the property shall receive this stereotype.
version	Association role	If in an application schema an association role ends at a spatial object type, this stereotype denotes that the value of the property is meant to be a specific version of the spatial object, not the spatial object in general.

5.1.2 Placeholder and candidate types

Some of the INSPIRE Annex I data specifications (which were developed previously to the Annex II+III data specifications) refer to types that were considered to thematically belong and which were expected to be fully specified in Annex II or III spatial data themes. Two kinds of such types were distinguished:

- *Placeholder types* were created as placeholders for types (typically spatial object types) that were to be specified as part of a future spatial data theme, but which was already used as a value type of an attribute or association role in this data specification.

  Placeholder types received the stereotype «placeholder» and were placed in the application schema package of the future spatial data theme where they thematically belong. For each placeholder, a definition was specified based on the requirements of the Annex I theme. The Annex II+III TWGs were required to take into account these definitions in the specification work of the Annex II or III theme.

  If necessary, the attributes or association roles in the Annex I data specification(s) that have a placeholder as a value type shall be updated.

- *Candidate types* were types (typically spatial object types) for which already a preliminary specification was given in the Annex I data specification. Candidate types did not receive a specific stereotype and were placed in the application schema package of the future spatial data theme where they thematically belong. For each candidate type, a definition and attributes and association roles were specified based on the requirements of the Annex I theme. The

Annex II+III TWGs were required to take into account these specifications in the specification work of the Annex II or III theme.

If the type could not be incorporated in the Annex II or III data specification according to its preliminary specification, it should be moved into the application schema of the Annex I theme where it had first been specified. In this case, the attributes or association roles in the Annex I data specification(s) that have the type as a value type shall be updated if necessary.

NOTE Once the Annex II+III data specifications have been finalised by the TWGs (version 3.0), all placeholders and candidate types should have been removed. In some cases, this may require one or several of the Annex I data specifications (and the Implementing Rule on interoperability of spatial data sets and services) to be updated.

5.1.3 Voidable characteristics

If a characteristic of a spatial object is not present in the spatial data set, but may be present or applicable in the real world, the property shall receive this stereotype.

If and only if a property receives this stereotype, the value of *void* may be used as a value of the property. A *void* value shall imply that no corresponding value is contained in the spatial data set maintained by the data provider or no corresponding value can be derived from existing values at reasonable costs, even though the characteristic may be present or applicable in the real world.

It is possible to qualify a value of void in the data with a reason using the VoidValueReason type. The VoidValueReason type is a code list, which includes the following pre-defined values:

- *Unpopulated*: The characteristic is not part of the dataset maintained by the data provider. However, the characteristic may exist in the real world. For example when the “elevation of the water body above the sea level” has not been included in a dataset containing lake spatial objects, then the reason for a void value of this property would be ‘Unpopulated’. The characteristic receives this value for all objects in the spatial data set.
- *Unknown*: The correct value for the specific spatial object is not known to, and not computable by the data provider. However, a correct value may exist. For example when the “elevation of the water body above the sea level” *of a certain lake* has not been measured, then the reason for a void value of this property would be ‘Unknown’. This value is applied on an object-by-object basis in a spatial data set.

NOTE It is expected that additional reasons will be identified in the future, in particular to support reasons / special values in coverage ranges.

The «voidable» stereotype does not give any information on whether or not a characteristic exists in the real world. This is expressed using the multiplicity:

- If a characteristic may or may not exist in the real world, its minimum cardinality shall be defined as 0. For example, if an Address may or may not have a house number, the multiplicity of the corresponding property shall be 0..1.
- If at least one value for a certain characteristic exists in the real world, the minimum cardinality shall be defined as 1. For example, if an Administrative Unit always has at least one name, the multiplicity of the corresponding property shall be 1..*.

In both cases, the «voidable» stereotype can be applied. A value (the real value or void) only needs to be made available for properties that have a minimum cardinality of 1.

5.1.4 Enumerations

Enumerations are modelled as classes in the application schemas. Their values are modelled as attributes of the enumeration class using the following modelling style:

- No initial value, but only the attribute name part, is used.

– The attribute name conforms to the rules for attributes names, i.e. is a lowerCamelCase name. Exceptions are words that consist of all uppercase letters (acronyms).

IR Requirement 2	Attributes of spatial object types or data types whose type is an enumeration shall only take values included in the enumeration.

5.1.5 Code lists

Code lists are modelled as classes in the application schemas. Their values, however, are managed outside of the application schema.

5.1.5.1. Obligation

For each attribute that has a code list as its value, a tagged value called “obligation” is specified to define the level of obligation to use values from the list. The tagged value can take the following values:

– *IR* means that only the values defined by the code list shall be used for the attribute. This obligation is also included in the Implementing Rule on interoperability of spatial data and services.
– *TG* means that only the values defined by the code list should be used for the attribute. This obligation is *not* included in the Implementing Rule on interoperability of spatial data and services.

IR Requirement 3	Attributes of spatial object types or data types whose type is a code list with an “obligation” value of “IR” shall only take values that are valid according to the code list’s specification.

Recommendation 3	Attributes of spatial object types or data types whose type is a code list with an “obligation” value of “TG” should only take values that are valid according to the code list’s specification.

5.1.5.2. Governance

The following two types of code lists are distinguished in INSPIRE:

– *Code lists that are governed by INSPIRE (INSPIRE-governed code lists).* These code lists will be managed centrally in the INSPIRE code list register, which is managed and governed by the INSPIRE expert group on maintenance and implementation. Change requests to these code lists (e.g. to add, deprecate or supersede values) are processed and decided upon using the maintenance workflows defined by the INSPIRE expert group.

  INSPIRE-governed code lists will be made available in the INSPIRE code list register at *http://inspire.ec.europa.eu/codeList/<CodeListName>*. They will be available in SKOS/RDF, XML and HTML. The maintenance will follow the procedures defined in ISO 19135. This means that the only allowed changes to a code list are the addition, deprecation or supersession of values, i.e. no value will ever be deleted, but only receive different statuses (valid, deprecated, superseded). Identifiers for values of INSPIRE-governed code lists are constructed using the pattern *http://inspire.ec.europa.eu/codeList/<CodeListName>*/<value>.

– *Code lists that are governed by an organisation outside of INSPIRE (externally governed code lists).* These code lists are managed by an organisation outside of INSPIRE, e.g. the World Meteorological Organization (WMO) or the World Health Organization (WHO). Change requests to these code lists follow the maintenance workflows defined by the maintaining organisations. Note that in some cases, no such workflows may be formally defined.

The tables describing externally governed code lists in this section contain the following columns:

- The *Governance* column describes the external organisation that is responsible for maintaining the code list.
- If the code list is versioned, the *Version* column specifies which version of the code list shall be used in INSPIRE. The version can be specified using a version number or the publication date of a version. The specification can also refer to the "latest available version".
- The *Availability* column specifies from where the values of the externally governed code list are available, through a URL for code lists that are available online, or a citation for code lists that are only available offline.
- In the *Formats* column the formats are listed, in which a code list is available. These can be machine-readable (e.g. SKOS/RDF, XML) or human-readable (e.g. HTML, PDF).
- In some cases, for INSPIRE only a subset of an externally governed code list is relevant. The subset is specified using the *Subset* column.
- For encoding values of externally governed code lists, rules have to be specified for generating URI identifiers and labels for code list values. These are specified in a separate table.

5.1.5.3. Vocabulary

For each code list, a tagged value called "vocabulary" is specified to define a URI identifying the values of the code list. For INSPIRE-governed code lists and externally governed code lists that do not have a persistent identifier, the URI is constructed following the pattern *http://inspire.ec.europa.eu/codeList/<UpperCamelCaseName>*.

If the value is missing or empty, this indicates an empty code list. If no sub-classes are defined for this empty code list, this means that any code list may be used that meets the given definition.

An empty code list may also be used as a super-class for a number of specific code lists whose values may be used to specify the attribute value. If the sub-classes specified in the model represent all valid extensions to the empty code list, the subtyping relationship is qualified with the standard UML constraint "{complete,disjoint}".

5.1.5.4. Extensibility

For each code list, a tagged value called "extensibility" is specified to define which additional values (other than those explicitly specified) are allowed as valid values of the code list. The tagged value can take the following values:

- *none* means that only the values explicitly specified shall / should[16] be used for the attribute.
- *narrower* means that only the values explicitly specified or values narrower than the specified values shall / should be used for the attribute.
- *any* means that, in addition to the values explicitly specified, any other value may be used.

NOTE The "extensibility" tagged value does *not* affect the possibility to update the code list values following the formal maintenance procedure. For example, even for code lists, for which the "extensibility" is set to *none*, it is still possible to add values following the maintenance procedure of the code list. As a result of this update, the code list may include additional valid values, and these additional may be used for attributes having the code list as a type.

5.1.6 Coverages

[16] It depends on the level of the "obligation" tagged value on the attribute, whether this is a requirement or recommendation.

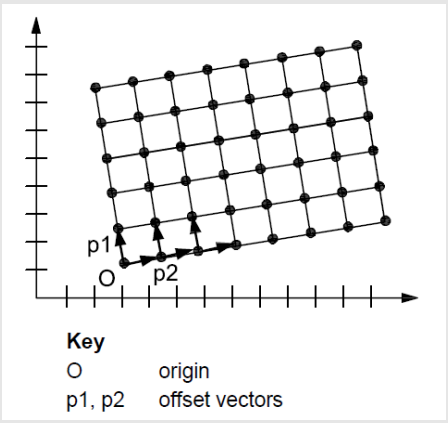
Coverage functions are used to describe characteristics of real-world phenomena that vary over space and/or time. Typical examples are temperature, elevation, precipitation, imagery. A coverage contains a set of such values, each associated with one of the elements in a spatial, temporal or spatio-temporal domain. Typical spatial domains are point sets (e.g. sensor locations), curve sets (e.g. contour lines), grids (e.g. orthoimages, elevation models), etc.

In INSPIRE application schemas, coverage functions are defined as properties of spatial object types where the type of the property value is a realisation of one of the types specified in ISO 19123.

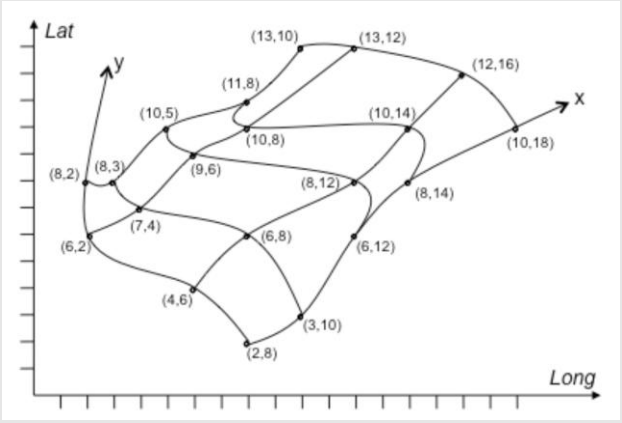
To improve alignment with coverage standards on the implementation level (e.g. ISO 19136 and the OGC Web Coverage Service) and to improve the cross-theme harmonisation on the use of coverages in INSPIRE, an application schema for coverage types is included in the Generic Conceptual Model in 9.9.4. This application schema contains the following coverage types:

- *RectifiedGridCoverage*: coverage whose domain consists of a rectified grid – a grid for which there is an affine transformation between the grid coordinates and the coordinates of a coordinate reference system (see Figure 1, left).
- *ReferenceableGridCoverage*: coverage whose domain consists of a referenceable grid – a grid associated with a transformation that can be used to convert grid coordinate values to values of coordinates referenced to a coordinate reference system (see Figure 1, right).
- *MultiTimeInstantCoverage*: coverage providing a representation of the time instant/value pairs, i.e. time series (see Figure 2).

Where possible, only these coverage types (or a subtype thereof) are used in INSPIRE application schemas.



(Source: ISO 19136:2007)



(Source: GML 3.3.0)

Figure 1 – Examples of a rectified grid (left) and a referenceable grid (right)

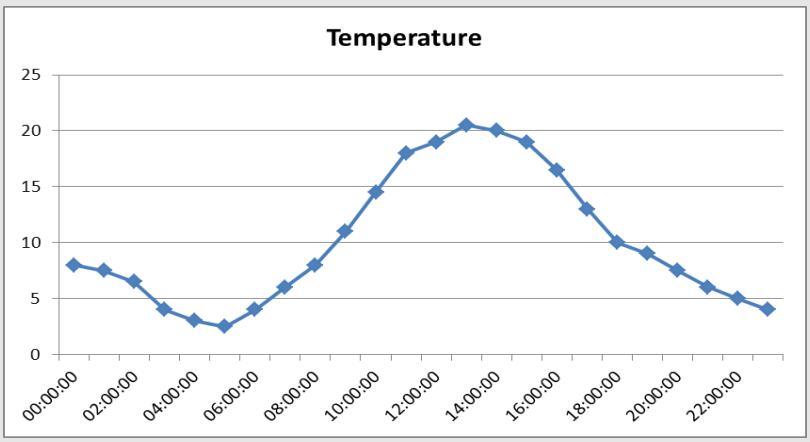


Figure 2 – Example of a MultiTimeSeriesCoverage (a time series)

5.2 Application schema Core_Model

5.2.1 Description

5.2.1.1. Narrative description

The common schema covers elements that are seen as necessary by the thematic working group to describe natural risk zones.

The common schema allows the user to model the main concepts of risk as defined in chapter 2 (hazard, vulnerability, exposure and risk).

A natural risk zone is a feature which results from the coincidence over the same area of a natural hazard and exposed elements that are vulnerable to this hazard.

This model is based upon ISO 19103 Spatial schema, and therefore concerns vector features.

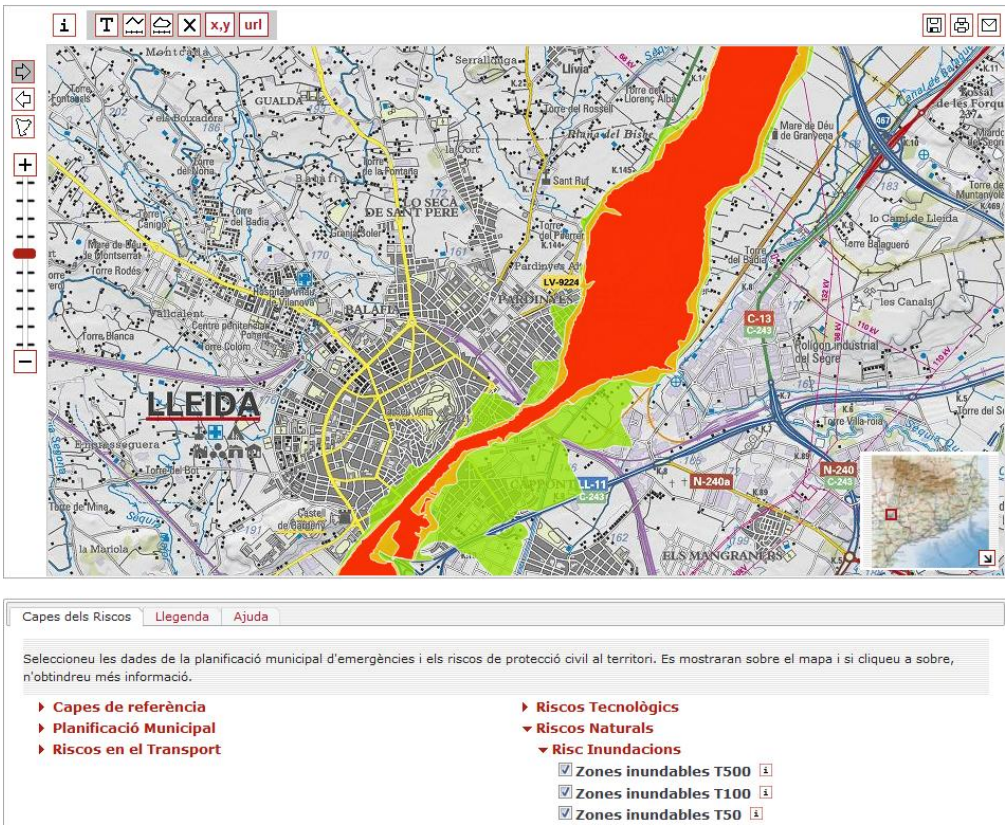
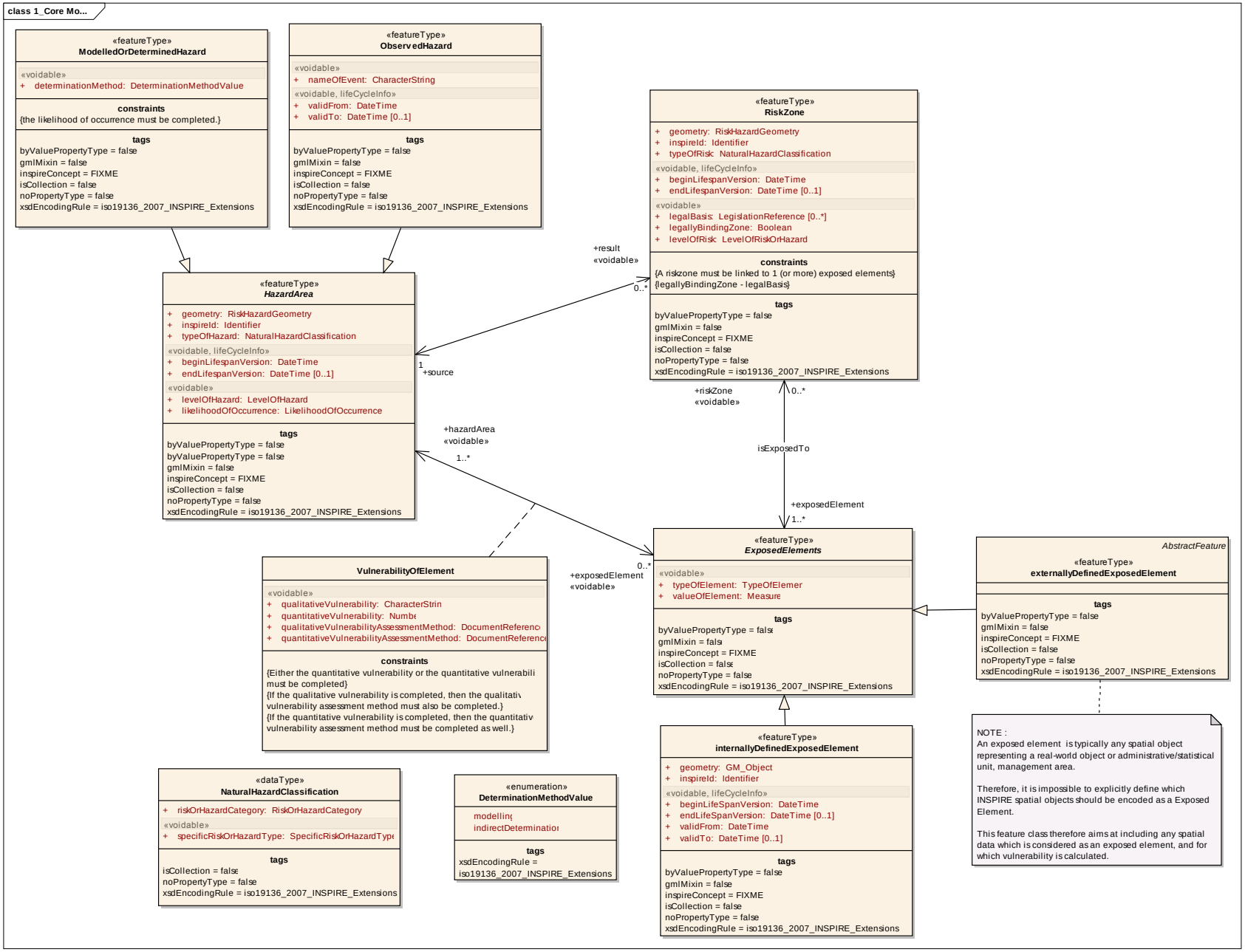
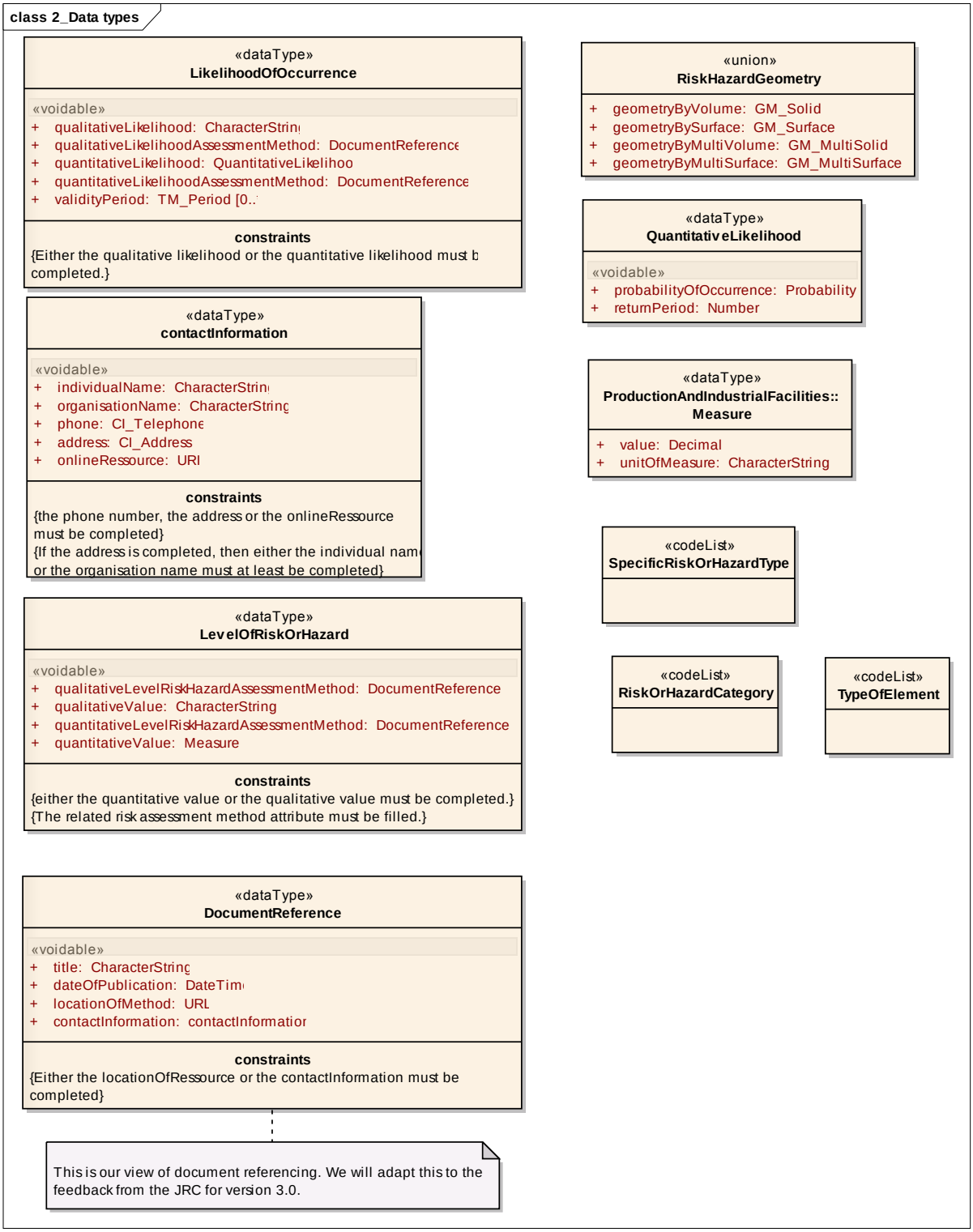


Figure 3 – Example of natural risk zones data covered by the Core model: "Mapa de Protecció Civil de Catalunya". http://taure.icc.cat/pcivil/map.jsp

5.2.1.2. UML Overview


class 1_Core Mo...
«featureType»
ModelledOrDeterminedHazard
«voidable»
+ determinationMethod: DeterminationMethodValue
constraints
{the likelihood of occurrence must be completed.}
tags
byValuePropertyType = false
gmlMixin = false
inspireConcept = FIXME
isCollection = false
noPropertyType = false
xsdEncodingRule = iso19136_2007_INSPIRE_Extensions
«featureType»
ObservedHazard
«voidable»
+ nameOfEvent: CharacterString
«voidable, lifeCycleInfo»
+ validFrom: DateTime
+ validTo: DateTime [0..1]
tags
byValuePropertyType = false
gmlMixin = false
inspireConcept = FIXME
isCollection = false
noPropertyType = false
xsdEncodingRule = iso19136_2007_INSPIRE_Extensions
«featureType»
RiskZone
+ geometry: RiskHazardGeometry
+ inspireId: Identifier
+ typeOfRisk: NaturalHazardClassification
«voidable, lifeCycleInfo»
+ beginLifespanVersion: DateTime
+ endLifespanVersion: DateTime [0..1]
«voidable»
+ legalBasis: LegislationReference [0..*]
+ legallyBindingZone: Boolean
+ levelOfRisk: LevelOfRiskOrHazard
constraints
{A riskzone must be linked to 1 (or more) exposed elements}
{legallyBindingZone - legalBasis}
tags
byValuePropertyType = false
gmlMixin = false
inspireConcept = FIXME
isCollection = false
noPropertyType = false
xsdEncodingRule = iso19136_2007_INSPIRE_Extensions
+result
«voidable»
0..*
«featureType»
HazardArea
+ geometry: RiskHazardGeometry
+ inspireId: Identifier
+ typeOfHazard: NaturalHazardClassification
«voidable, lifeCycleInfo»
+ beginLifespanVersion: DateTime
+ endLifespanVersion: DateTime [0..1]
«voidable»
+ levelOfHazard: LevelOfHazard
+ likelihoodOfOccurrence: LikelihoodOfOccurrence
tags
byValuePropertyType = false
byValuePropertyType = false
gmlMixin = false
inspireConcept = FIXME
isCollection = false
noPropertyType = false
xsdEncodingRule = iso19136_2007_INSPIRE_Extensions
1
+source
+riskZone
«voidable»
0..*
isExposedTo
+hazardArea
«voidable»
1..*
+exposedElement
1..*
«featureType»
ExposedElements
«voidable»
+ typeOfElement: TypeOfElemer
+ valueOfElement: Measure
tags
byValuePropertyType = false
gmlMixin = false
inspireConcept = FIXME
isCollection = false
noPropertyType = false
xsdEncodingRule = iso19136_2007_INSPIRE_Extensions
0..*
+exposedElement
«voidable»
VulnerabilityOfElement
«voidable»
+ qualitativeVulnerability: CharacterStrin
+ quantitativeVulnerability: Numb
+ qualitativeVulnerabilityAssessmentMethod: DocumentReferenc
+ quantitativeVulnerabilityAssessmentMethod: DocumentReferenc
constraints
{Either the quantitative vulnerability or the quantitative vulnerabili
must be completed}
{If the qualitative vulnerability is completed, then the qualitati
vulnerability assessment method must also be completed.}
{If the quantitative vulnerability is completed, then the quantitativ
vulnerability assessment method must be completed as well.}
AbstractFeature
«featureType»
externallyDefinedExposedElement
tags
byValuePropertyType = false
gmlMixin = false
inspireConcept = FIXME
isCollection = false
noPropertyType = false
xsdEncodingRule = iso19136_2007_INSPIRE_Extensions
«featureType»
internallyDefinedExposedElement
+ geometry: GM_Object
+ inspireId: Identifier
«voidable, lifeCycleInfo»
+ beginLifeSpanVersion: DateTime
+ endLifeSpanVersion: DateTime [0..1]
+ validFrom: DateTime
+ validTo: DateTime [0..1]
tags
byValuePropertyType = false
gmlMixin = false
inspireConcept = FIXME
isCollection = false
noPropertyType = false
xsdEncodingRule = iso19136_2007_INSPIRE_Extensions
NOTE :
An exposed element is typically any spatial object representing a real-world object or administrative/statistical unit, management area.
Therefore, it is impossible to explicitly define which INSPIRE spatial objects should be encoded as a Exposed Element.
This feature class therefore aims at including any spatial data which is considered as an exposed element, and for which vulnerability is calculated.
«dataType»
NaturalHazardClassification
+ riskOrHazardCategory: RiskOrHazardCategory
«voidable»
+ specificRiskOrHazardType: SpecificRiskOrHazardTyp
tags
isCollection = false
noPropertyType = false
xsdEncodingRule = iso19136_2007_INSPIRE_Extensions
«enumeration»
DeterminationMethodValue
modelling
indirectDetermination
tags
xsdEncodingRule =
iso19136_2007_INSPIRE_Extensions


class 2_Data types
«dataType»
LikelihoodOfOccurrence
«voidable»
+ qualitativeLikelihood: CharacterStrin
+ qualitativeLikelihoodAssessmentMethod: DocumentReferenc
+ quantitativeLikelihood: QuantitativeLikelihoo
+ quantitativeLikelihoodAssessmentMethod: DocumentReference
+ validityPeriod: TM_Period [0..
constraints
{Either the qualitative likelihood or the quantitative likelihood must b
completed.}
«union»
RiskHazardGeometry
+ geometryByVolume: GM_Solid
+ geometryBySurface: GM_Surface
+ geometryByMultiVolume: GM_MultiSolid
+ geometryByMultiSurface: GM_MultiSurface
«dataType»
QuantitativeLikelihood
«voidable»
+ probabilityOfOccurrence: Probability
+ returnPeriod: Number
«dataType»
contactInformation
«voidable»
+ individualName: CharacterStrin
+ organisationName: CharacterString
+ phone: CI_Telephone
+ address: CI_Address
+ onlineRessource: URI
constraints
{the phone number, the address or the onlineRessource
must be completed}
{If the address is completed, then either the individual nam
or the organisation name must at least be completed}
«dataType»
ProductionAndIndustrialFacilities::
Measure
+ value: Decimal
+ unitOfMeasure: CharacterString
«codeList»
SpecificRiskOrHazardType
«dataType»
LevelOfRiskOrHazard
«voidable»
+ qualitativeLevelRiskHazardAssessmentMethod: DocumentReference
+ qualitativeValue: CharacterString
+ quantitativeLevelRiskHazardAssessmentMethod: DocumentReference
+ quantitativeValue: Measure
constraints
{either the quantitative value or the qualitative value must be completed.}
{The related risk assessment method attribute must be filled.}
«codeList»
RiskOrHazardCategory
«codeList»
TypeOfElement
«dataType»
DocumentReference
«voidable»
+ title: CharacterString
+ dateOfPublication: DateTim
+ locationOfMethod: URL
+ contactInformation: contactInformatior
constraints
{Either the locationOfRessource or the contactInformation must be
completed}
This is our view of document referencing. We will adapt this to the feedback from the JRC for version 3.0.

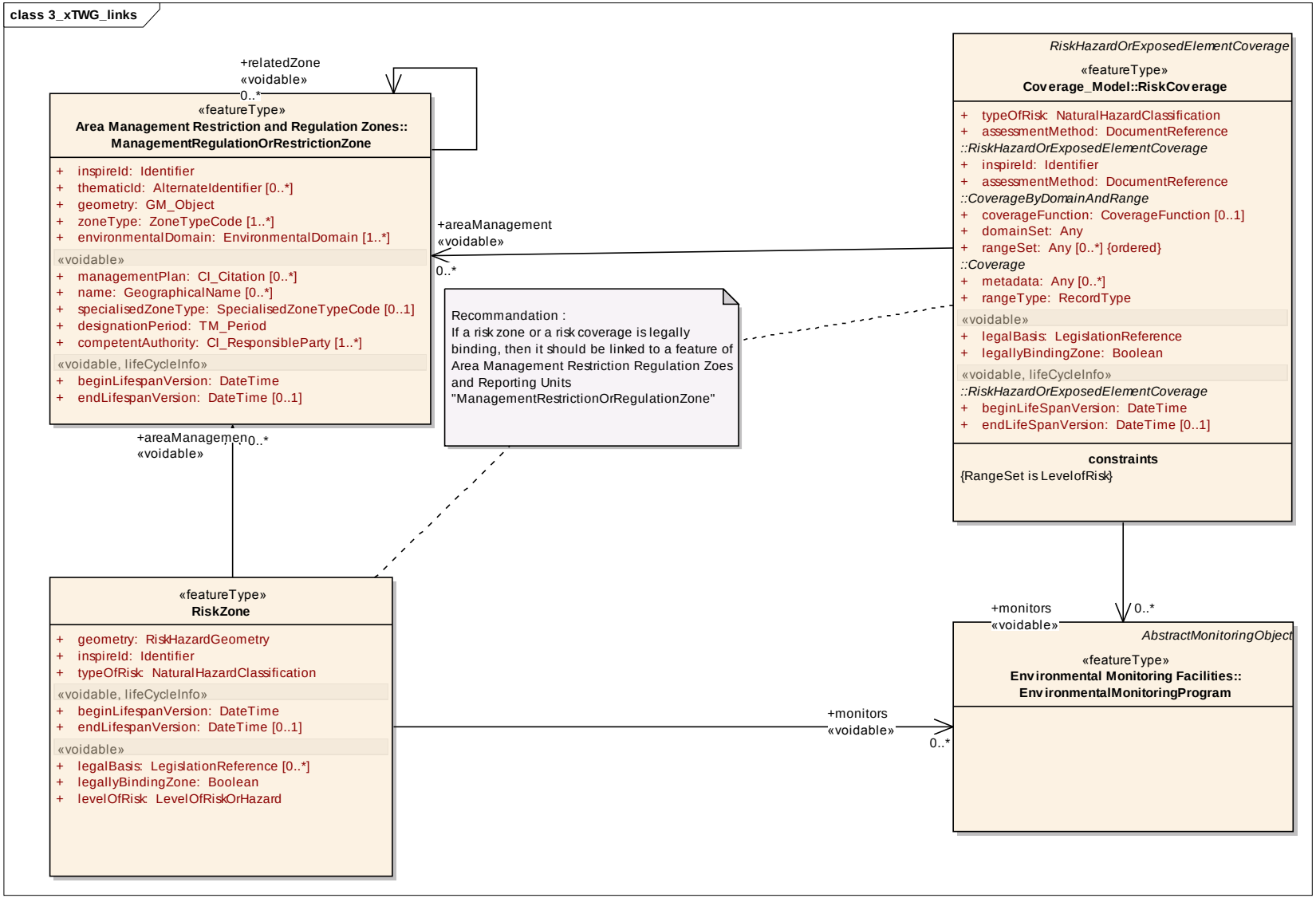

class 3_xTWG_links
+relatedZone
«voidable»
0..*
«featureType»
Area Management Restriction and Regulation Zones::
ManagementRegulationOrRestrictionZone
+ inspireId: Identifier
+ thematicId: AlternateIdentifier [0..*]
+ geometry: GM_Object
+ zoneType: ZoneTypeCode [1..*]
+ environmentalDomain: EnvironmentalDomain [1..*]
«voidable»
+ managementPlan: CI_Citation [0..*]
+ name: GeographicalName [0..*]
+ specialisedZoneType: SpecialisedZoneTypeCode [0..1]
+ designationPeriod: TM_Period
+ competentAuthority: CI_ResponsibleParty [1..*]
«voidable, lifeCycleInfo»
+ beginLifespanVersion: DateTime
+ endLifespanVersion: DateTime [0..1]
+areaManagement
«voidable»
0..*
RiskHazardOrExposedElementCoverage
«featureType»
Coverage_Model::RiskCoverage
+ typeOfRisk: NaturalHazardClassification
+ assessmentMethod: DocumentReference
::RiskHazardOrExposedElementCoverage
+ inspireId: Identifier
+ assessmentMethod: DocumentReference
::CoverageByDomainAndRange
+ coverageFunction: CoverageFunction [0..1]
+ domainSet: Any
+ rangeSet: Any [0..*] {ordered}
::Coverage
+ metadata: Any [0..*]
+ rangeType: RecordType
«voidable»
+ legalBasis: LegislationReference
+ legallyBindingZone: Boolean
«voidable, lifeCycleInfo»
::RiskHazardOrExposedElementCoverage
+ beginLifeSpanVersion: DateTime
+ endLifeSpanVersion: DateTime [0..1]
constraints
{RangeSet is LevelofRisk}
Recommandation :
If a risk zone or a risk coverage is legally binding, then it should be linked to a feature of Area Management Restriction Regulation Zoes and Reporting Units "ManagementRestrictionOrRegulationZone"
+areaManagemen
«voidable»
0..*
«featureType»
RiskZone
+ geometry: RiskHazardGeometry
+ inspireId: Identifier
+ typeOfRisk: NaturalHazardClassification
«voidable, lifeCycleInfo»
+ beginLifespanVersion: DateTime
+ endLifespanVersion: DateTime [0..1]
«voidable»
+ legalBasis: LegislationReference [0..*]
+ legallyBindingZone: Boolean
+ levelOfRisk: LevelOfRiskOrHazard
+monitors
«voidable»
0..*
+monitors
«voidable»
0..*
AbstractMonitoringObject
«featureType»
Environmental Monitoring Facilities::
EnvironmentalMonitoringProgram

Figure 4 – UML class diagram: Overview of the Core_model application schema

HAZARD AREA

A hazard area is an area affected by a natural hazard.

We defined a central abstract class “HazardArea”, from which 2 feature types are generalised: “ModelledOrDeterminedHazard” and “ObservedHazard”. It is indeed considered that a hazard area is either observed on one hand, or modelled or determined on the other hand.

A hazard area has either a surface (which itself can be a single or a multi-surface) geometry, or as a solid (which itself can also be a single or a multi-solid) geometry.

TYPE OF HAZARD AND TYPE OF RISK

A hazard area has also a type, which is addressed in the model with the “NaturalHazardClassification” data type. **The “NaturalRiskOrHazardClassification” data type is one central attribute of the core model**.

This data type is composed of:

- one mandatory attribute : the “RiskOrHazardCategory”
- one voidable attribute : the “SpecificRiskOrHazardType”

As there is currently no list, or thesaurus or classification of natural hazards, or risks that can be considered as an international standard, this data type deals with two challenges: creating an interoperable list of hazard in respect of enabling the provision of more specific information about the type of hazard.

This challenge has been met by the creation of a coexistence of a mandatory attribute (“riskOrHazardCategory”) that makes reference to an enumeration of high-level values of categories of hazards (“HazardCategoryValue”) with a voidable attribute (“specificRiskOrHazardType”) that provides additional information about the type of hazard.

The “RiskOrHazardCategory” refers to a codelist of natural hazard categories that is defined in this specification.

IR Requirement 1 The “RiskOrHazardCategory” must be completed for every “HazardArea” features

This codelist is centrally managed, and cannot be extended. On the other hand, the “specificRiskOrHazardType” is not defined, and can be extended for any data provider, for as much as the data provider makes a reference between the value he enters in this “specificRiskOrHazardType” and one of the existing values defined in the “RiskOrHazardCategory”. In this way, the data provider is let free to provide their own code list registers. Moreover, traceability between his register and the “RiskOrHazardCategory” is assured.

Apart from the hazard type and Inspire Id, there are two voidable attributes:

- the level of hazard (“LevelOfHazard”)
- the likelihood of occurrence (“LikelihoodOfOccurence”).

LEVEL OF HAZARD

This concept of level of hazard can integrate the notion of intensity. When described qualitatively, it can also address susceptibility. A level of hazard can be expressed either qualitatively, or quantitatively. A qualitative assessment resides in choosing a value (or a word) among a pre-determined list. For example, assessing that there is a “medium” or “high” level of hazard is a qualitative assessment. Contrary to this concept, a quantitative assessment involves applying a value among a range of possible values (the range being defined by the scale). For example, assessing the level of an earthquake magnitude along a scale is a quantitative assessment.

The data type is therefore made of 4 attributes, 2 for a qualitative assessment (“qualitativeLevelHazardAssessmentMethod” and “qualitativeValue”), and 2 for the quantitative assessment (“quantitativeLevelHazardAssessmentMethod” and “quantitativeValue”).

By assessment, we mean the combination of a value with a reference of the scale or method which is used to express the level of risk / hazard. The value is not useful if the method is not indicated as well. The qualitative value is a character string; the quantitative value is a measure (that is to say the combination of a number and a unit). Both the level of risk (respectively the level of hazard) can be assessed qualitatively and / or quantitatively.

LIKELIHOOD OF OCCURRENCE

The likelihood of occurrence is a general concept relating to the chance of an event occurring. This refers to the "LikelihoodOfOccurrence" data type.

A likelihood of occurrence can be expressed either qualitatively, or quantitatively. The process of modelling this specific issue is similar to the level of risk and level of hazard processes to the main extent. 4 attributes are set: 2 for a quantitative assessment ("quantitativeLikelihoodAssessmentMethod" and "quantitativeLikelihood"), and 2 for the qualitative assessment ("qualitativeLikelihoodAssessmentMethod" and "qualitativeLikelihood"). The qualitative assessment of the likelihood of occurrence is sometimes known as susceptibility.

Yet, the quantitative assessment attribute is not a Number: it is either a probability of occurrence, or a return period. A return period is a long-term average interval of time or number of years within which an event will be equalled or exceeded. The probability of occurrence is the inverse value of the return period.

The "LikelihoodOfOccurrence" data type also includes a "ValidityPeriod" attribute. This was decided because they both aim to address the same problem, which is to answer, "when does the hazard occur". And "when" it has two approaches; in terms of chances of it of occurring, and in terms of a period of time for which its chance is applicable. In a hypothetical case of forest fires, a dataset could be provided where two polygons are shown, one referring to the summer season whereas the other takes into consideration the winter season. Showing both polygons at the same time provides an overview of the year-round chances and extent for forest fires, but both polygons would not refer to the same season and therefore are not valid outside the time-frame provided in the valid assessment period attribute. It is a sort of multi-temporal hazard analysis that can also be taken care of with this attribute. The valid assessment period differs from return period (or chances, frequency) because the return period is bound by the season or cycle considered.

OBSERVED HAZARD

The "ObservedHazard" inherits from all the attributes defined at the "HazardArea" level, plus it has some specific ones:

- "NameOfEvent": an observed hazard can have a commonly known name (such as the "Xynthia" tempest that stroke part of the Atlantic coast-line of France in early 2010).
- "ValidFrom": which is about the date of appearance of the event ("February 26th 2010" for the "Xynthia" tempest)
- "ValidTo" : which is about the ending date of the event ("March 1st 2010" for the "Xynthia" tempest)

MODELLED OR DETERMINED HAZARD

The "ModelledOrDeterminedHazard" inherits all of the attributes defined at the "HazardArea" level, plus it has:

- one specific attribute: the "DeterminationMethod" which is an enumeration of 2 values : "modelling" and "indirectDetermination"
- a constraint : the "LikelihoodOfOccurrence" is mandatory for the "ModelledOrDeterminedHazard"

IR Requirement 2	The "LikelihoodOfOccurrence" must be completed for every "ModelledOrDeterminedHazard" features

ASSOCIATION TO OTHER FEATURE TYPES OF NATURAL RISK ZONES

A "HazardArea" can be linked to a risk zone (the "RiskZone" feature type). A "HazardArea" can also be linked to exposed element (the "ExposedElement" feature type). When it is, then information about the vulnerability of the exposed element toward this hazard area can be completed.

VULNERABILITY

The vulnerability is defined as such: "The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effect of a hazard. NOTE: It can also address exposure."

It is modelled as a set of attributes of the association between "ExposedElement" and "HazardArea" because the vulnerability depends both on the exposed element and on the hazard area (with its location, type, likelihood of occurrence, and level of hazard).

The vulnerability ("VulnerabilityOfElement") can be assessed or calculated either qualitatively or quantitatively. It is modelled in a similar way to the level of hazard and the level of risk. Four attributes are set; 2 for a quantitative assessment ("quantitativeVulnerabilityAssessmentMethod" and "quantitativeValue") and 2 for the qualitative assessment ("qualitativeVulnerabilityAssessmentMethod" and "qualitativeValue"). 2 attributes model the value of the vulnerability and 2 attributes are reference to the method or the scale that the value of vulnerability comes from.

EXPOSED ELEMENTS

Exposed elements are "People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses. "

An exposed element is a spatial feature for which vulnerability might be calculated (or assessed) according to a specific natural hazard (see the "vulnerability" chapter). It is also linked to the risk zones.

An exposed element has a type (a classification), and a value. The value is modelled as a measure; it has a number associated with a unit. In this case, the unit of measurement can be Euros, or people, or protected monuments, etc…

The model contains there first an abstract feature type, which is called "ExposedElement". This feature type is linked to the "HazardArea" and to the "RiskZone" feature type.

The same exposed element can have a different level of vulnerability depending on the type of natural hazard it is exposed to. The vulnerability piece of information is modelled as a set of attributes of the association class between the hazard are feature class ("HazardArea") and the exposed element feature class ("ExposedElement").

Moreover, it contains a voidable attribute which is called "typeOfExposedElement". This attribute aims at enhancing what the spatial object is about, and also from which angle the spatial object is considered as an exposed element. The same object might actually be considered as an exposed element from an economic point of view, as well as from a social point of view, also a cultural point of view, and so on… As a consequence the attribute is modelled by a codelist that can be fully extended by any other term.

2 cases are taken into account:

- When the exposed element spatial object has already been provided within the INSPIRE framework, as another INSPIRE feature type.

- When the spatial object has never been provided within the INSPIRE framework, as another INSPIRE feature type.

This has led to the creation of 2 feature types that are both generalised from the "ExposedElement" feature type:

- "internallyDefinedExposedElement", which addresses the issue when the exposed element spatial object has already been provided within the INSPIRE framework, as another INSPIRE feature type. It is generalized from the ISO 19136 "GML" "AbstractObject".

  In this case, an externally produced spatial object that is provided in the INSPIRE framework is considered as an exposed element, plus it might have vulnerability values that have been

calculated on along to a certain hazard area. The process is that in this case the natural risk zones data provider references the external object as an exposed element, and might eventually complete vulnerability values.

- "externallyDefinedExposedElement", which addresses the issue when the spatial object has never been provided within the INSPIRE framework, as another INSPIRE feature type. Here, the natural risk zones data provider produces itself spatial objects that do not fall under the scope of any INSPIRE theme. The "internallyDefinedExposedElement" has therefore a geometry (modelled as GM_Object). It besides inherits from the "typeOfExposedElement".

In this case the natural risk zones data provider does produce spatial object that fall under another INSPIRE theme, then he could first provide these data as the other Inspire theme, and then reference this new INSPIRE object as an "externallyDefinedExposedElement".

RISK ZONE

A risk zone is defined as "the spatial extent of a combination of the consequences of an event (hazard) and the associated probability/likelihood of its occurrence".

A risk zone ("RiskZone") is a feature that is either a surface (which itself can be a single or a multi-surface) geometry, or as a solid (which itself can also be a single or a multi-solid) geometry. Apart from the Inspire Identifier, it has one mandatory attribute; the type of risk ("typeOfRisk").
The type of risk refers to the "naturalRiskOrHazardClassification" data type.
A risk zone is linked to at least one hazard area and to at least one exposed element.

A risk zone is either modelled or determined using proxy methods. The "DeterminationMethod" attribute is an enumeration that enables the provision of this piece of information.

A risk zone feature has a level of risk ("levelOfRisk"). It is modelled exactly in the same as the "LevelOfHazard" is defined: both refer to the same "LevelOfRiskOrHazard" data type.

A level of risk can be expressed either qualitatively, or quantitatively. A qualitative assessment resides in choosing a value (or a word) among a pre-determined list. For example, assessing that there is a "moderate" or "high" level of risk is a qualitative assessment. Contrary to this concept, a quantitative assessment involves applying a value among a range of possible values (the range being defined by the scale). For example, assessing the level of potential losses of an earthquake of a given magnitude along a scale is a quantitative assessment.
The data type is therefore made of 4 attributes, 2 for a quantitative assessment ("qualitativeLevelRiskAssessmentMethod" and "qualitativeValue"), and 2 for the quantitative assessment ("quantitativeLevelRiskAssessmentMethod" and "quantitativeValue"). By "assessment", we mean the combination of a value with a reference of the scale or method which is used to express the level of risk / hazard. The value is not useful if the method is not indicated as well. The qualitative value is a character string; the quantitative value is a number. The reference is a document reference ("DocumentReference").

Both the level of risk (respectively the level of hazard) can be assessed qualitatively and / or quantitatively.

IR Requirement 3 Each risk zone must have a risk type value.

The definition of a risk zone may have an impact on the local regulation. A boolean attribute is set to indicate whether the risk zone feature is legally binding or not. Moreover, an attribute is set so as to provide a reference about the legal basis if the risk zone is legally binding.

ASSOCIATION TO OTHER FEATURE TYPES OF NATURAL RISK ZONES

A “RiskZone” feature is linked to “HazardArea” and “ExposedElements”.

IR Requirement 4	Every “RiskZone” features must be linked to one “HazardArea” feature

IR Requirement 5	Every “RiskZone” features must be linked to at least one “ExposedElement” feature

DOCUMENT REFERENCE

In the core model, there is a mention of the “DocumentReference” data type anytime a value -either qualitative or quantitative- is mentioned.

All the references are modelled as a subset of attributes of the ISO 19115 CI_Citation leaf. A couple of constraints have been set in order to improve consistency. They are in the next chapter.

OPEN ISSUE This is our view of document referencing. We will adapt it according to the feedback brought by JRC before version 3.0

LINKS WITH OTHER THEMES

An association link is set between the “RiskZone” feature type and the “EnvironmentalMonitoringProgram” feature type. A risk zone feature can actually be monitored, and therefore be linked to the environmental monitoring facility.

An association link is set between the “RiskZone” feature type and the “Management RegulationOrRestrictionZone” modelled in “Area management, restriction, regulation zones and reporting Units” theme.

Those two links are set in the case when a risk zone feature has an impact a regulated or a restricted area.

Recommendation: If a risk zone is legally binding, then it should be linked to a feature of the “Management RegulationOrRestrictionZone” feature type.

5.2.1.3. Consistency between spatial data sets

IR Requirement 6	In the ‘DocumentReference’, either the locationOfMethod or the contact Information attribute must be completed.

IR Requirement 7	In the “Contact Information”, either the phone, or the address, or the online resource must be completed.

IR Requirement 8	In the “Contact Information”, if the address is completed, then either the individual name or the organisation must be completed.

IR Requirement 9	When a risk zone feature is associated with a hazard area, then the risk zone feature and the hazard area feature must overlay (at least partially).

IR Requirement 10	When a risk zone feature is associated with an exposed element, then the exposed element must overlay with the risk zone feature.

5.2.1.4. Modelling of object references

The “externallyDefinedExposed*E*lement” feature type makes full use of references to features that will be provided under other INSPIRE themes. This is done in order to avoid duplication of geometry. The “externallyDefinedExposedElement” should therefore reference them using inspireId, or should directly reference their geometry.

Recommendation: The “externallyDefinedExposedElement” should reference features defined by other INSPIRE themes using the inspireId or should directly reference their geometry

5.2.1.5. Temporality representation

The application schema(s) use(s) the derived attributes "beginLifespanObject" and "endLifespanObject" to record the lifespan of a spatial object.

The attributes "beginLifespanVersion" specifies the date and time at which this version of the spatial object was inserted or changed in the spatial data set. The attribute "endLifespanVersion" specifies the date and time at which this version of the spatial object was superseded or retired in the spatial data set.

NOTE 1 The attributes specify the beginning of the lifespan of the version in the spatial data set itself, which is different from the temporal characteristics of the real-world phenomenon described by the spatial object. This lifespan information, if available, supports mainly two requirements: First, knowledge about the spatial data set content at a specific time; second, knowledge about changes to a data set in a specific time frame. The lifespan information should be as detailed as in the data set (i.e., if the lifespan information in the data set includes seconds, the seconds should be represented in data published in INSPIRE) and include time zone information.

NOTE 2 Changes to the attribute "endLifespanVersion" does not trigger a change in the attribute "beginLifespanVersion".

Recommendation 4	If life-cycle information is not maintained as part of the spatial data set, all spatial objects belonging to this data set should provide a void value with a reason of "unpopulated".

5.2.2 INSPIREFeature catalogue

Table 3 - Feature catalogue metadata

Feature catalogue name	INSPIRE feature catalogue Core_Model
Scope	Core_Model
Version number	2.9
Version date	2012-02-24
Definition source	INSPIRE data specification Core_Model

Table 4 - Types defined in the feature catalogue

Type	Package	Stereotypes	Section
DeterminationMethodValue	Core_Model	«enumeration»	5.2.2.3.1
DocumentReference	Core_Model	«dataType»	5.2.2.2.1
ExposedElements	Core_Model	«featureType»	5.2.2.1.1
ExternallyDefinedExposedElement	Core_Model	«featureType»	5.2.2.1.2
HazardArea	Core_Model	«featureType»	5.2.2.1.3
InternallyDefinedExposedElement	Core_Model	«featureType»	5.2.2.1.4
LevelOfRiskOrHazard	Core_Model	«dataType»	5.2.2.2.2
LikelihoodOfOccurrence	Core_Model	«dataType»	5.2.2.2.3
ModelledOrDeterminedHazard	Core_Model	«featureType»	5.2.2.1.5
NaturalHazardClassification	Core_Model	«dataType»	5.2.2.2.4
ObservedHazard	Core_Model	«featureType»	5.2.2.1.6
QuantitativeLikelihood	Core_Model	«dataType»	5.2.2.2.5
RiskHazardGeometry	Core_Model	«union»	5.2.2.2.6
RiskOrHazardCategory	Core_Model	«codeList»	5.2.2.4.1
RiskZone	Core_Model	«featureType»	5.2.2.1.7
SpecificRiskOrHazardType	Core_Model	«codeList»	5.2.2.4.2
TypeOfElement	Core_Model	«codeList»	5.2.2.4.3
VulnerabilityOfElement	Core_Model		5.2.2.2.7
contactInformation	Core_Model	«dataType»	5.2.2.2.8

5.2.2.1. Spatial object types

5.2.2.1.1. ExposedElements

ExposedElements (abstract)	
Name:	Exposed Elements
Definition:	SOURCE : [UNISDR, 2009] People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses.
Status:	Proposed
Stereotypes:	«featureType»
Identifier:	null
Attribute: typeOfElement	
Value type:	TypeOfElement

ExposedElements (abstract)

Definition: A classification of the exposed element.
Multiplicity: 1
Stereotypes: «voidable»
Obligation: Technical Guidance (recommendation)

Attribute: valueOfElement

Value type: Measure
Definition: The value of the element.
Description: This can be expressed in euros, in number of people, or in any other unit.
Multiplicity: 1
Stereotypes: «voidable»

Association role: riskZone

Value type: RiskZone
Definition: The risk zone that is linked to an exposed element.
Multiplicity: 0..*
Stereotypes: «voidable»

Association role: hazardArea [the association has additional attributes - see association class VulnerabilityOfElement]

Value type: HazardArea
Multiplicity: 1..*
Stereotypes: «voidable»

5.2.2.1.2. ExternallyDefinedExposedElement

ExternallyDefinedExposedElement

Name: Externally Defined Exposed Element
Subtype of: AbstractFeature, ExposedElements
Definition: A spatial object that has already been provided within the INSPIRE framework, and which is now considered as an exposed element to a natural hazard.
Description: An exposed element is typically any spatial object representing a real-world object or administrative/statistical unit. Therefore, it is impossible to explicitly define which INSPIRE spatial objects should be encoded as a Exposed Element. This feature class aims at including any spatial data which is considered as an exposed element.
Status: Proposed
Stereotypes: «featureType»
Identifier: null

5.2.2.1.3. HazardArea

HazardArea (abstract)

Name: Hazard Area
Definition: Area affected by a natural hazard.
Description: A natural hazard is a natural process or phenomenon that may cause loss of life, injury or other impacts, property damage, loss livelihoods and services, social and economic disruption, or environmental damage. [Council of The European Union - Commission Staff Working Paper - Risk Assessment and Mapping Guidelines for Disaster Management].
Status: Proposed
Stereotypes: «featureType»
Identifier: null

Attribute: likelihoodOfOccurrence

HazardArea (abstract)

Value type: LikelihoodOfOccurrence
Definition: Likelihood is a general concept relating to the chance of an event occuring.
Multiplicity: 1
Stereotypes: «voidable»

Attribute: beginLifespanVersion

Value type: DateTime
Definition: Date and time at which this version of the spatial object was inserted or changed in the spatial data set.
Multiplicity: 1
Stereotypes: «voidable,lifeCycleInfo»

Attribute: endLifespanVersion

Value type: DateTime
Definition: Date and time at which this version of the spatial object was superseded or retired in the spatial data set.
Multiplicity: 0..1
Stereotypes: «voidable,lifeCycleInfo»

Attribute: geometry

Value type: RiskHazardGeometry
Definition: Geometric representation of spatial extent covered by the hazard area.
Multiplicity: 1

Attribute: inspireId

Value type: Identifier
Definition: External object identifier of the hazard area.
Description: An external object identifier is a unique object identifier published by the responsible body, which may be used by external applications to reference the spatial object. The identifier is an identifier of the spatial object, not an identifier of the real-world phenomenon.
Multiplicity: 1

Attribute: levelOfHazard

Value type: LevelOfHazard
Definition: Assessment of the level of the hazard.
Description: The level of hazard can either be described quantitatively or qualitative. This notion can integrate the notion of intensity. When described qualitatively, it can also adress susceptibility.
Multiplicity: 1
Stereotypes: «voidable»

Attribute: typeOfHazard

Value type: NaturalHazardClassification
Definition: A generic classification and a specific classification of the type of hazard.
Multiplicity: 1

Association role: result

Value type: RiskZone
Definition: The risk zone that result from the hazard area.
Multiplicity: 0..*
Stereotypes: «voidable»

Association role: exposedElement [the association has additional attributes - see association class

HazardArea (abstract)
VulnerabilityOfElement]
Value type: ExposedElements Multiplicity: 0..* Stereotypes: «voidable»

5.2.2.1.4. InternallyDefinedExposedElement

InternallyDefinedExposedElement
Name: Internally Defined Exposed Element Subtype of: ExposedElements Definition: A spatial object that has never been provided within the INSPIRE framework, and which is considered as featuring an element exposed to a natural hazard. Description: Status: Proposed Stereotypes: «featureType» Identifier: null
Attribute: geometry
Value type: GM_Object Definition: Geometric representation of the exposed element. Multiplicity: 1
Attribute: inspireId
Value type: Identifier Definition: External object identifier of the exposed element. Multiplicity: 1
Attribute: beginLifeSpanVersion
Value type: DateTime Definition: Date and time at which this version of the spatial object was inserted or changed in the spatial data set. Multiplicity: 1 Stereotypes: «voidable,lifeCycleInfo»
Attribute: endLifeSpanVersion
Value type: DateTime Definition: Date and time at which this version of the spatial object was superseded or retired in the spatial data set. Multiplicity: 0..1 Stereotypes: «voidable,lifeCycleInfo»
Attribute: validFrom
Value type: DateTime Definition: The time when the exposed element started to exist in the real world. Multiplicity: 1 Stereotypes: «voidable,lifeCycleInfo»
Attribute: validTo
Value type: DateTime Definition: The time from which the exposed element no longer exists in the real world. Multiplicity: 0..1 Stereotypes: «voidable,lifeCycleInfo»

5.2.2.1.5. ModelledOrDeterminedHazard

ModelledOrDeterminedHazard	
Name:	Modelled Or Determined Hazard
Subtype of:	HazardArea
Definition:	A hazard which extent is modeled, or inferred by the interpretation of indirect artefacts.
Status:	Proposed
Stereotypes:	«featureType»
Identifier:	null
Attribute: determinationMethod	
Value type:	DeterminationMethodValue
Definition:	A simplified enumeration to describe whether the area was delineated after modelling or determined after interpretation of indirect artefacts.
Multiplicity:	1
Stereotypes:	«voidable»
Constraint: the likelihood of occurrence must be completed.	
Natural language:	the likelihood of occurrence must be completed.
OCL:	inv: self.likelihoodOfOccurrence.notEmpty()

5.2.2.1.6. ObservedHazard

ObservedHazard	
Name:	Observed Hazard
Subtype of:	HazardArea
Definition:	A hazard which occurred, or is currently occuring, and which has been observed.
Status:	Proposed
Stereotypes:	«featureType»
Identifier:	null
Attribute: nameOfEvent	
Value type:	CharacterString
Definition:	common name of the observed hazard.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: validFrom	
Value type:	DateTime
Definition:	The time when the phenomenon started to exist in the real world.
Multiplicity:	1
Stereotypes:	«voidable,lifeCycleInfo»
Attribute: validTo	
Value type:	DateTime
Definition:	The time from which the phenomenon no longer exists in the real world.
Multiplicity:	0..1
Stereotypes:	«voidable,lifeCycleInfo»

5.2.2.1.7. RiskZone

RiskZone	
Name:	Risk Zone
Definition:	A risk zone is the spatial extent of a combination of the consequences of an event (hazard) and the associated probability/likelihood of its occurrence.

RiskZone

Status: Proposed
Stereotypes: «featureType»
Identifier: null

Attribute: beginLifespanVersion

Value type: DateTime
Definition: Date and time at which this version of the spatial object was inserted or changed in the spatial data set.
Multiplicity: 1
Stereotypes: «voidable,lifeCycleInfo»

Attribute: endLifespanVersion

Value type: DateTime
Definition: Date and time at which this version of the spatial object was superseded or retired in the spatial data set.
Multiplicity: 0..1
Stereotypes: «voidable,lifeCycleInfo»

Attribute: geometry

Value type: RiskHazardGeometry
Definition: Geometric representation of spatial extent covered by this risk zone.
Multiplicity: 1

Attribute: inspireId

Value type: Identifier
Definition: External object identifier of the risk zone.
Description: An external object identifier is a unique object identifier published by the responsible body, which may be used by external applications to reference the spatial object. The identifier is an identifier of the spatial object, not an identifier of the real-world phenomenon.
Multiplicity: 1

Attribute: legalBasis

Value type: LegislationReference
Definition: Legal basis upon which the risk zone coverage is based (if any).
Multiplicity: 0..*
Stereotypes: «voidable»

Attribute: legallyBindingZone

Value type: Boolean
Definition: A boolean to express whether the risk zone feature has an impact on the use of the zone, based on a legal basis.
Multiplicity: 1
Stereotypes: «voidable»

Attribute: levelOfRisk

Value type: LevelOfRiskOrHazard
Definition: The level of risk is an assessment of the combination of the consequences of an event (hazard) and the associated probability/likelihood of the occurrence of the event.
Multiplicity: 1
Stereotypes: «voidable»

Attribute: typeOfRisk

RiskZone	
Value type:	NaturalHazardClassification
Definition:	A generic classification and a specific classification of the type of risk.
Multiplicity:	1
Association role: monitors	
Value type:	EnvironmentalMonitoringProgram
Definition:	The monitoring program that monitors the risk zone
Multiplicity:	0..*
Stereotypes:	«voidable»
Association role: areaManagement	
Value type:	ManagementRegulationOrRestrictionZone
Definition:	The area management to which the risk zone is linked.
Multiplicity:	0..*
Stereotypes:	«voidable»
Association role: source	
Value type:	HazardArea
Definition:	The hazard area that is linked to the risk zone.
Multiplicity:	1
Stereotypes:	«voidable»
Association role: exposedElement	
Value type:	ExposedElements
Definition:	The exposed element that is linked to the risk zone.
Multiplicity:	1..*
Stereotypes:	«voidable»
Constraint: A riskzone must be linked to 1 (or more) exposed elements	
Natural language:	A riskzone must be linked to 1 (or more) exposed element
OCL:	inv: self.involvedFeature.notEmpty()
Constraint: legallyBindingZone - legalBasis	
Natural language:	If the risk zone attribute “legallyBinding is set to “True”, then the attribute “legalBasis” must not be empty.
OCL:	inv: self.legallyBindingZone = 'True' implies self.legalBasis.notEmpty()

5.2.2.2. Data types

5.2.2.2.1. DocumentReference

DocumentReference	
Name:	Document Reference
Definition:	the piece of information which is required to get further information about a method that is described and explained in a paper.
Status:	Proposed
Stereotypes:	«dataType»
Identifier:	null
Attribute: title	
Value type:	CharacterString
Definition:	Name by which the cited information is known.
Multiplicity:	1
Stereotypes:	«voidable»

DocumentReference

Attribute: dateOfPublication

Value type:	DateTime
Definition:	Date when the reference was published.
Multiplicity:	1
Stereotypes:	«voidable»

Attribute: locationOfMethod

Value type:	URL
Definition:	A URI that enables to locate and get the reference document.
Multiplicity:	1
Stereotypes:	«voidable»

Attribute: contactInformation

Value type:	contactInformation
Definition:	Data that enable the user to contact a person in order to get more information about a method.
Multiplicity:	1
Stereotypes:	«voidable»

Constraint: Either the locationOfRessource or the contactInformation must be completed

Natural language:	Either the locationOfMethod or the contactInformation must be completed.
OCL:	inv: self.locationOfMethod.isEmpty() implies self.contactInformation.notEmpty() and self.contactInformation.isEmpty() implies self.locationOfMethod.notEmpty()

5.2.2.2.2. LevelOfRiskOrHazard

LevelOfRiskOrHazard

Name:	Level Of Risk Or Hazard
Definition:	Level of risk, or level of hazard
Description:	The level of risk is an assessment of the combination of the consequences of an event (hazard) and the associated probability/likelihood of the occurrence of the event.
Status:	Proposed
Stereotypes:	«dataType»
Identifier:	null

Attribute: qualitativeLevelRiskHazardAssessmentMethod

Value type:	DocumentReference
Definition:	A citation to the method used to express the level of risk or hazard qualitatively.
Multiplicity:	1
Stereotypes:	«voidable»

Attribute: qualitativeValue

Value type:	CharacterString
Definition:	A qualitative assessment of the level of risk or hazard.
Multiplicity:	1
Stereotypes:	«voidable»

Attribute: quantitativeLevelRiskHazardAssessmentMethod

Value type:	DocumentReference
Definition:	A citation to the method used to express the level of risk or hazard quantitatively.
Multiplicity:	1
Stereotypes:	«voidable»

LevelOfRiskOrHazard

Attribute: quantitativeValue

Value type:	Measure
Definition:	A quantitative assessment of the level of risk or hazard.
Multiplicity:	1
Stereotypes:	«voidable»

Constraint: either the quantitative value or the qualitative value must be completed.

Natural language:	either the qualitative value or the quantitative value must be completed.
OCL:	inv: self.qualitativeValue.isEmpty() implies self.quantitativeValue.notEmpty() and self.quantitativeValue.isEmpty() implies self.qualitativeValue.notEmpty()

Constraint: The related risk assessment method attribute must be filled.

Natural language:	The related risk or hazard assessment method attribute must be filled.
OCL:	inv: self.quantitativeValue.notEmpty() implies self.quantitativeLevelRiskHazardAssessmentMethod.notEmpty() inv: self.qualitativeValue.notEmpty() implies self.qualitativeLevelRiskHazardAssessmentMethod.notEmpty()

5.2.2.2.3. LikelihoodOfOccurrence

LikelihoodOfOccurrence

Name:	Likelihood Of Occurrence
Definition:	Likelihood is a general concept relating to the chance of an event occurring.
Description:	Likelihood is generally expressed as a probability or a frequency. [EXCIFF].
Status:	Proposed
Stereotypes:	«dataType»
Identifier:	null

Attribute: qualitativeLikelihood

Value type:	CharacterString
Definition:	A qualitative assessment of the likelihood of occurrence of a hazard.
Description:	Sometimes, this is known as susceptibility.
Multiplicity:	1
Stereotypes:	«voidable»

Attribute: qualitativeLikelihoodAssessmentMethod

Value type:	DocumentReference
Definition:	A citation to the method used to express the likelihood qualitatively, along to a predefined scale.
Multiplicity:	1
Stereotypes:	«voidable»

Attribute: quantitativeLikelihood

Value type:	QuantitativeLikelihood
Definition:	A frequency of occurence or return period of a hazard phenomenon.
Description:	Sometimes, this is known as susceptibility.
Multiplicity:	1
Stereotypes:	«voidable»

Attribute: quantitativeLikelihoodAssessmentMethod

Value type:	DocumentReference
Definition:	A reference to the method used to express the likelihood quantitatively.

LikelihoodOfOccurrence

Multiplicity: 1
Stereotypes: «voidable»

Attribute: validityPeriod

Value type: TM_Period
Definition: Future finite time frame where likelihood of occurrence assessment applies.
Description: It is an interval of dates, or the expression of a time frame for which the estimates are meant (eg: until 2090; summer of 2011; winter seasons until 2015).
Multiplicity: 0..*
Stereotypes: «voidable»

Constraint: Either the qualitative likelihood or the quantitative likelihood must be completed.

Natural language: either the qualitative likelihood or the quantitative likelihood must be completed.
OCL: inv: self.qualitativeLikelihood.isEmpty() implies self.quantitativeLikelihood.notEmpty() and self.quantitativeLikelihood.isEmpty() implies self.qualitativeLikelihood.notEmpty()

5.2.2.2.4. NaturalHazardClassification

NaturalHazardClassification

Name: Natural Hazard Classification
Definition: This class provides piece of information about the nature of the natural risk or hazard.
Status: Proposed
Stereotypes: «dataType»
Identifier: null

Attribute: riskOrHazardCategory

Value type: RiskOrHazardCategory
Definition: A generic classification of types of natural risks or hazards.
Multiplicity: 1
Obligation: Implementing Rule (requirement)

Attribute: specificRiskOrHazardType

Value type: SpecificRiskOrHazardType
Definition: A classification of the natural risk or hazard according to a nomenclature that is specific to this dataset.
Multiplicity: 1
Stereotypes: «voidable»
Obligation: Technical Guidance (recommendation)

5.2.2.2.5. QuantitativeLikelihood

QuantitativeLikelihood

Name: Quantitative Likelihood
Definition: A frequency of occurrence or return period of a hazard phenomenon.
Status: Proposed
Stereotypes: «dataType»
Identifier: null

Attribute: probabilityOfOccurrence

Value type: Probability

QuantitativeLikelihood	
Definition:	The probability of occurrence of a hazard event, expressed as a value between 0 and 1.
Description:	This is the inverse value of the return period.
Multiplicity:	1
Stereotypes:	«voidable»

Attribute: returnPeriod

Value type:	Number
Definition:	Long-term average interval of time or number of years within which an event will be equalled or exceeded [UNESCO].
Multiplicity:	1
Stereotypes:	«voidable»

5.2.2.2.6. RiskHazardGeometry

RiskHazardGeometry	
Name:	Risk Hazard Geometry
Definition:	Defines the allowed geometries for the hazard area and risk zone features.
Status:	Proposed
Stereotypes:	«union»
Identifier:	null

Attribute: geometryByVolume

Value type:	GM_Solid
Definition:	A feature which geometry is a volume
Multiplicity:	1

Attribute: geometryBySurface

Value type:	GM_Surface
Definition:	A feature which geometry is a surface
Multiplicity:	1

Attribute: geometryByMultiVolume

Value type:	GM_MultiSolid
Definition:	A feature which geometry is composed of several volumes
Multiplicity:	1

Attribute: geometryByMultiSurface

Value type:	GM_MultiSurface
Definition:	A feature which geometry is composed of several surfaces
Multiplicity:	1

5.2.2.2.7. VulnerabilityOfElement

VulnerabilityOfElement (association class)	
Name:	Vulnerability Of Element
Definition:	SOURCE : [UNISDR, 2009] The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effect of a hazard. NOTE : It can also address exposure.
Description:	SOURCE : [Council of The European Union - Commission Staff Working Paper - Risk Assessment and Mapping Guidelines for Disaster Management] In probablistic/quantitative risk assessments the term vulnerability expresses the part of percentage of Exposure that is likely to be lost due to a certain hazard.
Status:	Proposed

VulnerabilityOfElement (association class)	
Identifier:	null
Attribute: qualitativeVulnerability	
Value type:	CharacterString
Definition:	A qualitative assessment or calculation of the vulnerability.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: quantitativeVulnerability	
Value type:	Number
Definition:	A quantitative assessment or calculation of the vulnerability.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: qualitativeVulnerabilityAssessmentMethod	
Value type:	DocumentReference
Definition:	A citation to the method used to assess the qualitative vulnerability.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: quantitativeVulnerabilityAssessmentMethod	
Value type:	DocumentReference
Definition:	A citation to the method used to assess the quantitative vulnerability.
Multiplicity:	1
Stereotypes:	«voidable»
Constraint: Either the quantitative vulnerability or the quantitative vulnerability must be completed	
Natural language:	Either the quantitative vulnerability or the quantitative vulnerability must be completed.
OCL:	inv: self.qualititativeVulnerability.isEmpty() implies self.quantitativeVulnerability.notEmpty() and self.quantitativeVulnerability.isEmpty() implies self.qualititativeVulnerability.notEmpty()
Constraint: If the qualitative vulnerability is completed, then the qualitative vulnerability assessment method must also be completed.	
Natural language:	If the qualitative vulnerability is completed, then the qualitative vulnerability assessment method must also be completed.
OCL:	inv: self.qualitativeVulnerability.notEmpty() implies qualitativeVulnerabilityAssessmentMethod.notEmpty()
Constraint: If the quantitative vulnerability is completed, then the quantitative vulnerability assessment method must be completed as well.	
Natural language:	If the quantitative vulnerability is completed, then the quantitative vulnerability assessment method must be completed as well.
OCL:	inv: self.quantitativeVulnerability.notEmpty() implies quantitativeVulnerabilityAssessmentMethod.notEmpty()

5.2.2.2.8. contactInformation

contactInformation	
Name:	contact Information
Definition:	Data that enable the user to contact a person in order to get more information about a method.
Status:	Proposed

contactInformation

Stereotypes: «dataType»
Identifier: null

Attribute: individualName

Value type: CharacterString
Definition: Name of the responsible person-
Description: SURNAME, given name, title separated by a delimiter.
Multiplicity: 1
Stereotypes: «voidable»

Attribute: organisationName

Value type: CharacterString
Definition: Name of the responsible organisation.
Multiplicity: 1
Stereotypes: «voidable»

Attribute: phone

Value type: CI_Telephone
Definition: Telephone numbers at which the organisation or individual may be contacted.
Multiplicity: 1
Stereotypes: «voidable»

Attribute: address

Value type: CI_Address
Definition: Physical and email address at which the organisation or individual may be contacted.
Multiplicity: 1
Stereotypes: «voidable»

Attribute: onlineRessource

Value type: URI
Definition: Online information that can be used to contact the individual or organisation.
Multiplicity: 1
Stereotypes: «voidable»

Constraint: If the address is completed, then either the individual name or the organisation name must at least be completed

Natural language: If the address is completed, then either the individual name or the organisation name must at least be completed
OCL: inv: self.address.notEmpty() implies self.individualName.netEmpty() or self.organisationName.notEmpty()

Constraint: the phone number, the address or the onlineRessource must be completed

Natural language: Either the phone, or the address, or the onlineRessource must be completed
OCL: inv: self.phone.isEmpty() and self.address.isEmpty() implies self.onlineRessource.notEmpty() and self.phone.isEmpty() and self.onlineRessource.isEmpty() implies self.address.notEmpty() and self.address.isEmpty() and self.onlineRessource.isEmpty() implies self.phone.notEmpty()

5.2.2.3. Enumerations

5.2.2.3.1. DeterminationMethodValue

DeterminationMethodValue

DeterminationMethodValue	
Name:	Determination Method
Definition:	An enumeration to describe the method used to define the area of hazard or risk.
Description:	There are several ways to delineate the perimeter of a hazard or a risk : to model it, or to assess it using indirect parameters or evidence.
Status:	Proposed
Stereotypes:	«enumeration»
Identifier:	null
Value: modelling	
Definition:	The area as it could -or would- have been after having modelled the occurence of the event.
Value: indirectDetermination	
Definition:	The area as it has been identified by artifacts or other indirect methods.

5.2.2.4. Code lists

5.2.2.4.1. RiskOrHazardCategory

RiskOrHazardCategory	
Name:	Risk Or Hazard Category
Definition:	A generic classification of types of natural risks or hazards.
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	none
Identifier:	http://inspire.ec.europa.eu/codeList/RiskOrHazardCategory

5.2.2.4.2. SpecificRiskOrHazardType

SpecificRiskOrHazardType	
Name:	Specific Risk Or Hazard Type
Definition:	A classification of the natural risk or hazard according to a nomenclature that is specific to this dataset.
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	narrower
Identifier:	

5.2.2.4.3. TypeOfElement

TypeOfElement	
Name:	Type Of Element
Definition:	A classification of the exposed element.
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	any
Identifier:	

5.2.2.5. Imported types (informative)

This section lists definitions for feature types, data types and enumerations and code lists that are defined in other application schemas. The section is purely informative and should help the reader understand the feature catalogue presented in the previous sections. For the normative documentation of these types, see the given references.

5.2.2.5.1. AbstractFeature

AbstractFeature (abstract)

AbstractFeature (abstract)	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19136 GML::feature [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.5.2. Boolean

Boolean	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19103:2005 Schema Language::Basic Types::Primitive::Truth [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.5.3. CI_Address

CI_Address	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19115:2006 Metadata (Corrigendum)::Citation and responsible party information [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.5.4. CI_Telephone

CI_Telephone	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19115:2006 Metadata (Corrigendum)::Citation and responsible party information [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.5.5. CharacterString

CharacterString	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19103:2005 Schema Language::Basic Types::Primitive::Text [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.5.6. DateTime

DateTime	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19103:2005 Schema Language::Basic Types::Primitive::Date and Time [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.5.7. EnvironmentalMonitoringProgram

EnvironmentalMonitoringProgram	
Package:	INSPIRE Consolidated UML Model::Themes::Annex III::Environmental Monitoring Facilities::Environmental Monitoring Facilities [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	An Environmental Monitoring Program is a policy relevant document defining the target of a collection of observations and/or the deployment of Abstract Monitoring Features on the field. Usually an Environmental Monitoring Program has a long term perspective over at least a few years.

5.2.2.5.8. GM_MultiSolid

GM_MultiSolid

GM_MultiSolid	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19107:2003 Spatial Schema:: Geometry::Geometric aggregates [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.5.9. GM_MultiSurface

GM_MultiSurface	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19107:2003 Spatial Schema:: Geometry::Geometric aggregates [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.5.10. GM_Object

GM_Object (abstract)	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19107:2003 Spatial Schema:: Geometry::Geometry root [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.5.11. GM_Solid

GM_Solid	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19107:2003 Spatial Schema:: Geometry::Geometric primitive [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.5.12. GM_Surface

GM_Surface	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19107:2003 Spatial Schema:: Geometry::Geometric primitive [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.5.13. Identifier

Identifier	
Package:	INSPIRE Consolidated UML Model::Generic Conceptual Model::Base Types [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	External unique object identifier published by the responsible body, which may be used by external applications to reference the spatial object.
Description:	NOTE1 External object identifiers are distinct from thematic object identifiers. NOTE 2 The voidable version identifier attribute is not part of the unique identifier of a spatial object and may be used to distinguish two versions of the same spatial object. NOTE 3 The unique identifier will not change during the life-time of a spatial object.

5.2.2.5.14. LegislationReference

LegislationReference	
Package:	INSPIRE Consolidated UML Model::Generic Conceptual Model::Base Types 2 [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

LegislationReference	
Definition:	Unique identifier or citation to unambiguously reference a legal act or a specific part of a legal act.

5.2.2.5.15. LevelOfHazard

LevelOfHazard	
Package:	INSPIRE Consolidated UML Model::Themes::Annex III::Natural Risk Zones::Coverage_Model [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	Assessment of the level of the hazard.

5.2.2.5.16. LikelihoodOfOccurrence

LikelihoodOfOccurrence	
Package:	INSPIRE Consolidated UML Model::Themes::Annex III::Natural Risk Zones::Coverage_Model [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	SOURCE : [EXCIFF] Likelihood is a general concept relating to the chance of an event occuring. Likelihood is generally expressed as a probability or a frequency.

5.2.2.5.17. ManagementRegulationOrRestrictionZone

ManagementRegulationOrRestrictionZone	
Package:	INSPIRE Consolidated UML Model::Themes::Annex III::Area Management Restriction Regulation Zones and Reporting units::Area Management Restriction and Regulation Zones [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	Area managed, regulated or used for reporting at international, European, national, regional and local levels.
Description:	SOURCE [INSPIRE Directive]

5.2.2.5.18. Measure

Measure	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19103:2005 Schema Language::Basic Types::Derived::Units of Measure [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.5.19. Number

Number (abstract)	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19103:2005 Schema Language::Basic Types::Primitive::Numerics [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.5.20. Probability

Probability	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19103:2005 Schema Language::Basic Types::Primitive::Truth [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.5.21. TM_Period

TM_Period	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19108:2006 Temporal Schema::Temporal Objects [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.5.22. URI

URI	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19139 Metadata - XML Implementation::Web environment [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.5.23. URL

URL	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19115:2006 Metadata (Corrigendum)::Citation and responsible party information [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.3 INSPIRE-governed code lists

The INSPIRE-defined code lists included in this application schema include the values specified in the tables in this section.

5.2.3.1. Values of code list RiskOrHazardCategory

Value	Name	Definition	Description	Parent value
geologicalHydrological	Geological / Hydrological	Processes that have a geological (geosphere) or hydrological (hydrosphere) nature (or origin).	Some of the processes here included are clearly addressed as geological in the scientific literature, such as volcanic hazards or earthquake hazards, whereas other processes cannot be understood without geological and hydrological input, such as certain types of landslides (that can be triggered and mobilised by water), or floods (highly dependent on soil infiltration properties, topography, water table fluctuations), etc.	
tsunami	Tsunami	Long wave disruption in a large water body reaching emerged land	Tsunamis can be triggered by earthquakes, landslide, volcanic explosions, meteorites, etc. Even though it is a certain type of flood it is usually considered as a separated process.	geologicalHydrological
volcanic	Volcanic	An opening, or rupture, in the Earth's crust that allows hot magma, ash and gases to escape.	Process directly linked to volcanic eruptions are expected to be included in this category, such as lahars, jökulhaups, ash fall, volcanic explosions, freatic	geologicalHydrological

			explosions, etc.	
earthquake	Earthquake	Earthquake hazards involve the propagation of elastic waves on the surface or near if after the release of tectonic stress or other natural sources, such as volcanic explosions or meteorite impacts	Liquefaction, ground shaking and other effects directly caused by seismic waves should also be included in this category. Processes that might be triggered by other processes might fit best in other classes.	geologicalHydrological
subsidenceAndCollapse	Subsidence and collapse	Subsidence and collapse involve mainly vertical downwards ground movement of the surface of the Earth due to different processes of rock or soil weathering or rock compaction to a point where the rock structure cannot bear its own load (collapse) or causing relatively slow downwards movements (subsidence).	Subsidence and collapse can be associated with carbonate rocks in karstic areas, but it can occur in other regions such as loessic soils or compressible soils.	geologicalHydrological
landslide	Landslide	Processes of downhill slope movements of soil, rock, and organic materials related to different types of ground failure.	Some common terms used for describing different types of landslides include but are not restricted to slides, rock fall, debris flow.	geologicalHydrological
snowAvalanche	Snow avalanche	A snow mass with typically a volume greater than 100 m3 and a minimum length of 50 meters that slides rapidly downhill	Snow avalanches usually incorporate materials swept along the path of the snow avalanche, such as trees, rocks, etc. Avalanche formation is the result of a complex interaction between terrain, snow pack and meteorological conditions	geologicalHydrological
flood	Flood	Processes of inundation of usually dry (emerged) land, or temporary covering by water of land not normally covered by water.	Floods can be of many types (flash floods, river overflow, tidal floods), and can have many triggers (precipitation, natural water reservoir dam failure, river channel obstruction, etc). Tsunamis and a storm surges are usually considered as a different natural hazard.	geologicalHydrological

toxicOrRadioactiveMaterials	Toxic or radioactive materials	Processes related to the nature of substances that might pose a threat to human health.	Asbestos, natural radioactivity or gas emanation are some examples of hazards within this category	geologicalHydrological
otherGeologicalHydrological	other geological / hydrological hazard	Any process not already addressed within other geological or hydrological categories	Sand dune movements, soil erosion, maelstroms, iceberg movements among other processes can be included here.	geologicalHydrological
meteorologicalClimatological	Meteorological / climatological	processes that have a meteorological (atmospheric) or climatic (changes in the long-run of environmental variables) nature (or origin).		
drought	Drought	Sustained and extensive occurrence of below-average water availability, caused by climate variability	Drought should not be confused with aridity, which is a long-term average feature of a dry climate. Likewise, drought should not be confused with water scarcity, which reflects conditions of long-term imbalances between water availability and demands. Droughts can affect both high and low rainfall areas of Europe and can develop over short periods of weeks and months or much longer periods of several seasons, years and even decades.	meteorological Climatological
extremeTemperature	Extreme temperature	An abnormal temperature rise or decrease lasting longer than usual temperature rise or drop.	Heat waves or cold waves.	meteorological Climatological
tornadosAndHurricanesStrongWinds	Tornados, hurricanes and strong winds	Violent (high speed) winds.		meteorological Climatological
lightning	Lightning	Discharge of atmospheric electricity.		meteorological Climatological
stormSurge	Storm surge	Water pushed from the sea onto the land caused by an atmospheric disruption such as a hurricane or a rapid change in atmospheric	Although a storm surge is a kind of flood, it is usually considered as a separated class.	meteorological Climatological

		pressure.		
otherMeteorologicalClimatological	other meteorological / climatological hazard	Any process not already addressed within other meteorological / Climatological categories	Natural desertification can be included in this category.	meteorological Climatological
fires	Fires	This super-class includes all types of processes that involve the occurrence and spreading of fire.		
ForestFireWildfire	Forest fires or wild fires	Fire occurrence and spreading on vegetated land.	Forest fire means fire which breaks out and spreads on forest and other wooded land or which breaks out on other land and spreads to forest and other wooded land. The definition of forest fire excludes prescribed or controlled burning, usually with the aim of reducing or eliminating the quantity of accumulated fuel on the ground (Regulation EC 2152/2003 - Forest Focus). Wildland Fire: Any fire occurring on wildland regardless of ignition sources, damages or benefits (FAO, 2011, Wildland Fire Management Terminology, FAO, updated September 2010).	fires
undergroundFires	Underground fires	Fire spreading below the surface, typically occurring in peat rich soils.		fires
other Fires	Other fires	Other natural fires not already addressed within other fire categories	Spontaneous combustion can be included in this category	fires
biological	Biological	Processes that are directly linked to living organisms or products produced by living organisms.		
infestation	Infestation	Abnormal population increase of living organisms.		biological
epidemic	Epidemic	Unusually large occurrence of a disease.		biological

allergens	Allergens	Biological products or substances (such as pollen) that might cause allergy over a large number of people.		biological
otherBiological	Other biological hazards	Other biological hazards not already addressed within other biological categories	Prions and other toxic substances produced by (or within) living organisms can be included here.	biological
cosmic	Cosmic	Processes from outer space.		
meteoriteImpact	Meteorite impact	Solid materials from outer space reaching the Earth.		cosmic
magneticDisruption	Magnetic disruption	Disturbances of the magnetic field of the Earth.		cosmic
solarAndCosmicRadiation	Solar and cosmic radiations	Radiation from outer space (UV, gamma ray, etc).		cosmic
otherCosmic	Other cosmic hazard	Other cosmic hazards not already addressed within other cosmic categories		cosmic

5.2.4 Externally governed code lists

The externally governed code lists included in this application schema are specified in the tables in this section.

5.2.4.1. Governance, availability and constraints

Code list	Governance	Version	Availability	Formats	Subset
SpecificRiskOrHazardType	Any public body that owns a codelist of natural risk or hazards	Latest available version			
TypeOfElement	Any public body that owns a codelist of types of elements that are exposed to a natural risk.	Latest available version			

5.2.4.2. Rules for code list values

Code list	Identifiers	Identifier examples	Labels
SpecificRiskOrHazardType			
TypeOfElement			

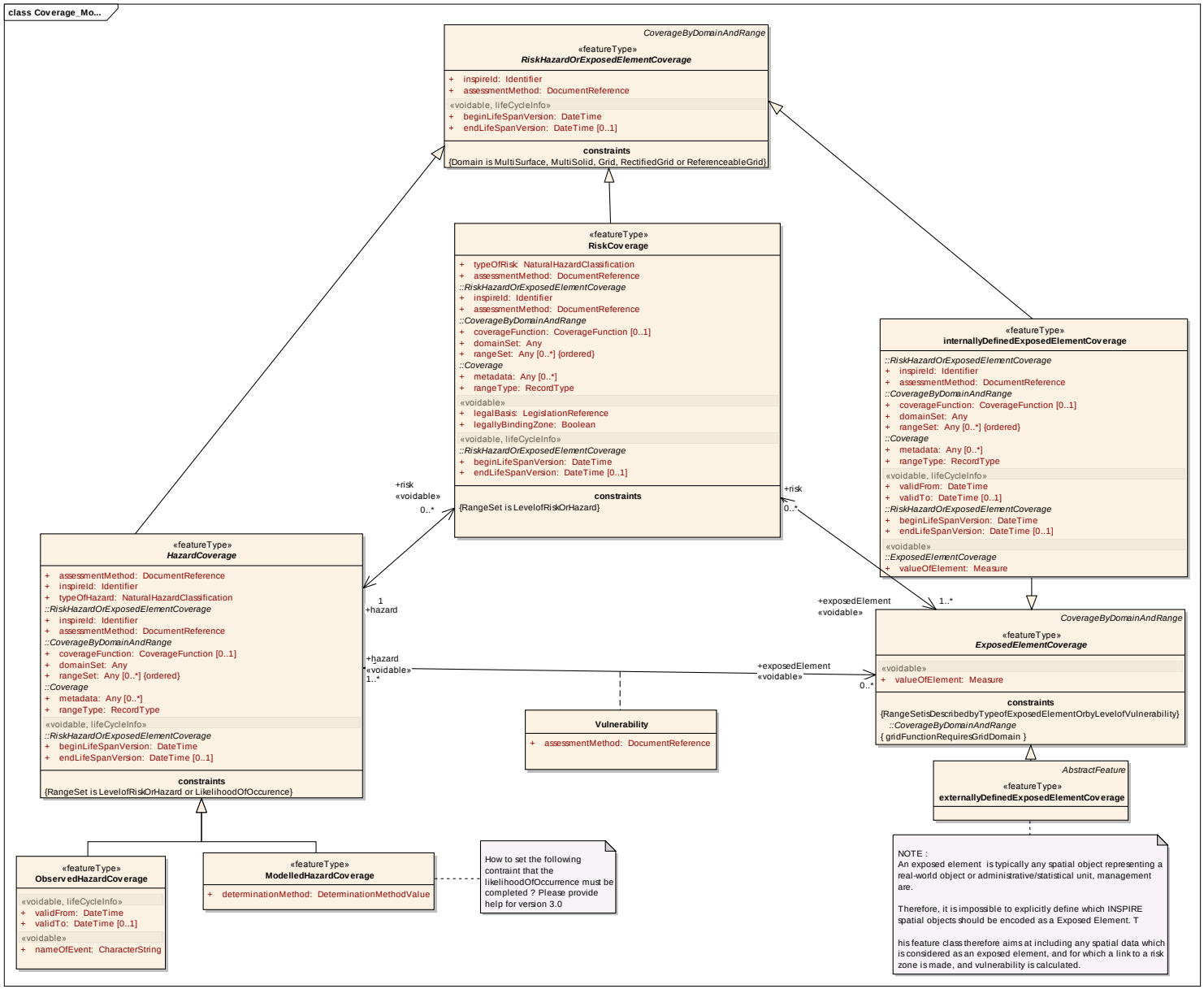
5.3 Application schema Coverage Model

5.3.1 Description

5.3.1.1. Narrative description

The common schema covers elements seen as necessary by the thematic working group to describe (text missing will be updated)

5.3.1.2. UML Overview


class Coverage_Mo...
CoverageByDomainAndRange
«featureType»
RiskHazardOrExposedElementCoverage
+ inspireId: Identifier
+ assessmentMethod: DocumentReference
«voidable, lifeCycleInfo»
+ beginLifeSpanVersion: DateTime
+ endLifeSpanVersion: DateTime [0..1]
constraints
{Domain is MultiSurface, MultiSolid, Grid, RectifiedGrid or ReferenceableGrid}
«featureType»
RiskCoverage
+ typeOfRisk: NaturalHazardClassification
+ assessmentMethod: DocumentReference
::RiskHazardOrExposedElementCoverage
+ inspireId: Identifier
+ assessmentMethod: DocumentReference
::CoverageByDomainAndRange
+ coverageFunction: CoverageFunction [0..1]
+ domainSet: Any
+ rangeSet: Any [0..*] {ordered}
::Coverage
+ metadata: Any [0..*]
+ rangeType: RecordType
«voidable»
+ legalBasis: LegislationReference
+ legallyBindingZone: Boolean
«voidable, lifeCycleInfo»
::RiskHazardOrExposedElementCoverage
+ beginLifeSpanVersion: DateTime
+ endLifeSpanVersion: DateTime [0..1]
constraints
{RangeSet is LevelofRiskOrHazard}
«featureType»
internallyDefinedExposedElementCoverage
::RiskHazardOrExposedElementCoverage
+ inspireId: Identifier
+ assessmentMethod: DocumentReference
::CoverageByDomainAndRange
+ coverageFunction: CoverageFunction [0..1]
+ domainSet: Any
+ rangeSet: Any [0..*] {ordered}
::Coverage
+ metadata: Any [0..*]
+ rangeType: RecordType
«voidable, lifeCycleInfo»
+ validFrom: DateTime
+ validTo: DateTime [0..1]
::RiskHazardOrExposedElementCoverage
+ beginLifeSpanVersion: DateTime
+ endLifeSpanVersion: DateTime [0..1]
«voidable»
::ExposedElementCoverage
+ valueOfElement: Measure
+risk
«voidable»
0..*
+risk
0..*
«featureType»
HazardCoverage
+ assessmentMethod: DocumentReference
+ inspireId: Identifier
+ typeOfHazard: NaturalHazardClassification
::RiskHazardOrExposedElementCoverage
+ inspireId: Identifier
+ assessmentMethod: DocumentReference
::CoverageByDomainAndRange
+ coverageFunction: CoverageFunction [0..1]
+ domainSet: Any
+ rangeSet: Any [0..*] {ordered}
::Coverage
+ metadata: Any [0..*]
+ rangeType: RecordType
«voidable, lifeCycleInfo»
::RiskHazardOrExposedElementCoverage
+ beginLifeSpanVersion: DateTime
+ endLifeSpanVersion: DateTime [0..1]
constraints
{RangeSet is LevelofRiskOrHazard or LikelihoodOfOccurence}
1
+hazard
+hazard
«voidable»
1..*
+exposedElement
«voidable»
0..*
+exposedElement
«voidable»
1..*
Vulnerability
+ assessmentMethod: DocumentReference
CoverageByDomainAndRange
«featureType»
ExposedElementCoverage
«voidable»
+ valueOfElement: Measure
constraints
{RangeSetisDescribedbyTypeofExposedElementOrbyLevelofVulnerability}
::CoverageByDomainAndRange
{ gridFunctionRequiresGridDomain }
AbstractFeature
«featureType»
externallyDefinedExposedElementCoverage
«featureType»
ObservedHazardCoverage
«voidable, lifeCycleInfo»
+ validFrom: DateTime
+ validTo: DateTime [0..1]
«voidable»
+ nameOfEvent: CharacterString
«featureType»
ModelledHazardCoverage
+ determinationMethod: DeterminationMethodValue
How to set the following contraint that the likelihoodOfOccurrence must be completed ? Please provide help for version 3.0
NOTE :
An exposed element is typically any spatial object representing a real-world object or administrative/statistical unit, management are.
Therefore, it is impossible to explicitly define which INSPIRE spatial objects should be encoded as a Exposed Element. T
his feature class therefore aims at including any spatial data which is considered as an exposed element, and for which a link to a risk zone is made, and vulnerability is calculated.

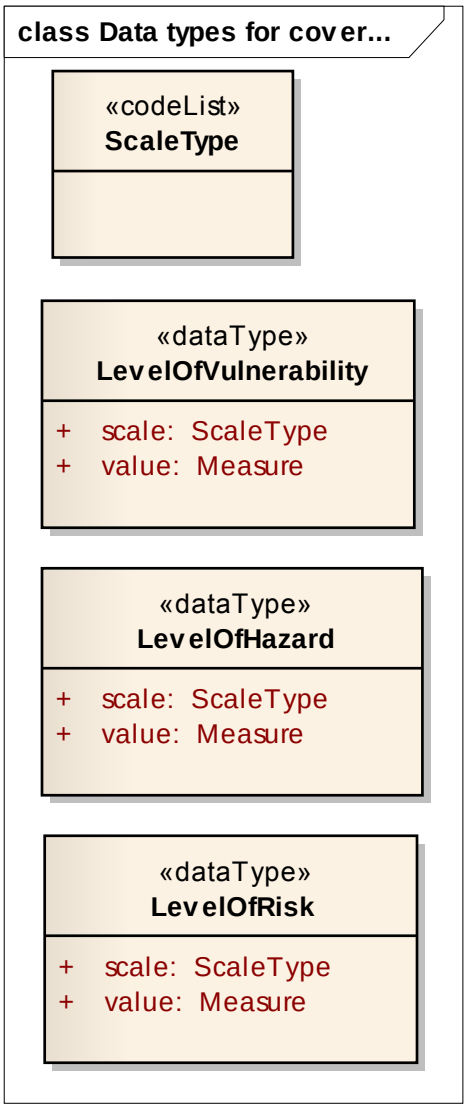


Figure 5 – UML class diagram: Overview of the Coverage_Model application schema

All the coverage feature types are modelled as “Domain and Range” coverages.

COMMON GENERIC COVERAGE FEATURE TYPE BETWEEN HAZARD, RISK AND VULNERABILITY

The “HazardCoverage”, “RiskCoverage” and “InternallyDefinedExposedElementCoverage” share a couple of common properties:

- The domain is either Grid, rectified Grid, referenceable Grid, multi-surface or multi-solid.
- There is an attribute “InspireId” (Identifier)
- There are attributes “BeginLifeSpanVersion” and “EndLifeSpanVersion”
- There is an attribute that documents the assessment method that is employed “Assessment”)

All those properties are defined in a generic abstract feature type “RiskHazardOrExposedElementCoverage”, from which the hazard coverage, the risk coverage and the vulnerability coverage are specialized.

HAZARD COVERAGE
The hazard coverage ("HazardCoverage") is similar to the hazard area ("HazardArea") from the core model. From this are generated the "ObservedHazardCoverage" feature class and the "ModelledOrDeterminedCoverage" feature class.
The hazard coverage has the type of hazard data ("TypeOfHazard") as an attribute; it is therefore assumed that a hazard coverage feature concerns one, and one only, hazard type. The values that vary over space (and therefore declared as the range of the coverage) are either the level of hazard ("LevelOfHazard"), or the likelihood of occurrence ("LikelihoodOfOccurence").
The level of hazard ("LevelOfHazard") is the combination of a value ("value") expressed according to a scale ("scale"). The scale is a codelist with refers to the Theory of scale types; a scale can be "nominal", "ordinal", "interval" or "ratio").
The likelihood of occurrence ("LikelihoodOfOccurence") is the combination of a value ("value") expressed according to a scale ("scale"), and a period of validity ("validityPeriod"). This latter value is expressed as a data type from the Core_Model which is "QuantitativeLikelihood". The quantitative likelihood is either expressed as a probability of occurrence ("probabilityOfOccurence") or as a return period ("ReturnPeriod"). The method that is employed to set the level of hazard is documented in the attribute "Assessment" of the "HazardCoverage" feature type.

PROPERTIES THAT VARY OVER SPACE
In a hazard coverage, the properties that vary over space are:

- "LikelihoodOfOccurence"
- "LevelOfRiskOrHazard" (the common data type used to describe the level of hazard for HazardCoverage- and the level of risk for the RiskCoverage.

With respect to norm ISO 19123, those properties are modelled as constraints, and hence do not appear as attributes.

VULNERABILITY
As in the core model, the vulnerability is set as an association class between exposed element ("ExposedElementCoverage") and hazard area ("HazardCoverage").

It however, only contains the "assessmentMethod" the "levelOfVulnerability" is a property that varies over space, and that must therefore be modelled as a constraint. This constraint is carried by the "ExposedElementCoverage" feature type. As vulnerability is calculated or assessed for each exposed element according to a HazardCoverage, the "ExposedElementCoverage" is more adequate to carry this constraint than the HazardCoverage.

LEVELS OF HAZARD, RISK AND VULNERABILITY
Those 3 properties are modelled in the same way:

- A "Value" attribute
- A "ScaleType" attribute

The "ScaleType" attribute refers to an internally defined codelist. The values refer to the theory of sc**ale types** developed by the psychologist *Stanley Smith Stevens*.

EXPOSED ELEMENT COVERAGE
The exposed elements are modelled in the Coverage_model in the same way they are modelled in the core model: there is one abstract feature type: the "ExposedElementCoverage"

2 feature types are generalised from the "ExposedElementCoverage":

- "InternallyDefinedExposedElementCoverage", which is also generated from the "RiskHazard or ExposedElementCoverage", the generic type of this model previously detailed.
  In addition to the "ExposedElementCoverage", the "InternallyDefinedExposedElementCoverage" has a "ValidFrom" and "ValidTo" attributes.

- "ExternallyDefinedExposedElementCoverage" addresses the issue when the exposed element spatial object has already been provided within the INSPIRE framework, as another INSPIRE feature type. It is generalized from the ISO 19136 "GML" "AbstractObject". In this case, an externally produced coverage that is provided in the INSPIRE framework is considered as an

exposed element coverage, plus might have vulnerability values been calculated on –along to a certain hazard area coverage. The process is that in this case the natural risk zones data provider references the external object as an exposed element coverage, and might eventually complete vulnerability values.

PROPERTIES THAT VARY OVER SPACE
In the "ExposedElementCoverage", the properties that vary over space are:
- "TypeOfElement"
- "LevelOVulnerability" (see the related chapter).

RISK COVERAGE
In the same way the "RiskCoverage" is similar to the "RiskZone" feature class. It shares particularly the same associations linked with feature types that belong to specifications of other Annex III INSPIRE themes. It contains the same attributes as the core_model "RiskZone" feature type, apart from the level of risk ("LevelOfRisk"). The level of risk varies over space in a risk coverage: as a consequence, the range of the "RiskCoverage" is the level of risk. It is therefore assumed that a risk coverage feature concerns one and one only risk type.
The level of risk ("LevelOfRisk") is the combination of a value ("value") expressed according to a scale "scale". The method that is employed to set the level of risk is documented in the attribute "Assessment" of the "RiskCoverage" feature type.

PROPERTIES THAT VARY OVER SPACE
In a risk coverage, the properties that vary over space are:
- LevelOfRiskOrHazard" (the common data type used to describe the level of hazard for HazardCoverage and the level of risk for the RiskCoverage.

IR Requirement 11	A "RiskZoneCoverage" must be associated with at least one "ExposedElementCoverage"

IR Requirement 12	A "RiskZoneCoverage" must be associated with at least one "HazardCoverage"

LINKS WITH OTHER THEMES
An association link is set between the "RiskCoverage" feature type and the "EnvironmentalMonitoringProgram" feature type. A risk zone feature can actually be monitored, and therefore be linked to the environmental monitoring facility.

An association link is set between the "RiskCoverage" feature type and the "Management RegulationOrRestrictionZone" modelled in "Area management, restriction, regulation zones and reporting units" theme.

Those two links are set in the case when a risk zone feature has an impact a regulated or a restricted area.

5.3.1.3. Consistency between spatial data sets

5.3.1.4. Identifier management

IR Requirement 4	The value domain of spatial properties used in this specification shall be restricted to the Simple Feature spatial schema as defined by EN ISO 19125-1.

NOTE The specification restricts the spatial schema to 0-, 1-, 2-, and 2.5-dimensional geometries where all curve interpolations are linear.

NOTE The topological relations of two spatial objects based on their specific geometry and topology properties can in principle be investigated by invoking the operations of the types defined in ISO 19107 (or the methods specified in EN ISO 19125-1).

5.3.1.5. Temporality representation

5.3.2 Feature catalogue

Table 3 - Feature catalogue metadata

Feature catalogue name	INSPIRE feature catalogue Coverage_Model
Scope	Coverage_Model
Version number	2.9
Version date	2012-02-24
Definition source	INSPIRE data specification Coverage_Model

Table 4 - Types defined in the feature catalogue

Type	Package	Stereotypes	Section
ExposedElementCoverage	Coverage_Model	«featureType»	5.2.2.1.1
HazardCoverage	Coverage_Model	«featureType»	5.2.2.1.2
LevelOfHazard	Coverage_Model	«dataType»	5.2.2.2.1
LevelOfRisk	Coverage_Model	«dataType»	5.2.2.2.2
LevelOfVulnerability	Coverage_Model	«dataType»	5.2.2.2.3
LikelihoodOfOccurrence	Coverage_Model	«dataType»	5.2.2.2.4
ModelledHazardCoverage	Coverage_Model	«featureType»	5.2.2.1.3
ObservedHazardCoverage	Coverage_Model	«featureType»	5.2.2.1.4
RiskCoverage	Coverage_Model	«featureType»	5.2.2.1.5
RiskHazardOrExposedElementCoverage	Coverage_Model	«featureType»	5.2.2.1.6
ScaleType	Coverage_Model	«codeList»	5.2.2.3.1
Vulnerability	Coverage_Model		5.2.2.2.5
VulnerabilityCoverage	Coverage_Model	«featureType»	5.2.2.1.7
externallyDefinedExposedElementCoverage	Coverage_Model	«featureType»	5.2.2.1.8
internallyDefinedExposedElementCoverage	Coverage_Model	«featureType»	5.2.2.1.9

5.3.2.1. Spatial object types

5.3.2.1.1. ExposedElementCoverage

ExposedElementCoverage (abstract)	
Name:	Exposed Element Coverage
Subtype of:	CoverageByDomainAndRange
Definition:	A coverage of exposed elements.
Status:	Proposed
Stereotypes:	«featureType»

ExposedElementCoverage (abstract)	
Identifier:	null
Attribute: valueOfElement	
Value type:	Measure
Multiplicity:	1
Stereotypes:	«voidable»
Association role: vulnerability	
Value type:	VulnerabilityCoverage
Definition:	The vulnerability coverage that is calculated after an exposed element coverage.
Multiplicity:	1..*
Stereotypes:	«voidable»
Association role: risk	
Value type:	RiskCoverage
Definition:	The risk coverage that is linked to a coverage of exposed element.
Multiplicity:	0..*
Stereotypes:	«voidable»
Association role: hazard [the association has additional attributes - see association class Vulnerability]	
Value type:	HazardCoverage
Definition:	The hazard coverage according to which vulneability is calculated -or assessed- for a coverage of exposed element
Multiplicity:	1..*
Stereotypes:	«voidable»
Constraint: RangeSetisDescribedbyTypeofExposedElementOrbyLevelofVulnerability	
Natural language:	range set is described by type of exposed element or by level of vulnerability
OCL:	inv: rangeSet.oclIsKindOf(TypeOfExposedElement) or rangeSet.oclIsKindOf(LevelOfVulnerability)

5.3.2.1.2. HazardCoverage

HazardCoverage (abstract)	
Name:	Hazard Coverage
Subtype of:	RiskHazardOrExposedElementCoverage
Definition:	A coverage of natural hazards.
Status:	Proposed
Stereotypes:	«featureType»
Identifier:	null
Attribute: assessmentMethod	
Value type:	DocumentReference
Definition:	A reference to the method used to express the level of hazard.
Multiplicity:	1
Attribute: inspireId	
Value type:	Identifier
Multiplicity:	1
Attribute: typeOfHazard	
Value type:	NaturalHazardClassification
Definition:	A generic classification and a specific classification of the type of hazard.
Multiplicity:	1

HazardCoverage (abstract)	
Association role: risk	
Value type:	RiskCoverage
Multiplicity:	0..*
Stereotypes:	«voidable»
Association role: exposedElement [the association has additional attributes - see association class Vulnerability]	
Value type:	ExposedElementCoverage
Definition:	The exposed element coverage on which vulnerability is calculated -or assessed- according to a certain hazard.
Multiplicity:	0..*
Stereotypes:	«voidable»
Constraint: RangeSet is LevelofHazard or LikelihoodOfOccurence	
Natural language:	range set is described by hazard range characteristics
OCL:	inv: rangeSet.oclIsKindOf(LevelofHazard) or rangeSet.oclIsKindOf(LikelihoodOfOccurence)

5.3.2.1.3. ModelledHazardCoverage

ModelledHazardCoverage	
Name:	Modelled Hazard Coverage
Subtype of:	HazardCoverage
Definition:	A coverage for hazards which extent is modeled, or inferred by the interpretation of indirect artefacts
Status:	Proposed
Stereotypes:	«featureType»
Identifier:	null
Attribute: determinationMethod	
Value type:	DeterminationMethodValue
Definition:	Specifies if the hazard area result is delineated after a modelling or determined after interpretation of indirect artefacts.
Multiplicity:	1

5.3.2.1.4. ObservedHazardCoverage

ObservedHazardCoverage	
Name:	Observed Hazard Coverage
Subtype of:	HazardCoverage
Definition:	A coverage for observed hazards.
Status:	Proposed
Stereotypes:	«featureType»
Identifier:	null
Attribute: validFrom	
Value type:	DateTime
Definition:	The time when the phenomenon started to exist in the real world.
Multiplicity:	1
Stereotypes:	«voidable,lifeCycleInfo»
Attribute: validTo	
Value type:	DateTime
Definition:	The time from which the phenomenon no longer exists in the real world.
Multiplicity:	0..1

ObservedHazardCoverage	
Stereotypes:	«voidable,lifeCycleInfo»
Attribute: nameOfEvent	
Value type:	CharacterString
Definition:	common name of the observed hazard.
Multiplicity:	1
Stereotypes:	«voidable»

5.3.2.1.5. RiskCoverage

RiskCoverage	
Name:	Risk Coverage
Subtype of:	RiskHazardOrExposedElementCoverage
Definition:	A coverage of natural risks.
Status:	Proposed
Stereotypes:	«featureType»
Identifier:	null
Attribute: legalBasis	
Value type:	LegislationReference
Definition:	Legal basis upon which the risk zone coverage is based (if any).
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: legallyBindingZone	
Value type:	Boolean
Definition:	A boolean to express wether the risk zone feature has an impact on the use of the zone, based on a legal basis.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: typeOfRisk	
Value type:	NaturalHazardClassification
Definition:	A generic classification and a specific classification of the type of risk.
Multiplicity:	1
Attribute: assessmentMethod	
Value type:	DocumentReference
Definition:	A reference to the method used to express the level of risk.
Multiplicity:	1
Association role: exposedElement	
Value type:	ExposedElementCoverage
Definition:	The exposed element coverage that is linked to the risk zone coverage.
Multiplicity:	1..*
Stereotypes:	«voidable»
Association role: areaManagement	
Value type:	ManagementRegulationOrRestrictionZone
Definition:	The area management to which the risk zone coverage is linked.
Multiplicity:	0..*
Stereotypes:	«voidable»
Association role: monitors	
Value type:	EnvironmentalMonitoringProgram

RiskCoverage	
Definition:	The monitoring program that monitors the risk zone
Multiplicity:	0..*
Stereotypes:	«voidable»

Association role: monitors	
Value type:	AbstractMonitoringFeature
Definition:	The monitoring feature that monitors the risk zone coverage.
Multiplicity:	0..*
Stereotypes:	«voidable»

Association role: hazard	
Value type:	HazardCoverage
Definition:	The hazard area coverage that is source of the risk zone coverage.
Multiplicity:	1
Stereotypes:	«voidable»

Constraint: RangeSet is LevelofRisk	
Natural language:	range set is described by llevel of risk
OCL:	inv: rangeSet.oclIsKindOf(LevelOfRisk)

5.3.2.1.6. RiskHazardOrExposedElementCoverage

RiskHazardOrExposedElementCoverage (abstract)	
Name:	Risk Hazard Or Exposed Element Coverage
Subtype of:	CoverageByDomainAndRange
Definition:	An abstract feature type that contains the properties that are common to the hazard coverage feature type, the risk coverage feature type, and the internally defined exposed element coverage feature.
Status:	Proposed
Stereotypes:	«featureType»
Identifier:	null

Attribute: inspireId	
Value type:	Identifier
Definition:	External object identifier of the risk, hazard, or exposed element coverage.
Multiplicity:	1

Attribute: assessmentMethod	
Value type:	DocumentReference
Definition:	A document reference to the method used to express the level of hazard / level of risk / level of vulnerability.
Multiplicity:	1

Attribute: beginLifeSpanVersion	
Value type:	DateTime
Definition:	Date and time at which this version of the spatial object was inserted or changed in the spatial data set.
Multiplicity:	1
Stereotypes:	«voidable,lifeCycleInfo»

Attribute: endLifeSpanVersion	
Value type:	DateTime
Definition:	Date and time at which this version of the spatial object was superseded or retired in the spatial data set.

RiskHazardOrExposedElementCoverage (abstract)	
Multiplicity:	0..1
Stereotypes:	«voidable,lifeCycleInfo»
Constraint: Domain is MultiSurface, MultiSolid, Grid, RectifiedGrid or ReferenceableGrid	
Natural language:	domain is a multi surface, multisolid, grid, rectified grid or referenceable grid
OCL:	inv: domainSet.oclIsKindOf(GM_MultiSurface) or domainSet.oclIsKindOf(CV_RectifiedGrid) or domainSet.oclIsKindOf(CV_Grid) or domainSet.oclIsKindOf(CV_ReferenceableGrid) or domainSet.oclIsKindOf(GM_MultiSolid)

5.3.2.1.7. VulnerabilityCoverage

VulnerabilityCoverage	
Name:	Vulnerability Coverage
Subtype of:	RiskHazardOrExposedElementCoverage
Definition:	A coverage for vulnerability of exposed elements for a specific risk.
Status:	Proposed
Stereotypes:	«featureType»
Identifier:	null
Attribute: assessmentMethod	
Value type:	DocumentReference
Definition:	A reference to the method used to express the level of vulnerability.
Multiplicity:	1
Association role: exposedElement	
Value type:	ExposedElementCoverage
Definition:	The exposed elementcoverage for which vulnerability is calculated.
Multiplicity:	1
Stereotypes:	«voidable»
Constraint: Range set is LevelOfVulnerability	
Natural language:	range set is described by type of qualitative or quantitative vulnerability
OCL:	inv: rangeSet.oclIsKindOf(LevelOfVulnerability)

5.3.2.1.8. externallyDefinedExposedElementCoverage

externallyDefinedExposedElementCoverage	
Name:	externally Defined Exposed Element Coverage
Subtype of:	ExposedElementCoverage, AbstractFeature
Definition:	A spatial object modelled as a coverage that has already been provided within the INSPIRE framework, and which is now considered as an exposed element coverage to a natural hazard.
Description:	An exposed element is typically any spatial object representing a real-world object or administrative/statistical unit. Therefore, it is impossible to explicitly define which INSPIRE spatial objects should be encoded as an exposed element. This feature class aims at including any spatial data coverage which is considered as an exposed element.
Status:	Proposed
Stereotypes:	«featureType»
Identifier:	null

5.3.2.1.9. internallyDefinedExposedElementCoverage

internallyDefinedExposedElementCoverage	
Name:	internally Defined Exposed Element Coverage

internallyDefinedExposedElementCoverage	
Subtype of:	ExposedElementCoverage, RiskHazardOrExposedElementCoverage
Definition:	A coverage that has never been provided within the INSPIRE framework, and which is considered as featuring elements exposed to a natural hazard.
Status:	Proposed
Stereotypes:	«featureType»
Identifier:	null
Attribute: validFrom	
Value type:	DateTime
Definition:	The time when the exposed element started to exist in the real world.
Multiplicity:	1
Stereotypes:	«voidable,lifeCycleInfo»
Attribute: validTo	
Value type:	DateTime
Definition:	The time from which the exposed element no longer exists in the real world.
Multiplicity:	0..1
Stereotypes:	«voidable,lifeCycleInfo»

5.3.2.2. Data types

5.3.2.2.1. LevelOfHazard

LevelOfHazard	
Name:	Level Of Hazard
Definition:	Assessment of the level of the hazard.
Status:	Proposed
Stereotypes:	«dataType»
Identifier:	null
Attribute: scale	
Value type:	ScaleType
Definition:	Type of scale according to which the value is expressed.
Description:	
Multiplicity:	1
Obligation:	Technical Guidance (recommendation)
Attribute: value	
Value type:	Measure
Definition:	The value that expresses the level of hazard.
Multiplicity:	1

5.3.2.2.2. LevelOfRisk

LevelOfRisk	
Name:	Level Of Risk
Definition:	The level of risk is an assessment of the combination of the consequences of an event (hazard) and the associated probability/likelihood of the occurence of the event.
Status:	Proposed
Stereotypes:	«dataType»
Identifier:	null
Attribute: scale	
Value type:	ScaleType
Definition:	Type of scale according to which the value is expressed.

LevelOfRisk	
Multiplicity:	1
Obligation:	Technical Guidance (recommendation)
Attribute: value	
Value type:	Measure
Definition:	the value that expresses the level of risk.
Multiplicity:	1

5.3.2.2.3. LevelOfVulnerability

LevelOfVulnerability	
Name:	Level Of Vulnerability
Definition:	SOURCE : [UNISDR, 2009] The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effect of a hazard. NOTE : It can also adress exposure.
Description:	SOURCE : [Council of The European Union - Commission Staff Working Paper - Risk Assessment and Mapping Guidelines for Disaster Management] In probablistic/quantitative risk assessments the term vulnerability expresses the part of percentage of Exposure that is likely to be lost due to a certain hazard.
Status:	Proposed
Stereotypes:	«dataType»
Identifier:	null
Attribute: scale	
Value type:	ScaleType
Definition:	Type of scale according to which the value is expressed.
Multiplicity:	1
Obligation:	Technical Guidance (recommendation)
Attribute: value	
Value type:	Measure
Definition:	the value that expresses the level of vulnerability.
Multiplicity:	1

5.3.2.2.4. LikelihoodOfOccurrence

LikelihoodOfOccurrence	
Name:	Likelihood Of Occurrence
Definition:	SOURCE : [EXCIFF] Likelihood is a general concept relating to the chance of an event occuring. Likelihood is generally expressed as a probability or a frequency.
Status:	Proposed
Stereotypes:	«dataType»
Identifier:	null
Attribute: scale	
Value type:	ScaleTypeValue
Definition:	Type of scale according to which the value is expressed.
Multiplicity:	1
Obligation:	null
Attribute: validityPeriod	
Value type:	TM_Period
Definition:	Future finite time frame where likelihood of occurrence assessment applies. It is an interval of dates, or the expression of a time frame for which the estimates are meant (eg: until 2090; summer of 2011; winter seasons until 2015).
Multiplicity:	0..*

LikelihoodOfOccurrence	
Attribute: value	
Value type:	Any
Definition:	The value that expresses the likelihood of occurence.
Multiplicity:	1

5.3.2.2.5. Vulnerability

Vulnerability (association class)	
Name:	Vulnerability
Definition:	The vulnerability expressed for a coverage of exposed elements according to a specific hazard.
Status:	Proposed
Identifier:	null
Attribute: assessmentMethod	
Value type:	DocumentReference
Definition:	A reference to the method used to express the level of vulnerability.
Multiplicity:	1

5.3.2.3. Code lists

5.3.2.3.1. ScaleType

ScaleType	
Name:	Scale Type
Definition:	Type of scale according to which the value is expressed.
Description:	Reference is made to the theory of scale types developed by the psychologist Stanley Smith Stevens
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	narrower
Identifier:	http://inspire.ec.europa.eu/codeList/ScaleType

5.3.2.4. Imported types (informative)

This section lists definitions for feature types, data types and enumerations and code lists that are defined in other application schemas. The section is purely informative and should help the reader understand the feature catalogue presented in the previous sections. For the normative documentation of these types, see the given references.

5.3.2.4.1. AbstractFeature

AbstractFeature (abstract)	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19136 GML::feature [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.3.2.4.2. AbstractMonitoringFeature

AbstractMonitoringFeature (abstract)	
Package:	INSPIRE Consolidated UML Model::Themes::Annex III::Environmental Monitoring Facilities::Environmental Monitoring Facilities [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	An abstract base class for environmental monitoring features in the real world (Environmental Monitoring Network, Environmental Monitoring Facility).

5.3.2.4.3. Any

Any

Any	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19103:2005 Schema Language::Basic Types::Implementation::Records and Class Metadata [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.3.2.4.4. Boolean

Boolean	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19103:2005 Schema Language::Basic Types::Primitive::Truth [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.3.2.4.5. CharacterString

CharacterString	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19103:2005 Schema Language::Basic Types::Primitive::Text [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.3.2.4.6. CoverageByDomainAndRange

CoverageByDomainAndRange (abstract)	
Package:	INSPIRE Consolidated UML Model::Generic Conceptual Model::Base Models::Coverages (Domain and Range) [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	coverage which provide the domain and range as separate properties

5.3.2.4.7. DateTime

DateTime	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19103:2005 Schema Language::Basic Types::Primitive::Date and Time [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.3.2.4.8. DeterminationMethodValue

DeterminationMethodValue	
Package:	INSPIRE Consolidated UML Model::Themes::Annex III::Natural Risk Zones::Core_Model [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	An enumeration to describe the method used to define the area of hazard or risk.
Description:	There are several ways to delineate the perimeter of a hazard or a risk : to model it, or to assess it using indirect parameters or evidence.

5.3.2.4.9. DocumentReference

DocumentReference	
Package:	INSPIRE Consolidated UML Model::Themes::Annex III::Natural Risk Zones::Core_Model [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	the piece of information which is required to get further information about a method that is described and explained in a paper.

5.3.2.4.10. EnvironmentalMonitoringProgram

EnvironmentalMonitoringProgram	
Package:	INSPIRE Consolidated UML Model::Themes::Annex III::Environmental Monitoring Facilities::Environmental Monitoring Facilities [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

EnvironmentalMonitoringProgram	
Definition:	An Environmental Monitoring Program is a policy relevant document defining the target of a collection of observations and/or the deployment of Abstract Monitoring Features on the field. Usually an Environmental Monitoring Program has a long term perspective over at least a few years.

5.3.2.4.11. Identifier

Identifier	
Package:	INSPIRE Consolidated UML Model::Generic Conceptual Model::Base Types [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	External unique object identifier published by the responsible body, which may be used by external applications to reference the spatial object.
Description:	NOTE1 External object identifiers are distinct from thematic object identifiers. NOTE 2 The voidable version identifier attribute is not part of the unique identifier of a spatial object and may be used to distinguish two versions of the same spatial object. NOTE 3 The unique identifier will not change during the life-time of a spatial object.

5.3.2.4.12. LegislationCitation

LegislationCitation	
Package:	INSPIRE Consolidated UML Model::Generic Conceptual Model::Base Types 2 [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	Citation to unambiguously reference a legal act or a specific part of a legal act.

5.3.2.4.13. ManagementRegulationOrRestrictionZone

ManagementRegulationOrRestrictionZone	
Package:	INSPIRE Consolidated UML Model::Themes::Annex III::Area Management Restriction Regulation Zones and Reporting units::Area Management Restriction and Regulation Zones [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	Area managed, regulated or used for reporting at international, European, national, regional and local levels.
Description:	SOURCE [INSPIRE Directive]

5.3.2.4.14. Measure

Measure	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19103:2005 Schema Language::Basic Types::Derived::Units of Measure [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.3.2.4.15. NaturalHazardClassification

NaturalHazardClassification	
Package:	INSPIRE Consolidated UML Model::Themes::Annex III::Natural Risk Zones::Core_Model [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	This class provides piece of information about the nature of the natural risk or hazard.

5.3.2.4.16. TM_Period

TM_Period

TM_Period	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19108:2006 Temporal Schema::Temporal Objects [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.3.3 INSPIRE-governed code lists

The INSPIRE-defined code lists included in this application schema include the values specified in the tables in this section.

5.3.3.1. Values of code list ScaleTypeValue

Value	Name	Definition	Description	Parent value
nominal	Nominal			
ordinal	Ordinal			
interval	Interval			
ratio	Ratio			

5.3.3.2. Values of Code List RiskorHazard Category

Value	Name	Definition	Description	Parent value
geologicalHydrological	Geological / Hydrological	Processes that have a geological (geosphere) or hydrological (hydrosphere) nature (or origin).	Some of the processes here included are clearly addressed as geological in the scientific literature, such as volcanic hazards or earthquake hazards, whereas other processes cannot be understood without geological and hydrological input, such as certain types of landslides (that can be triggered and mobilised by water), or floods (highly dependent on soil infiltration properties, topography, water table fluctuations), etc.	
tsunami	Tsunami	Long wave disruption in a large water body reaching emerged land	Tsunamis can be triggered by earthquakes, landslide, volcanic explosions, meteorites, etc. Even though it is a certain type of flood it is usually considered as a separated process.	geologicalHydrological
volcanic	Volcanic	An opening, or rupture, in the Earth's crust that allows hot magma,	Process directly linked to volcanic eruptions are expected to be included in this category, such as lahars,	geologicalHydrological

		ash and gases to escape.	jökulhaups, ash fall, volcanic explosions, freatic explosions, etc.	
earthquake	Earthquake	Earthquake hazards involve the propagation of elastic waves on the surface or near if after the release of tectonic stress or other natural sources, such as volcanic explosions or meteorite impacts	Liquefaction, ground shaking and other effects directly caused by seismic waves should also be included in this category. Processes that might be triggered by other processes might fit best in other classes.	geologicalHydrological
subsidenceAndCollapse	Subsidence and collapse	Subsidence and collapse involve mainly vertical downwards ground movement of the surface of the Earth due to different processes of rock or soil weathering or rock compaction to a point where the rock structure cannot bear its own load (collapse) or causing relatively slow downwards movements (subsidence).	Subsidence and collapse can be associated with carbonate rocks in karstic areas, but it can occur in other regions such as loessic soils or compressible soils.	geologicalHydrological
landslide	Landslide	Processes of downhill slope movements of soil, rock, and organic materials related to different types of ground failure.	Some common terms used for describing different types of landslides include but are not restricted to slides, rock fall, debris flow.	geologicalHydrological
snowAvalanche	Snow avalanche	A snow mass with typically a volume greater than 100 m3 and a minimum length of 50 meters that slides rapidly downhill	Snow avalanches usually incorporate materials swept along the path of the snow avalanche, such as trees, rocks, etc. Avalanche formation is the result of a complex interaction between terrain, snow pack and meteorological conditions	geologicalHydrological
flood	Flood	Processes of inundation of usually dry (emerged) land, or temporary covering by water of land not normally covered by water.	Floods can be of many types (flash floods, river overflow, tidal floods), and can have many triggers (precipitation, natural water reservoir dam failure, river channel obstruction, etc). Tsunamis and a storm surges are usually considered as a different natural hazard.	geologicalHydrological

toxicOrRadioactiveMaterials	Toxic or radioactive materials	Processes related to the nature of substances that might pose a threat to human health.	Asbestos, natural radioactivity or gas emanation are some examples of hazards within this category	geologicalHydrological
otherGeologicalHydrological	other geological / hydrological hazard	Any process not already addressed within other geological or hydrological categories	Sand dune movements, soil erosion, maelstroms, iceberg movements among other processes can be included here.	geologicalHydrological
meteorologicalClimatological	Meteorological / climatological	processes that have a meteorological (atmospheric) or climatic (changes in the long-run of environmental variables) nature (or origin).		
drought	Drought	Sustained and extensive occurrence of below-average water availability, caused by climate variability	Drought should not be confused with aridity, which is a long-term average feature of a dry climate. Likewise, drought should not be confused with water scarcity, which reflects conditions of long-term imbalances between water availability and demands. Droughts can affect both high and low rainfall areas of Europe and can develop over short periods of weeks and months or much longer periods of several seasons, years and even decades.	meteorological Climatological
extremeTemperature	Extreme temperature	An abnormal temperature rise or decrease lasting longer than usual temperature rise or drop.	Heat waves or cold waves.	meteorological Climatological
tornadosAndHurricanesStrongWinds	Tornados, hurricanes and strong winds	Violent (high speed) winds.		meteorological Climatological
lightning	Lightning	Discharge of atmospheric electricity.		meteorological Climatological
stormSurge	Storm surge	Water pushed from the sea onto the land caused by an atmospheric disruption such as a hurricane or a rapid change in atmospheric pressure.	Although a storm surge is a kind of flood, it is usually considered as a separated class.	meteorological Climatological

otherMeteorologicalClimatological	other meteorological / climatological hazard	Any process not already addressed within other meteorological / Climatological categories	Natural desertification can be included in this category.	meteorological Climatological
fires	Fires	This super-class includes all types of processes that involve the occurrence and spreading of fire.		
ForestFireWildfire	Forest fires or wild fires	Fire occurrence and spreading on vegetated land.	Forest fire means fire which breaks out and spreads on forest and other wooded land or which breaks out on other land and spreads to forest and other wooded land. The definition of forest fire excludes prescribed or controlled burning, usually with the aim of reducing or eliminating the quantity of accumulated fuel on the ground (Regulation EC 2152/2003 - Forest Focus). Wildland Fire: Any fire occurring on wildland regardless of ignition sources, damages or benefits (FAO, 2011, Wildland Fire Management Terminology, FAO, updated September 2010).	fires
undergroundFires	Underground fires	Fire spreading below the surface, typically occurring in peat rich soils.		fires
other Fires	Other fires	Other natural fires not already addressed within other fire categories	Spontaneous combustion can be included in this category	fires
biological	Biological	Processes that are directly linked to living organisms or products produced by living organisms.		
infestation	Infestation	Abnormal population increase of living organisms.		biological
epidemic	Epidemic	Unusually large occurrence of a disease.		biological
allergens	Allergens	Biological products or substances (such as pollen) that might cause allergy over a large number of people.		biological

otherBiological	Other biological hazards	Other biological hazards not already addressed within other biological categories	Prions and other toxic substances produced by (or within) living organisms can be included here.	biological
cosmic	Cosmic	Processes from outer space.		
meteoriteImpact	Meteorite impact	Solid materials from outer space reaching the Earth.		cosmic
magneticDisruption	Magnetic disruption	Disturbances of the magnetic field of the Earth.		cosmic
solarAndCosmicRadiation	Solar and cosmic radiations	Radiation from outer space (UV, gamma ray, etc).		cosmic
otherCosmic	Other cosmic hazard	Other cosmic hazards not already addressed within other cosmic categories		cosmic

5.3.4 Externally governed code lists

The externally governed code lists included in this application schema are specified in the tables in this section.

5.3.4.1. Governance, availability and constraints

5.3.4.2. Rules for code list values

Code list	Identifiers	Identifier examples	Labels
SpecificRiskOrHazardType			
TypeOfElement			

6 Reference systems

6.1 Coordinate reference systems

6.1.1 Datum

IR Requirement 5	For the coordinate reference systems used for making available the INSPIRE spatial data sets, the datum shall be the datum of the European Terrestrial Reference System 1989 (ETRS89) in areas within its geographical scope, and the datum of the International Terrestrial Reference System (ITRS) or other geodetic coordinate reference systems compliant with ITRS in areas that are outside the geographical scope of ETRS89. Compliant with the ITRS means that the system definition is based on the definition of the ITRS and there is a well-established and described relationship between both systems, according to EN ISO 19111.

6.1.2 Coordinate reference systems

IR Requirement 6	INSPIRE spatial data sets shall be made available using one of the three-dimensional, two-dimensional or compound coordinate reference systems specified in the list below. Other coordinate reference systems than those listed below may only be used for regions outside of continental Europe. The geodetic codes and parameters for these coordinate reference systems shall be documented, and an identifier shall be created, according to EN ISO 19111 and ISO 19127.

1. Three-dimensional Coordinate Reference Systems
   - Three-dimensional Cartesian coordinates
   - Three-dimensional geodetic coordinates (latitude, longitude and ellipsoidal height), using the parameters of the GRS80 ellipsoid

2. Two-dimensional Coordinate Reference Systems
   - Two-dimensional geodetic coordinates, using the parameters of the GRS80 ellipsoid
   - Plane coordinates using the Lambert Azimuthal Equal Area projection and the parameters of the GRS80 ellipsoid
   - Plane coordinates using the Lambert Conformal Conic projection and the parameters of the GRS80 ellipsoid
   - Plane coordinates using the Transverse Mercator projection and the parameters of the GRS80 ellipsoid

3. Compound Coordinate Reference Systems
   - For the horizontal component of the compound coordinate reference system, one of the two-dimensional coordinate reference systems specified above shall be used.
   - For the vertical component on land, the European Vertical Reference System (EVRS) shall be used to express gravity-related heights within its geographical scope.
   - Other vertical reference systems related to the Earth gravity field shall be used to express gravity-related heights in areas that are outside the geographical scope of EVRS. The geodetic codes and parameters for these vertical reference systems shall be documented and an identifier shall be created, according to EN ISO 19111 and ISO 19127.
   - For the vertical component in the free atmosphere, barometric pressure, converted to height using ISO 2533:1975 International Standard Atmosphere shall be used.

6.1.3 Display

IR Requirement 7	For the display of the INSPIRE spatial data sets with the View Service specified in D003152/02 Draft Commission Regulation implementing Directive 2007/2/EC of the European Parliament and of the Council as regards Network Services, at least the two dimensional geodetic coordinate system shall be made available.

6.1.4 Identifiers for coordinate reference systems

IR Requirement 8	For referring to the non-compound coordinate reference systems listed in this Section, the identifiers listed below shall be used. For referring to a compound coordinate reference system, an identifier composed of the identifier of the horizontal component, followed by a slash (/), followed by the identifier of the vertical component, shall be used.

- ETRS89-XYZ for Cartesian coordinates in ETRS89
- ETRS89-GRS80h for three-dimensional geodetic coordinates in ETRS89 on the GRS80 ellipsoid
- ETRS89-GRS80 for two-dimensional geodetic coordinates in ETRS89 on the GRS80
- EVRS for height in EVRS
- LAT for depth of the sea floor, where there is an appreciable tidal range
- MSL for depth of the sea floor, in marine areas without an appreciable tidal range, in open oceans and effectively in waters that are deeper than 200m
- ISA for pressure coordinate in the free atmosphere
- PFO for Pressure coordinate in the free ocean
- ETRS89-LAEA for ETRS89 coordinates projected into plane coordinates by the Lambert Azimuthal Equal Area projection
- ETRS89-LCC for ETRS89 coordinates projected into plane coordinates by the Lambert Conformal Conic projection
- ETRS89-TMzn for ETRS89 coordinates projected into plane coordinates by the Transverse Mercator projection

6.2 Temporal reference system

IR Requirement 9	The Gregorian calendar shall be used for as a reference system for date values, and the Universal Time Coordinated (UTC) or the local time including the time zone as an offset from UTC shall be used as a reference system for time values.

6.3 Theme-specific requirements and recommendations on reference systems

There are no theme-specific requirements or recommendations on reference systems.

7 Data quality

This chapter includes a description of the data quality elements and sub-elements as well as the corresponding data quality measures that should be used to evaluate and document data quality for data sets related to the spatial data theme *Natural Risk Zones* (section 7.1).

It may also define requirements or recommendations about the targeted data quality results applicable for data sets related to the spatial data theme *Natural Risk Zones* (sections 7.2 and 7.3).

In particular, the data quality elements, sub-elements and measures specified in section 7.1 should be used for

- evaluating and documenting data quality properties and constraints of spatial objects, where such properties or constraints are defined as part of the application schema(s) (see section 5);
- evaluating and documenting data quality metadata elements of spatial data sets (see section 8); and/or
- specifying requirements or recommendations about the targeted data quality results applicable for data sets related to the spatial data theme *Natural Risk Zones* (see sections 7.2 and 7.3).

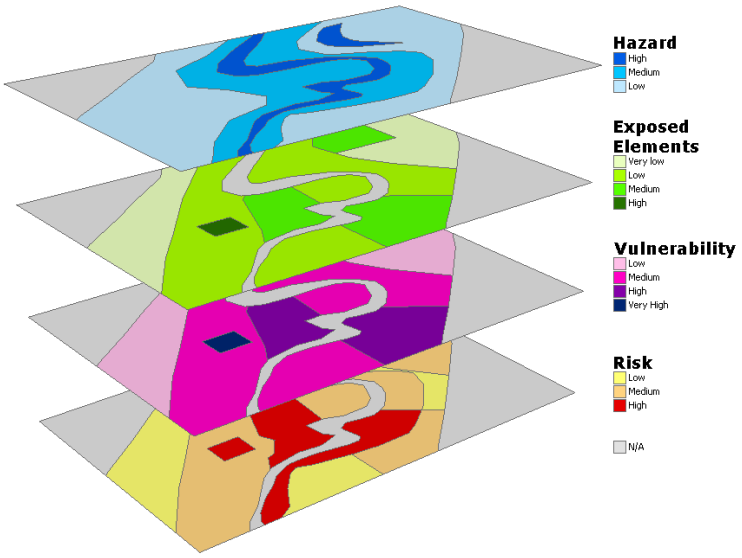
The descriptions of the elements and measures are based on Annex D of ISO/DIS 19157 Geographic information – Data quality.

7.1 Data quality elements

Table 2 lists all data quality elements and sub-elements that are being used in this specification. Data quality information can be evaluated at level of spatial object, spatial object type, dataset or dataset series. The level at which the evaluation is performed is given in the “Evaluation Scope” column.

The measures to be used for each of the listed data quality sub-elements are defined in the following sub-sections.

Name	**<Name of the measure, from ISO/DIS 19157>**
Alternative name	
Data quality element	Logical Consistency
Data quality sub-element	Conceptual Consistency
Data quality basic measure	1) Counting-related data quality basic measures: Error count
Definition	Total number of items not compliant with the rules of the NZ conceptual schema.
Description	Spatial relations between basic object types: • A spatial object classified as "RiskZone" must spatially overlay one or several spatial objects classified as "HazardArea". • A spatial object classified as "RiskZone" must spatially overlay one or more spatial objects classified as "ExposedElements". • A spatial object classified as "ExposedElements" must spa-tially be within one or more spatial objects classified as "HazardArea". Spatial relations specifically for fluvial flood hazard / risk type (and not necessarily applicable for other hazard/risk types): • A fluvial flood prone area (spatial object type "HazardArea") or a fluvial flood risk area (spatial object type "RiskArea") with a certain return period (eg. T=500) shall include fluvial flood prone areas or risk areas (spatial object type "HazardArea" or "RiskArea") with lower return periods (eg. T=100, T=50, etc). • HazardArea or RiskArea for hazard type flood must be located in a certain coastal area, sub-basin, river basin and/or RBD
Evaluation scope	data set
Reporting scope	spatial object type: hazardArea, exposedElements, riskZone, data set
Parameter	
Data quality value type	integer

Data quality value structure	Single value Bag Set Sequence Table Matrix Coverage
Source reference	ISO/DIS 19157 Geographic information – Data quality
Example	
Measure identifier	

Recommendation 5 Where it is impossible to express the evaluation of a data quality element in a quantitative way, the evaluation of the element should be expressed with a textual statement as a data quality descriptive result.

7.1.1 Logical consistency – Conceptual consistency

Recommendation 6 Conceptual consistency should be evaluated and documented using Logical Consistency as specified in the tables below.

Table 2 – Data quality elements used in the spatial data theme *Natural Risk Zones*

Section	Data quality element	Data quality sub-element	Definition	Evaluation Scope
7.1.1	Logical consistency	Conceptual consistency	adherence to rules of the conceptual schema	dataset

7.2 Minimum data quality requirements

No minimum data quality requirements are defined for the spatial data theme Natural Risk Zones.
Insert more rows when additional requirements have been defined!

7.3 Recommendation on data quality

No minimum data quality recommendations are defined.

8 Dataset-level metadata

This section specifies dataset-level metadata elements, which should be used for documenting metadata for a complete dataset or dataset series.

NOTE Metadata can also be reported for each individual spatial object (spatial object-level metadata). Spatial object-level metadata is fully described in the application schema(s) (section 5).

For some dataset-level metadata elements, in particular those for reporting data quality and maintenance, a more specific scope can be specified. This allows the definition of metadata at sub-dataset level, e.g. separately for each spatial object type. When using ISO 19115/19157/19139 to encode the metadata, the following rules should be followed:

- The scope element (of type DQ_Scope) of the DQ_DataQuality subtype should be used to encode the reporting scope.

  NOTE The reporting scope can be different from the evaluation scope (see section 7).

- Only the following values should be used for the level element of DQ_Scope: Series, Dataset, featureType.

  NOTE The value featureType is used to denote spatial object type.

- If the level is featureType the levelDescription/MDScopeDescription/features element (of type Set< GF_FeatureType>) shall be used to list the feature type names.

Mandatory or conditional metadata elements are specified in Section 8.1. Optional metadata elements are specified in Section 8. The tables describing the metadata elements contain the following information:

- The first column provides a reference to a more detailed description.
- The second column specifies the name of the metadata element.
- The third column specifies the multiplicity.
- The fourth column specifies the condition, under which the given element becomes mandatory (only for Table 3 and Table 4).

8.1 Common metadata elements

IR Requirement 10	The metadata describing a spatial data set or a spatial data set series related to the theme **Natural Risk Zones** shall comprise the metadata elements required by Regulation 1205/2008/EC (implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata) for spatial datasets and spatial dataset series (Table 3) as well as the metadata elements specified in Table 4.

Table 3 – Metadata for spatial datasets and spatial dataset series specified in Regulation 1205/2008/EC (implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata)

Metadata Regulation Section	**Metadata element**	**Multiplicity**	**Condition**
1.1	Resource title	1	
1.2	Resource abstract	1	
1.3	Resource type	1	
1.4	Resource locator	0..*	Mandatory if a URL is available to obtain more information on the resource, and/or access related services.
1.5	Unique resource identifier	1..*	
1.7	Resource language	0..*	Mandatory if the resource includes textual information.
2.1	Topic category	1..*	
3	Keyword	1..*	
4.1	Geographic bounding box	1..*	
5	Temporal reference	1..*	
6.1	Lineage	1	
6.2	Spatial resolution	0..*	Mandatory for data sets and data set series if an equivalent scale or a resolution distance can be specified.
7	Conformity	1..*	
8.1	Conditions for access and use	1..*	
8.2	Limitations on public access	1..*	
9	Responsible organisation	1..*	
10.1	Metadata point of contact	1..*	
10.2	Metadata date	1	
10.3	Metadata language	1	

Table 4 – Mandatory and conditional common metadata elements

INSPIRE Data Specification Natural Risk Zones **Section**	**Metadata element**	**Multiplicity**	**Condition**

8.1.1	Coordinate Reference System	1	
8.1.2	Temporal Reference System	0..*	Mandatory, if the spatial data set or one of its feature types contains temporal information that does not refer to the Gregorian Calendar or the Coordinated Universal Time.
8.1.3	Encoding	1..*	
8.1.4	Character Encoding	0..*	Mandatory, if an encoding is used that is not based on UTF-8.
8.1.5	Data Quality – Logical Consistency – Topological Consistency	0..*	Mandatory, if the data set includes types from the Generic Network Model and does not assure centreline topology (connectivity of centrelines) for the network.

8.1.1 Coordinate Reference System

Metadata element name	**Coordinate Reference System**
Definition	Description of the coordinate reference system used in the dataset.
ISO 19115 number and name	13. referenceSystemInfo
ISO/TS 19139 path	referenceSystemInfo
INSPIRE obligation / condition	mandatory
INSPIRE multiplicity	1
Data type(and ISO 19115 no.)	186. MD_ReferenceSystem
Domain	To identify the reference system, the referenceSystemIdentifier (RS_Identifier) shall be provided. NOTE More specific instructions, in particular on pre-defined values for filling the referenceSystemIdentifier attribute should be agreed among Member States during the implementation phase to support interoperability.
Implementing instructions	
Example	referenceSystemIdentifier: code: ETRS_89 codeSpace: INSPIRE RS registry
Example XML encoding	<gmd:referenceSystemInfo> <gmd:MD_ReferenceSystem> <gmd:referenceSystemIdentifier> <gmd:RS_Identifier> <gmd:code> <gco:CharacterString>ETRS89 </gco:CharacterString> </gmd:code> <gmd:codeSpace> <gco:CharacterString>INSPIRE RS registry</gco:CharacterString> </gmd:codeSpace> </gmd:RS_Identifier> </gmd:referenceSystemIdentifier> </gmd:MD_ReferenceSystem> </gmd:referenceSystemInfo>
Comments	

8.1.2 Temporal Reference System

Metadata element name	**Temporal Reference System**
Definition	Description of the temporal reference systems used in the dataset.
ISO 19115 number and name	13. referenceSystemInfo
ISO/TS 19139 path	referenceSystemInfo
INSPIRE obligation / condition	Mandatory, if the spatial data set or one of its feature types contains temporal information that does not refer to the Gregorian Calendar or the Coordinated Universal Time.
INSPIRE multiplicity	0..*
Data type(and ISO 19115 no.)	186. MD_ReferenceSystem
Domain	No specific type is defined in ISO 19115 for temporal reference systems. Thus, the generic MD_ReferenceSystem element and its reference SystemIdentifier (RS_Identifier) property shall be provided. NOTEMore specific instructions, in particular on pre-defined values for filling the referenceSystemIdentifier attribute should be agreed among Member States during the implementation phase to support interoperability.
Implementing instructions	
Example	referenceSystemIdentifier: code: GregorianCalendar codeSpace: INSPIRE RS registry
Example XML encoding	<gmd:referenceSystemInfo> <gmd:MD_ReferenceSystem> <gmd:referenceSystemIdentifier> <gmd:RS_Identifier> <gmd:code> <gco:CharacterString>GregorianCalendar</gco:CharacterString> > </gmd:code> <gmd:codeSpace> <gco:CharacterString>INSPIRE RS registry</gco:CharacterString> </gmd:codeSpace> </gmd:RS_Identifier> </gmd:referenceSystemIdentifier> </gmd:MD_ReferenceSystem> </gmd:referenceSystemInfo>
Comments	

8.1.3 Encoding

Metadata element name	**Encoding**
Definition	Description of the computer language construct that specifies the representation of data objects in a record, file, message, storage device or transmission channel
ISO 19115 number and name	271. distributionFormat
ISO/TS 19139 path	distributionInfo/MD_Distribution/distributionFormat
INSPIRE obligation / condition	mandatory
INSPIRE multiplicity	1
Data type (and ISO 19115 no.)	284. MD_Format

Domain	See B.2.10.4. The property values (name, version, specification) specified in section 9 **shall be** used to document the default and alternative encodings.
Implementing instructions	
Example	name: **Natural Risk Zones** GML application schema version: version **2.9**, GML, version 3.2.1 specification: D2.8.**III**.**12** Data Specification on **Natural Risk Zones** – Draft Guidelines
Example XML encoding	<gmd:MD_Format> <gmd:name> <gco:CharacterString> **Natural Risk Zones** GML application schema </gco:CharacterString> </gmd:name> <gmd:version> <gco:CharacterString>**2.9**, GML, version 3.2.1</gco:CharacterString> </gmd:version> <gmd:specification> <gco:CharacterString>D2.8.**III**.**12** Data Specification on **Natural Risk Zones** – Draft Guidelines</gco:CharacterString> </gmd:specification> </gmd:MD_Format>
Comments	

8.1.4 Character Encoding

Metadata element name	**Character Encoding**
Definition	The character encoding used in the data set.
ISO 19115 number and name	
ISO/TS 19139 path	
INSPIRE obligation / condition	Mandatory, if an encoding is used that is not based on UTF-8.
INSPIRE multiplicity	0..*
Data type (and ISO 19115 no.)	
Domain	
Implementing instructions	
Example	-
Example XML encoding	<gmd:characterSet> <gmd:MD_CharacterSetCode codeListValue="8859part2" codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/ML_gmxCodelists.xml#CharacterSetCode">8859-2</gmd:MD_CharacterSetCode> </gmd:characterSet>
Comments	

8.1.5 Data Quality – Logical Consistency – Topological Consistency

Metadata element name	**Data Quality – Logical Consistency – Topological Consistency**
Definition	Correctness of the explicitly encoded topological characteristics of the dataset as described by the scope
INSPIRE obligation / condition	Mandatory, if the data set includes types from the Generic Network Model and does not assure centreline topology (connectivity of centrelines) for the network.

INSPIRE multiplicity	0..*
Comments	See clauses on topological consistency in section 7 for detailed information. This metadata element is mandatory if connectivity is not assured for network centrelines in the dataset. In this case the *Connectivity tolerance* parameter – as described in section 7 – must be provided in order to ensure automatic and unambiguous creation of centreline topology in post-process.

NOTE See section 8.2 for further instructions on how to implement metadata elements for reporting data quality.

8.2 Metadata elements for reporting data quality

Recommendation 7 For reporting the results of the data quality evaluation, the data quality elements, sub-elements and (for quantitative evaluation) measures defined in chapter 7 should be used.

The scope for reporting may be different from the scope for evaluating data quality (see section 7). If data quality is reported at the data set or spatial object type level, the results are usually derived or aggregated.

Recommendation 8 The metadata elements specified in the following tables should be used to report the results of the data quality evaluation. At least the information included in the row “Implementation instructions” should be provided.

The first table applies to reporting quantitative results (using the element DQ_QuantitativeResult), while the second table applies to reporting non-quantitative results (using the element DQ_DescriptiveResult).

NOTE These tables may need to be updated once the XML schemas for ISO 19157 have been finalised.

Metadata element name	**See chapter 7**
Definition	See chapter 7
ISO/DIS 19157 number and name	3. report
ISO/TS 19139 path	dataQualityInfo/*/report
INSPIRE obligation / condition	optional
INSPIRE multiplicity	0..*
Data type (and ISO/DIS 19157 no.)	Corresponding DQ_xxx subelement from ISO/DIS 19157, e.g. 12. DQ_CompletenessCommission
Domain	Lines 7-9 from ISO/DIS 19157 7. DQ_MeasureReference (C.2.1.3) 8. DQ_EvaluationMethod (C.2.1.4.) 9. DQ_Result (C2.1.5.)

Implementing instructions	39. nameOfMeasure NOTE This should be the name as defined in Chapter 7. 42. evaluationMethodType 43. evaluationMethodDescription NOTE If the reported data quality results are derived or aggregated (i.e. the scope levels for evaluation and reporting are different), the derivation or aggregation should also be specified using this property. 46. dateTime NOTE This should be data or range of dates on which the data quality measure was applied. 63. DQ_QuantitativeResult / 64. value NOTE The DQ_Result type should be DQ_QuantitativeResult and the value(s) represent(s) the application of the data quality measure (39.) using the specified evaluation method (42-43.)
Example	See Table E.12 — Reporting commission as metadata (ISO/DIS 19157)
Example XML encoding	

Metadata element name	**See chapter 7**
Definition	See chapter 7
ISO/DIS 19157 number and name	3. report
ISO/TS 19139 path	dataQualityInfo/*/report
INSPIRE obligation / condition	optional
INSPIRE multiplicity	0..*
Data type (and ISO/DIS 19157 no.)	Corresponding DQ_xxx subelement from ISO/DIS 19157, e.g. 12. DQ_CompletenessCommission
Domain	Line 9 from ISO/DIS 19157 9. DQ_Result (C2.1.5.)
Implementing instructions	67. DQ_DescripitveResult / 68. statement NOTE The DQ_Result type should be DQ_DescriptiveResult and in the statement (68.) the evaluation of the selected DQ sub-element should be expressed in a narrative way.
Example	See Table E.15 — Reporting descriptive result as metadata (ISO/DIS 19157)
Example XML encoding	

Open issue 1: For reporting compliance with minimum data quality requirements and recommendations specified in section 7, the INSPIRE conformity metadata element should be used. However, since this issue is part of the larger discussion on the Abstract Test Suite and the definition of conformance classes for the data specification, detailed instructions on how to provide metadata on compliance with minimum data quality requirements and recommendations will only be provided for v3.0.

8.3 Theme-specific metadata elements

IR Requirement 11	The metadata describing a spatial data set or a spatial data set series related to the theme *Natural Risk Zones* shall also comprise the theme-specific metadata elements specified in **Error! Reference source not found.**.

No mandatory or conditional theme-specific metadata elements are defined for this theme.

Recommendation 9	The metadata describing a spatial data set or a spatial data set series related to the theme *Natural Risk Zones* should comprise the theme-specific metadata elements specified in Table 5.

Table 5 – Optional theme-specific metadata elements for the theme *Natural Risk Zones*

Section	Metadata element	Multiplicity
AA	File Identifier	0..1
BB	Metadata standard name	0..1
CC	Metadata standard version	0..1
DD	Spatial representation type	0..*
EE	Reference system info	0..*
FF	Distribution format	0..*

8.3.1 File Identifier (AA)

Metadata element name	**File Identifier**
Definition	Metadata file identifier. Unique identifier (typically UUID) of the metadata record.
ISO 19115 number and name	2 fileIdentifier
ISO/TS 19139 path	fileIdentifier
INSPIRE obligation / condition	optional
INSPIRE multiplicity	0..1
Data type (and ISO 19115 no.)	CharacterString
Domain	Free text
Implementing instructions	The identifier should be described through UUID (Universally Unique Identifier) – ISO/IEC 11578:1996.
Example	**00d32154-1656-4fcc-9ddd-6dbe9a1baeb0**
Example XML encoding	
Comments	The element declares an unequivocal identifier of metadata file. The UUID of metadata record is used typically.

8.3.2 Metadata standard name (BB)

Metadata element name	**Metadata standard name**

Definition	Name of the metadata standard.
ISO 19115 number and name	10 metadataStandardName
ISO/TS 19139 path	metadataStandardName
INSPIRE obligation / condition	optional
INSPIRE multiplicity	0..1
Data type (and ISO 19115 no.)	CharacterString
Domain	Free text
Implementing instructions	
Example	ISO19115/19119 Dublin Core
Example XML encoding	
Comments	The publication of metadata standard name (as a free text) is important from the view of re-use of metadata set as well as of its sharing, combining and following harmonization.

8.3.3 Metadata and standard version (CC)

Metadata element name	**Metadata standard version**
Definition	Name of the metadata standard version. Version (profile) of the metadata standard used.
ISO 19115 number and name	11 metadataStandardVersion
ISO/TS 19139 path	metadataStandardVersion
INSPIRE obligation / condition	optional
INSPIRE multiplicity	0..1
Data type (and ISO 19115 no.)	CharacterString
Domain	Free text
Implementing instructions	
Example	2003/Cor.1:2006 – Plan4all:2010
Example XML encoding	
Comments	The elements specifies the previous information (Metadata standard name) in detail. Also reasons are same as in previous element – sharing, combining and re-use. The metadata standard version is written as free text.

8.3.4 Spatial representation type (DD)

Metadata element name	**Spatial representation type**
Definition	Method used to spatially represent geographic information (e.g. vector).

ISO 19115 number and name	37. spatialRepresentationType
ISO/TS 19139 path	identificationInfo/*/spatialRepresentationType
INSPIRE obligation / condition	optional
INSPIRE multiplicity	0..*
Data type (and ISO 19115 no.)	Class
Domain	MD_SpatialRepresentation TypeCode <<CodeList>> (B.5.26)
Implementing instructions	MD_SpatialRepresentationTypeCode (see Example)
Example	vector (domain code – 001), grid (002), textTable (003), tin (004), stereoModel (005), video (006)
Example XML encoding	
Comments	The publication of character of spatial representation is important from the view of simple re-using of data. The spatial representation is essential information to able (or unable) data uploading for many users. The values (domain) of this element is defined in ISO 19115 standard (part B.5.26; see the rom Example).

8.3.5 Reference system info (EE)

Metadata element name	**Reference system info**
Definition	Information on reference system.
ISO 19115 number and name	13 referenceSystemInfo
ISO/TS 19139 path	referenceSystemInfo/*/referenceSystemIdentifier
INSPIRE obligation / condition	optional
INSPIRE multiplicity	0..*
Data type (and ISO 19115 no.)	Association
Domain	MD_ReferenceSystem (B.2.7)
Implementing instructions	referenceSystemIdentifier – name of reference system (see ISO 19115 B.2.7.3 Identifier information
Example	Codespace: urn:ogc:def:crs:EPSG::Code: 4326
Example XML encoding	
Comments	Various coordinate systems limits the interoperability of data. Therefore a publication of this information in metadata enables an effective, simple and fast data processing. The form of value is defined in ISO 19115, B.2.7.3 Identifier information.

8.3.6 Distribution format (FF)

Metadata element	**Distribution format**

name	
Definition	Information on distribution format.
ISO 19115 number and name	271 distributionFormat
ISO/TS 19139 path	distributionInfo/*/distributionFormat
INSPIRE obligation / condition	optional
INSPIRE multiplicity	0..*
Data type (and ISO 19115 no.)	Association
Domain	MD_Format (B.2.10.4)
Implementing instructions	MD_Format - name (mandatory) - version (mandatory) - amendmentNumber - specification - fileDecompressionTechnique - formatDistributor
Example	Shapefile, version 1.0 GML, version 3.2.1
Example XML encoding	
Comments	The release of format is also important from the view of interoperability (see previous elements). The structure of this metadata record contain two mandatory items (name of the data format and its version) and four optional items.

Error! Not a valid filename.

8.4 Guidelines on using metadata elements defined in Regulation 1205/2008/EC

8.4.1 Conformity

The *Conformity* metadata element defined in Regulation 1205/2008/EC allows to report the conformance with the Implementing Rule for interoperability of spatial data sets and services or another specification. The degree of conformity of the dataset can be *Conformant* (if the dataset is fully conformant with the cited specification), *Not Conformant* (if the dataset does not conform to the cited specification) or *Not evaluated* (if the conformance has not been evaluated).

Recommendation 10 The Conformity metadata element should be used to report conceptual consistency with this INSPIRE data specification. The value of Conformant should be used for the Degree element only if the dataset passes all the requirements described in the abstract test suite presented in Annex A. The Specification element should be given as follows:
- title: “INSPIRE Data Specification on <Theme Name> – Draft Guidelines”
- date:
  - dateType: publication
  - date: **2012-02-24**

Conformance testing is still an open issue under discussion.

Open issue 2: Instructions on conformance testing and a common abstract test suite (including detailed instructions on how to test specific requirements) will be added at a later stage.

This may also lead to an update of the recommendations on how to fill the conformity metadata element.

Lineage

Following the ISO 19113 Quality principles, if a data provider has a procedure for quality validation of their spatial data sets then the data quality elements listed in the Chapters 7 and 8 should be used. If not, the *Lineage* metadata element (defined in Regulation 1205/2008/EC) should be used to describe the overall quality of a spatial data set.

According to Regulation 1205/2008/EC, lineage "is a statement on process history and/or overall quality of the spatial data set. Where appropriate it may include a statement whether the data set has been validated or quality assured, whether it is the official version (if multiple versions exist), and whether it has legal validity. The value domain of this metadata element is free text".

8.4.2 The Metadata Technical Guidelines based on EN ISO 19115 and EN ISO 19119 specify that the statement sub-element of LI_Lineage (EN ISO 19115) should be used to implement the lineage metadata element.

Recommendation 11	To describe the transformation steps and related source data, it is recommended to use the following sub-elements of LI_Lineage:
Recommendation 12	- For the description of the transformation process of the local to the common INSPIRE data structures, the *LI*_ProcessStep sub-element should be used.
Recommendation 13	- For the description of the source data the LI_Source sub-element should be used.
Recommendation 14	

NOTE 1 This recommendation is based on the conclusions of the INSPIRE Data Quality Working Group to avoid overloading of the overall lineage statement element with information on the transformation steps and related source data.

NOTE 2 In order to improve the interoperability, domain templates and instructions for filling these free text elements (descriptions) may be specified in an Annex of this data specification.

The suggested use of the LI_Lineage sub-elements needs to be discussed as part of the maintenance of the INSPIRE metadata Technical Guidelines.

Temporal reference

According to Regulation 1205/2008/EC, at least one of the following temporal reference metadata elements shall be provided: temporal extent, date of publication, date of last revision, date of creation. If feasible, the date of the last revision of a spatial data set should be reported using the *Date of last revision* metadata element.

9 Delivery

9.1 Delivery medium

TG Requirement 2	Data conformant to this INSPIRE data specification shall be made available through an INSPIRE network service.

TG Requirement 3	All information that is required by a calling application to be able to retrieve the data through the used network service shall be made available in accordance with the requirements defined in the Implementing Rules on Network Services.

EXAMPLE 1 Through the Get Spatial Objects function, a download service can either download a pre-defined data set or pre-defined part of a data set (non-direct access download service), or give direct access to the spatial objects contained in the data set, and download selections of spatial objects based upon a query (direct access download service). To execute such a request, some of the following information might be required:

- the list of spatial object types and/or predefined data sets that are offered by the download service (to be provided through the Get Download Service Metadata operation),
- and the query capabilities section advertising the types of predicates that may be used to form a query expression (to be provided through the Get Download Service Metadata operation, where applicable),
- a description of spatial object types offered by a download service instance (to be proviced through the Describe Spatial Object Types operation).

EXAMPLE 2 Through the Transform function, a transformation service carries out data content transformations from native data forms to the INSPIRE-compliant form and vice versa. If this operation is directly called by an application to transform source data (e.g. obtained through a download service) that is not yet conformant with this data specification, the following parameters are required:
Input data (mandatory). The data set to be transformed.

- Source model (mandatory, if cannot be determined from the input data). The model in which the input data is provided.
- Target model (mandatory). The model in which the results are expected.
- Model mapping (mandatory, unless a default exists). Detailed description of how the transformation is to be carried out.

9.2 Encodings

9.2.1 Default Encoding(s)

TG Requirement 4	Data conformant to the application schema(s) defined in section 5 shall be encoded using the encoding(s) specified in this section.

9.2.1.1. Default encoding for application schema <application schema name>

Name: <name of the application schema> GML Application Schema
Version: version <version of the GML Application Schema>, GML, version 3.2.1
Specification: D2.8.**III**.**12** Data Specification on **Natural Risk Zones** – Draft Guidelines
Character set: UTF-8

The GML Application Schema is distributed in a zip-file separately from the data specification document.

9.2.1.1.1. Specific mappings from UML classes to GML/XML Schema types and elements

In addition to the mappings between conceptual UML classes and the associated GML object element, XML Schema type and GML property type provided in Table D.2 of ISO 19136 (GML), the mappings included in have been used to generate the GML application schema.

Table 6. Mappings between conceptual UML classes and the associated GML object elements, XML Schema types and GML property types

UML class	GML object element	GML type	GML property type

9.2.1.1.2. Implementation UML model used for generating the GML application schema

The GML application schema was not derived directly from the conceptual model described in section 5, but from an implementation model (for a schematic illustration of this process, see Figure 6).

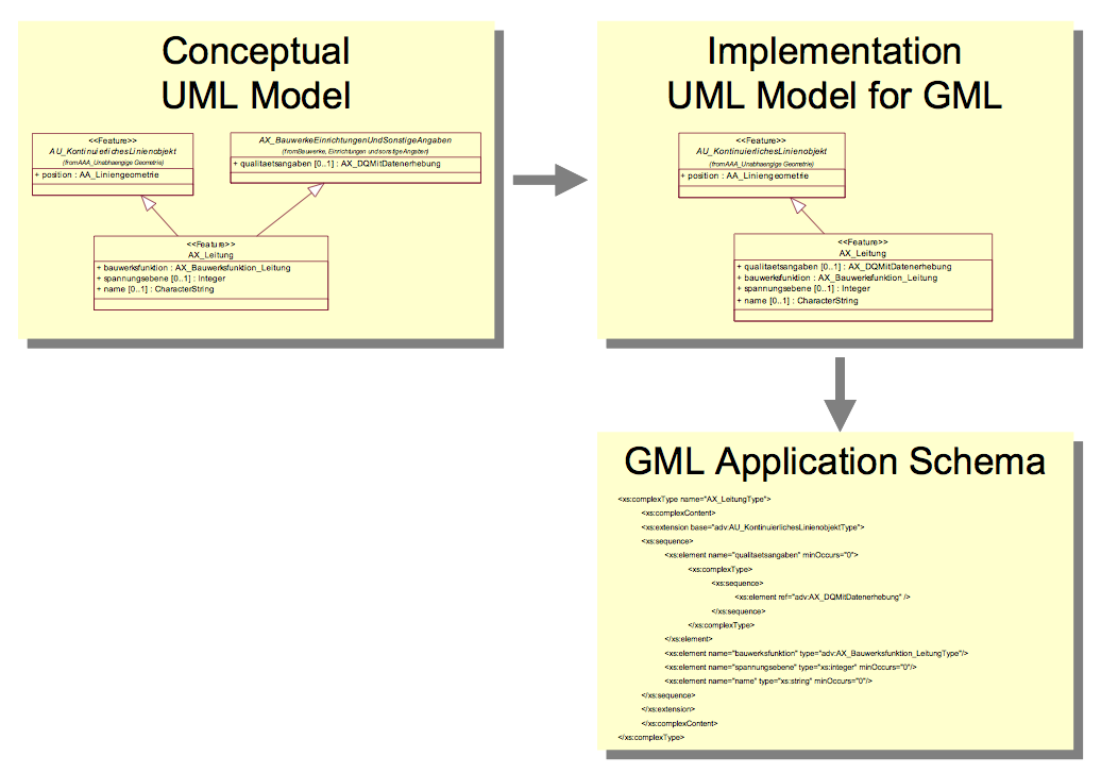


Figure 6 – Process of creating the GML application schema (from [DS-D2.7])

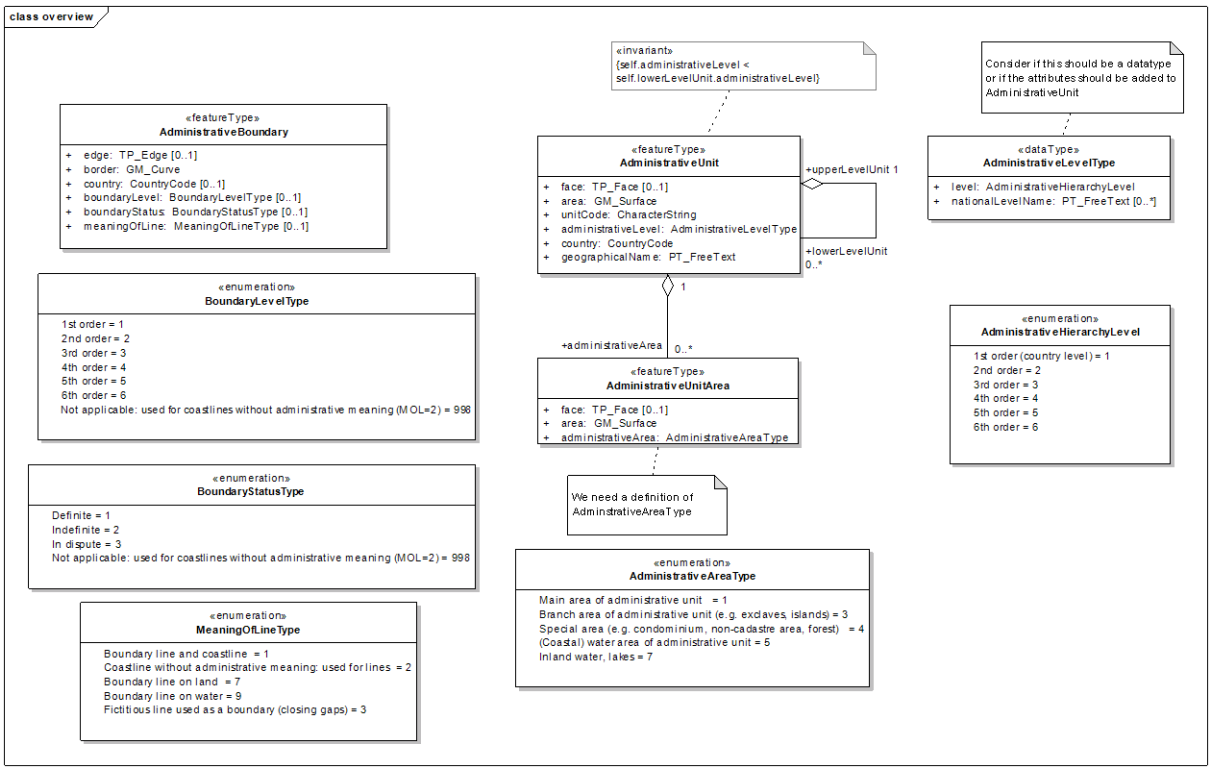


Figure 7 – UML class diagram: Overview of the implementation model for the Natural Risk Zones **application schema**

9.2.2 Alternative Encoding(s)

Recommendation 15 It is recommended that also the encodings specified in this section be provided for the relevant application schemas.

9.2.2.1. Alternative encoding for application schema <application schema name>

Name: <name of the format>
Version: <version of format>
Specification: <specification reference>
Character set: <character set>

9.2.2.1.1. Encoding rule(s) used

10 Data Capture

There is no specific guidance required with respect to data capture.

11 Portrayal

This clause defines the rules for layers and styles to be used for portrayal of the spatial object types defined for this theme.

In section 11.1, the types *of* layers are defined that are to be used for the portrayal of the spatial object types defined in this specification. A view service may offer several layers of the same type, one for each dataset that it offers on a specific topic.

Section 11.2 specifies the styles that shall be supported by INSPIRE view services for each of these layer types.

In section 11.3, further styles can be specified that represent examples of styles typically used in a thematic domain. It is recommended that also these styles should be supported by INSPIRE view services, where applicable.

Where XML fragments are used in these sections, the following namespace prefixes apply:
sld="http://www.opengis.net/sld" (WMS/SLD 1.1)
se="http://www.opengis.net/se" (SE 1.1)
ogc="http://www.opengis.net/ogc" (FE 1.1)

If an INSPIRE view services supports the portrayal of data related to the theme **Natural Risk Zones**, it shall provide layers of the types specified in this section.

-
- If an INSPIRE view network service supports the portrayal of spatial data sets corresponding to the spatial data theme **Natural Risk Zones**, it shall support the styles specified in section 11.2.
-
- If no user-defined style is specified in a portrayal request for a specific layer to an INSPIRE view service, the default style specified in section 11.2 for that layer shall be used.
-
- In addition to the styles defined in section 11.2, it is recommended that, where applicable, INSPIRE view services also support the styles defined in section 11.3.

11.1 Layers to be provided by INSPIRE view services

Layer Name	Layer Title	Spatial object type(s)	Keywords
NZ.RiskZone	Risk Zone	RiskZone	Risk zone
NZ.HazardArea	Hazard Area	HazardArea	Hazard Area
NZ.ExposedElements	Exposed Elements	ExposedElements	Exposed Elements
NZ.Vulnerability	Vulnerability	VulnerabilityZone	Vulnerability

11.1.1 Layers organisation

None.

11.2 Styles to be supported by INSPIRE view services

The Natural Risk Zones Theme includes three layers that apply to different natural hazard domains (e.g. floods, forest fires, landslides, etc.). A consequence of this is that the large number and variety of representation styles resulting from the multiple combinations of layer type, object type and hazard domain, produces a challenging number of different portrayal possibilities. Figure 11.1 shows an example of representation schema used in France for flood risk and hazard mapping. It is noticeable that the figure is one example for one hazard type and for one country. Hence a large number of options emerge when considering all the natural hazard and country approaches used in Europe. The aim of this chapter is to provide portrayal recommendations that should be simple and applicable and represent the best practices in the natural hazards domain. Therefore, the chapter should not be seen as an exhaustive revision of all the portrayal possibilities for natural hazards. Nevertheless, the chapter describes, by means of examples, best practices followed in several natural hazard domains.

OBJET	ATTRIBUT CARTOGRAPHIQUE	VALEUR	Style trait	Couleur trait	Style trame	Couleur trame
2 – 1 – 1 -	Risk basin	polygone		471	sans	sans
2 – 1 - 2	Outlet basin Type of slope					
		01 : Low		277		277
		02 : Moderate		306		306
		03 : High		286		286
	Run-off ratio					
		01 : Small		277		277
		02 : Average		306		306
		03 : Big		286		286
2 – 2 – 1	Geomorphological units					
	Type of area					
		010 Minor bed		noir		231
		020 Medium bed		noir		286
		030 Major bed		noir		306
2 – 2 – 2 -	Outlet					
	Type of outlet					
		010 Alluvial terrace		noir		100
		020 Outlet		noir		511
2 – 3 – 1 -	Flood area					
	Type of flood					
		01 : Decenial flood		360	sans	-
		02 : Centenial flood		150	sans	-
		03 : Historic flood		214	sans	-
	Flood determination					
		01 : Modeled		252		252
		02 : Observed		252		252
		03 : Calculated		252		252
		04 : Assessed		252		306
2 - 3 - 2 - :	Potential flooded area			306		306
2 – 3 – 3 -	Heights field Indication of water height					
		01 : 0 à 0,5m		noir		277
		02 : 0,5 à 1,0m		noir		306
		03 : > 1,0m		noir		286
2 – 3 – 4 -	Field of speeds Indicate speed of flow					
		01 : 0 à 0,5m/s		noir		277
		02 : 0,5 à 1,0m/s		noir		306
		03 : > 1,0m/s		noir		286
2 – 3 - 5 – :	Hazard area Type of area					
		Low		359		359
		Moderate		383		383
		High		150		150
		Very high		214		214
2 – 3 - 6 -	Zone of vulnerability Type of stakes					
		Low		359		359
		Moderate		383		383
		High		150		150
		Very high		214		214
	Land use					
		01 Agriculture	sans	-		102
		02 Dense urban node	sans	-		477
		02 Grouped habitat	sans	-		150
		02 Scattered habitat	sans	-		141
		03 Gathering places	sans	-		319
		04 Sensible facilities	sans	-		251
		05 Natural spaces	sans	-		341
2 – 3 - 7 –	Risk zone Type of risk					
		01 Low		359		359
		02 Moderate		383		383
		03 High		150		150
		04 Very high		214		214

Couleurs PANTONE dont les références sont disponible sur le nuancier MULTISET 500

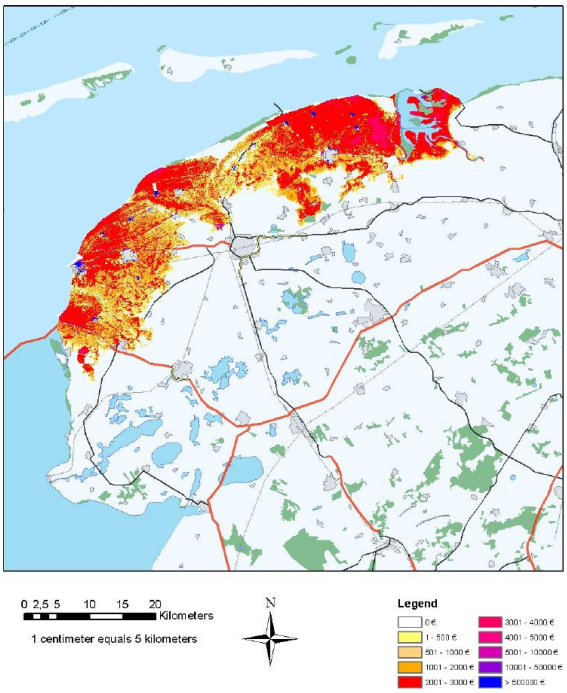
Figure 11.1. Representation styles for flood risk and hazard mapping from the Environmental Ministry of France[17] (source: Elaboration d'une base de données géographique pour la cartographie des zones inondables / guide de numérisation des objets géographiques. Direction de la Prévention des pollutions et des risques, February, 2002).

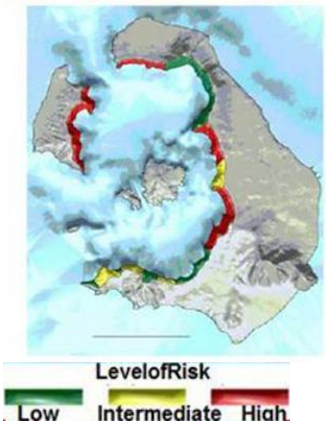
11.2.1 Styles for the layer NZ.RiskZone and NZ.HazardArea

This chapter is applicable both for risk zones and for hazard areas. The risk zones and the hazard areas are either polygons or grid cells in the case of coverages. Risk zones should be portrayed according to the values taken for the attributes "TypeOfRisk" and "LevelOfRisk". And Hazard areas according to "TypeOfHazard" and "LevelOfHazard".

[17] http://www.developpement-durable.gouv.fr/Direction-prevention-risques.html

When using a dataset that details the level of risk or hazard over a certain area for one type of risk (or hazard) the attribute “LevelOfRisk” (LevelOfHazard) has the information to be represented. It is either a qualitative or a quantitative concept. It is recommended that risk zones (and hazard areas) are portrayed with a classification: this requires no work when the level of risk (or hazard) is assessed qualitatively (when the “QualitativeValue” attribute is completed). When the level of risk (or hazard) is assessed quantitatively (when the “QuantitativeValue” attribute is completed), the user must set some classes depending upon a range of values. For this latter case, it is recommended to set no more than 5 classes. Each of those classes should be portrayed using shaded tones of colours.

Style name	NZ.RiskZone
Default Style	No (It can be different depending on TypeOfRisk i.e. natural hazard domain)
Style Title	Level of risk
Style Abstract	This style is for the representation of risk levels data as polygons or grid cells (coverage). The risk categories are usually represented using a colour ramp from clear to darker (low risk to high risk) depending on the attribute included in LevelOfRisk. The example below shows a coastal flood risk map from The Netherlands.
Risk Symbology	Example of portrayal layer of the TypeOfRisk floods: coastal flood risk map (source: Safecoast Action 3A, Trends in Flood Risk, July 2008: http://www.safecoast.org/editor/databank/File/rapport_SAFECOAST_final%2017-07-2008%281%29.pdf *http://www.safecoast.org/cohesion/risk_assessment.php*)  Example of portrayal layer of the TypeOfRisk landslides (source: Lekkas, E. (2009) Landslide hazard and risk in geologically active areas. The case of the caldera of

	Santorini (Thera) volcano island complex (Greece). International Association for Engineering Geology (IAEG), 7th Asian Regional Conference for IAEG, pp. 417-423, Chengdu. http://www.elekkas.gr/attachments/226_214.pdf 
Default Risk Zone symbology - SLD	This example Symbology applies to a feature Risk Zone layer classified in five risk classes. <?xml version="1.0" encoding="ISO-8859-1" standalone="yes"?> <sld:StyledLayerDescriptor version="1.0.0" xmlns:sld="http://www.opengis.net/sld" xmlns:ogc="http://www.opengis.net/ogc" xmlns:xlink="http://www.w3.org/1999/xlink"> <sld:NamedLayer> <sld:Name>RISK_ZONE</sld:Name> <sld:UserStyle> <sld:Name>Style1</sld:Name> <sld:FeatureTypeStyle> <sld:FeatureTypeName>RISK_ZONE</sld:FeatureTypeName> <sld:Rule> <sld:Name>100 - 300</sld:Name> <sld:Title>100 - 300</sld:Title> <ogc:Filter> <ogc:PropertyIsBetween> <ogc:PropertyName>sp_wfig</ogc:PropertyName> <ogc:LowerBoundary> <ogc:Literal>100</ogc:Literal> </ogc:LowerBoundary> <ogc:UpperBoundary> <ogc:Literal>300</ogc:Literal> </ogc:UpperBoundary> </ogc:PropertyIsBetween> </ogc:Filter> <sld:PolygonSymbolizer> <sld:Fill> <sld:CssParameter name="fill">#FFFF80</sld:CssParameter> <sld:CssParameter name="fill-opacity">1</sld:CssParameter> </sld:Fill> <sld:Stroke> <sld:CssParameter name="stroke">#000000</sld:CssParameter> <sld:CssParameter name="stroke-width">0.4</sld:CssParameter> <sld:CssParameter name="stroke-opacity">1</sld:CssParameter> </sld:Stroke> </sld:PolygonSymbolizer> </sld:Rule> <sld:Rule> <sld:Name>301 - 1000</sld:Name> <sld:Title>301 - 1000</sld:Title> <ogc:Filter>

```
            <ogc:PropertyIsBetween>
              <ogc:PropertyName>sp_wfig</ogc:PropertyName>
              <ogc:LowerBoundary>
                <ogc:Literal>300.000001</ogc:Literal>
              </ogc:LowerBoundary>
              <ogc:UpperBoundary>
                <ogc:Literal>1000</ogc:Literal>
              </ogc:UpperBoundary>
            </ogc:PropertyIsBetween>
          </ogc:Filter>
          <sld:PolygonSymbolizer>
            <sld:Fill>
              <sld:CssParameter name="fill">#FAD155</sld:CssParameter>
              <sld:CssParameter name="fill-opacity">1</sld:CssParameter>
            </sld:Fill>
            <sld:Stroke>
              <sld:CssParameter name="stroke">#000000</sld:CssParameter>
              <sld:CssParameter name="stroke-width">0.4</sld:CssParameter>
              <sld:CssParameter name="stroke-opacity">1</sld:CssParameter>
            </sld:Stroke>
          </sld:PolygonSymbolizer>
        </sld:Rule>
        <sld:Rule>
          <sld:Name>1001 - 1600</sld:Name>
          <sld:Title>1001 - 1600</sld:Title>
          <ogc:Filter>
            <ogc:PropertyIsBetween>
              <ogc:PropertyName>sp_wfig</ogc:PropertyName>
              <ogc:LowerBoundary>
                <ogc:Literal>1000.000001</ogc:Literal>
              </ogc:LowerBoundary>
              <ogc:UpperBoundary>
                <ogc:Literal>1600</ogc:Literal>
              </ogc:UpperBoundary>
            </ogc:PropertyIsBetween>
          </ogc:Filter>
          <sld:PolygonSymbolizer>
            <sld:Fill>
              <sld:CssParameter name="fill">#F2A72E</sld:CssParameter>
              <sld:CssParameter name="fill-opacity">1</sld:CssParameter>
            </sld:Fill>
            <sld:Stroke>
              <sld:CssParameter name="stroke">#000000</sld:CssParameter>
              <sld:CssParameter name="stroke-width">0.4</sld:CssParameter>
              <sld:CssParameter name="stroke-opacity">1</sld:CssParameter>
            </sld:Stroke>
          </sld:PolygonSymbolizer>
        </sld:Rule>
        <sld:Rule>
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          <sld:Title>1601 - 2700</sld:Title>
          <ogc:Filter>
            <ogc:PropertyIsBetween>
              <ogc:PropertyName>sp_wfig</ogc:PropertyName>
              <ogc:LowerBoundary>
                <ogc:Literal>1600.000001</ogc:Literal>
              </ogc:LowerBoundary>
              <ogc:UpperBoundary>
                <ogc:Literal>2700</ogc:Literal>
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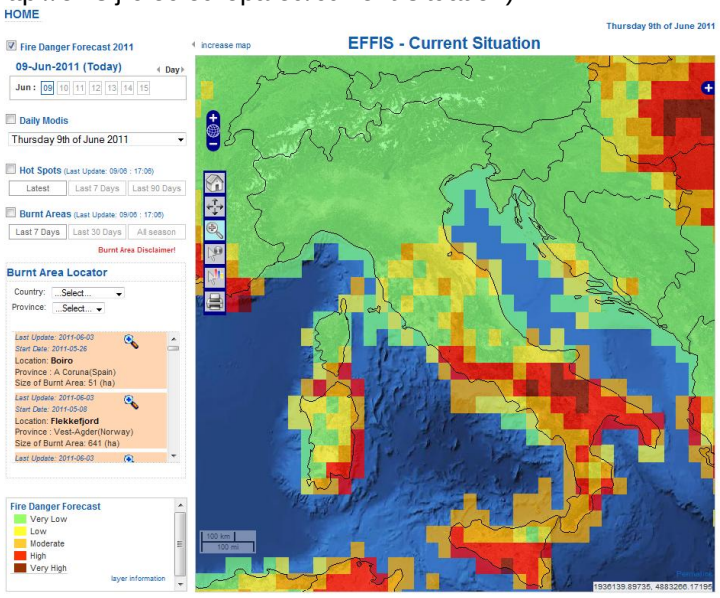
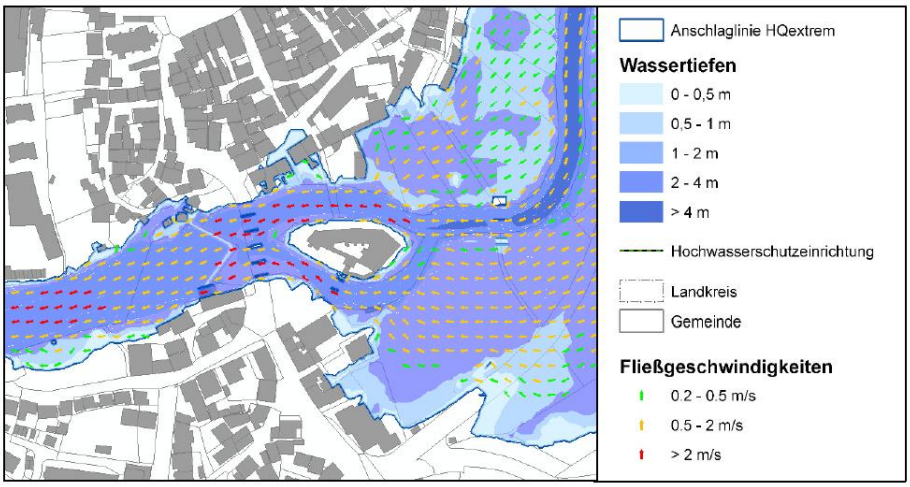
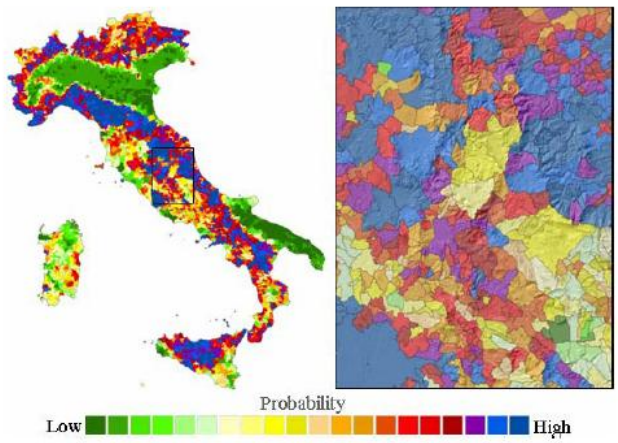
Minimum & maximum scales	No scale limit

Style name	NZ.HazardArea
Default Style	No (It can be different depending on TypeOfHazard)
Style Title	Level of hazard
Style Abstract	This style is for the representation of hazard levels data as polygons or grid cells (coverage). The hazard categories are usually represented using a colour ramp from clear to darker (low to high hazard) depending on the attribute included in LevelOfHazard. The example below shows a forest fires hazard map (coverage) and a

	flood hazard map (feature).
Hazard Symbology	Example of portrayal of layer for the TypeOfHazard forest fires (source: European Forest Fire Information System: Forest danger forecast. http://effis.jrc.ec.europa.eu/current-situation)  Example of portrayal of layer for the TypeOfHazard floods: water depth and velocity (source: LAWA, 2010, Recommendations for the Establishment of Flood Hazard Maps and Flood Risk Maps. German Working Group on Water Issues of the Federal States and the Federal Government, Dresden) 

	Example of portrayal of layer for the TypeOfHazard landslides (source: Guzzetti, F. (2005) Landslide Hazard and Risk Assessment. PhD Thesis, Naturwissenschaftlichen Fakultät der Rheinischen Friedrich-Wilhelms-Universität, University of Bonn. http://geomorphology.irpi.cnr.it/Members/fausto/ph.d.-dissertation) 
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Minimum & maximum scales	No scale limit

11.2.2 Styles for the layer NZ.ExposedElement

No guideline is provided for the portrayal of exposed elements.

11.3 Other recommended styles

For the portrayal of NZ.Vulnerability the same portrayal rules as for NZ.RiskZone applies.

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[ISO 19103] ISO/TS 19103:2005, Geographic information – Conceptual schema language

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[ISO 19111] EN ISO 19111:2007 Geographic information - Spatial referencing by coordinates (ISO 19111:2007)

[ISO 19115] EN ISO 19115:2005, Geographic information – Metadata (ISO 19115:2003)

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SEC(2010) 1626 final 5.01.2011 Risk Assessment and Mapping Guidelines for Disaster Management. Commission Staff Working Paper. Council of the European Union, Brussels http://register.consilium.europa.eu/pdf/en/10st17/st17833.en10.pdf

Annex A
(normative)

Abstract Test Suite

Any dataset conforming to this INSPIRE data specification shall meet all requirements specified in this document.

Open issue 3: Conformance testing is still an open issue under discussion.

Instructions on conformance testing and a common abstract test suite (including detailed instructions on how to test specific requirements) will be added at a later stage.

Annex B
(informative)
Use cases

This annex describes the use cases that were used as a basis for the development of this data specification.

B.1 Calculation of Flood impact

Use Case Description	
Name	
Primary actor	Analyst
Goal	Assessing of the presumed impact of a specific flood
System under consideration	Flood Information System
Importance	medium - high
Description	The analyst calculates for a given flood extent a set of maps that shows the affected area, number of people and type of land use that are affected by administrative unit (NUTS3)
Pre-condition	Flood extent has been calculated (if the analysis is based on a simulated event) or delineated on basis of orthophotos (if extent is based on a past event)
Post-condition	Flood impact dataset
Flow of Events – Basic Path	
Step 1.	The analyst imports the flood extent
Step 2.	The analyst identifies the administrative units (NUTS3) affected by the flood
Step 3.	For each administrative unit the analyst calculates the area that the flood extent covers (in ha)
Step 4.	For each administrative unit the analyst calculates the number of people living in the flooded area, based on a population density map
Step 5.	For each administrative unit the analyst calculates the affected land cover type (in ha) based on land cover information
Step 6.	The analyst combines all three thematic layers in a single flood impact dataset
Flow of Events – Alternative Paths	
	NONE
Data set: Flood extent	
Description	Flood extent showing the total extent of the flood
Type	input
Data provider	Flood monitoring centre
Geographic scope	Country XYZ
Thematic scope	Flood extent. Either based on historic observation or on flood simulation.
Scale, resolution	1:25.000
Delivery	Online
Documentation	http://floods.country.xyz

Use Case Description	
Data set: NUTS3	
Description	Administrative boundaries
Type	input
Data provider	EUROSTAT
Geographic scope	European
Thematic scope	Administrative boundaries
Scale, resolution	1:250.000
Delivery	Online
Documentation	http://epp.eurostat.ec.europa.eu/portal/page/portal/gisco_Geographical_information_maps/popups/references/administrative_units_statistical_units_1
Data set: Population density map	
Description	Population density map
Type	input
Data provider	Country's statistical office
Geographic scope	Country XYZ
Thematic scope	Population density per grid cell for a 250 x 250 m grid
Scale, resolution	250m
Delivery	DVD
Documentation	http://statistitics.country.xyz/populationDensity
Data set: CORINE Land Cover	
Description	Corine Land Cover 2006 raster data – version 13 (02/2010)
Type	input
Data provider	EEA
Geographic scope	Country XYZ
Thematic scope	Raster data on land cover for the CLC2006 inventory
Scale, resolution	250m
Delivery	online
Documentation	http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-2006-raster
Data set: Flood impact	
Description	The output of the flood impact analysis
Type	output
Data provider	The analysts organisation
Geographic scope	Country XYZ
Thematic scope	Flood impact indicator (scale 1-5) by NUTS3 administrative unit
Scale, resolution	1:250.000
Delivery	online
Documentation	http://www.flooding.xyz/flood-impact.html

Use case “Calculation of Floods Impact” describes how an analyst could carry out the level of flood impacts for human population at overview scale (at Country or at europeanwide level). This example shows that even when flood extents are available on local or regional level the meaningful output scale (here: flood impact dataset = 1:250.000) depends on the lowest scale of input datasets.

B.2 Reporting - Flood Risk Maps for 2007/60/EC

Use Case Description	
Name	Production of Flood Risk Maps
Primary actor	Analyst
Goal	Informing about potential adverse consequences (= impacts) to specific “exposed elements” for each area with potential significant flood risk
System under consideration	GIS
Importance	high
Description	*The analyst prepares for given flood extents maps that show potential affected areas and potential adverse consequences - expressed in terms of the indicative number of inhabitants, the type of economic activities, location of installations which might cause accidental pollution in the case of flooding and potentially affected protected areas (according to WFD Annex IV (1) (i) (iii) and (v)) under different flood scenarios. The flood maps must be prepared for the following flooding scenarios:* *(a) floods with low probability, or extreme event scenarios;* *(b) flood with a medium probability (likely return period ≥ 100 years);* *(c) floods with a high probability, where appropriate.* *Remark: cf. Reporting Sheet “Flood Hazard and Risk Maps”.*
Pre-condition	Calculated flood extents for each applicable type of flood and for each of the different scenarios. Flood extents are usually carried out by modelling. Preprocessed datasets about “exposed elements”. *Remark: Process of coordination in shared River Basins Districts and/or Units of Management for flow of events and data sets assumed.*
Post-condition	Datasets with potential adverse consequences for different types of flood under different scenarios
Flow of Events – Basic Path	
Step 1.	The analyst imports the areas with potential significant flood risk and flood extent datasets for the different types of flood and different scenarios (flood defence infrastrucuture is already considered in case of flood extent for floods with high and medium probability, no consideration of flood defence infrastrucuture for floods with low probability).
Step 2.	The analyst imports datasets with information about indicative number of inhabitants, types of economic activities, locations of installations which might cause accidental pollution in the case of flooding and potentially affected protected areas
Step 3.	For each area with potential significant flood risk the analyst identifies the indicative number of inhabitants, the type of economic activities, location of installations which might cause accidental pollution in the case of flooding and potentially affected protected areas (according to WFD Annex IV (1) (i) (iii) and (v) under different flood scenarios.
Step 4.	The analyst decides about map contents, the number of maps to be provided for each area with potential significant flood risk and in this context about the most appropriate map scale and the adequate way to provide information carried out by step 3 and 5. In dependence of scale and assessed adverse consequences for the different types of flood and scenarios it is feasible to provide more than one

Use Case Description	
	map respectively separate maps for the same area. For groundwater flooding and coastal floods where an adequate level of protection is in place the analyst decides to prepare flood risk maps for all scenarios or to limit scenarios to low probability or extreme event scenario.
Step 5.	Grouping/combining of thematic layers for map/separate maps
Step 6.	Reporting to WISE (Water Information System for Europe)
Flow of Events – Alternative Paths	
Step 1.	The analyst imports the areas with potential significant flood risk and flood extent datasets for the different types of flood and different scenarios
Step 2.	The analyst imports datasets with information about indicative number of inhabitants, types of economic activities, locations of installations which might cause accidental pollution in the case of flooding and potentially affected protected areas
Step 3.	For each area with potential significant flood risk the analyst identifies the indicative number of inhabitants, the type of economic activities, location of installations which might cause accidental pollution in the case of flooding and potentially affected protected areas (according to WFD Annex IV (1) (i) (iii) and (v) under different flood scenarios.
Step 4.	The analyst imports datasets with flood defence infrastructure
Step 5.	For each area with potential significant flood risk the analyst identifies where an adequate level of protection is in place
Step 6.	For groundwater flooding and coastal floods where an adequate level of protection is in place the analyst decides to prepare flood risk maps for all scenarios or to limit scenarios to low probability or extreme event scenario.
Step 7.	The analyst decides about map contents, the number of maps to be provided for each area with potential significant flood risk and in this context about the most appropriate map scale and the adequate way to provide information carried out by step 3 and 5. In dependence of scale and assessed adverse consequences for the different types of flood and scenarios it is feasible to provide more than one map respectively separate maps for the same area.
Step 8.	Grouping/combining of thematic layers for map/separate maps
Step 9.	Reporting to WISE (Water Information System for Europe)
Data set: Flood Extent	
Description	Flood extent for different types of flood and for each type of flood for different scenarios
Type	input
Data provider	Analyst of competent authority
Geographic scope	Country/State
Thematic scope	Flood extent (usually basing on documented extents of past flood events and flood modelling for different scenarios)
Scale, resolution	1: 2.500 – 1:25.000
Delivery	WFS
Documentation	http://floods.country.xzy
Data set: Population	
Description	Population on municipality level (number of inhabitants in each municipality)
Type	input
Data provider	Statistical office on country/state level
Geographic scope	Country/State

Use Case Description	
Thematic scope	Population per municipality
Scale, resolution	1: 2.500 – 1:25.000
Delivery	EXCEL-Table with number of inhabitants for each municipality
Documentation	http://statistical-office.country.xzy
Data set: Land Use	
Description	Land Use
Type	input
Data provider	Map Agency on country/state level
Geographic scope	Country/State
Thematic scope	Vector data on land use, to be preprocessed for "economic activities" by aggregating/classifying
Scale, resolution	1: 2.000 – 1:25.000
Delivery	Fixed hard disk
Documentation	http://map-agency.country.xzy
Data set: Industrial plants (as an example for "locations of installations")	
Description	plants falling under 2010/70/EC on industrial emissions (formerly 2008/1/EC respectively Directive 96/61/EC Annex I, known as IPPC Directive, concerning integrated pollution prevention and control)
Type	input
Data provider	State Agency
Geographic scope	Country/State
Thematic scope	Vector data
Scale, resolution	1: 2.500 – 1:25.000
Delivery	GIS-file
Documentation	http://state-agency.country.xzy
Data set: Protected Sites - Habitats (as an example for protected areas)	
Description	Protected sites falling under Habitats Directive
Type	input
Data provider	Agency for protection of the Environment
Geographic scope	Country/State
Thematic scope	Vector data
Scale, resolution	1: 5.000 – 1:25.000
Delivery	Online
Documentation	http://agency-environment.country.xzy

Use Case "Reporting – Flood Risk Maps for 2007/60/EC" describes examplary how steps for preparation of flood risk maps could look like in Member States. Therefore this example has no binding character (reporting requirements are layed down in Floods Directive Reporting Sheets and belonging documents like Floods Directive GIS Guidance, which is in progress). The mentioned examples for input data sets

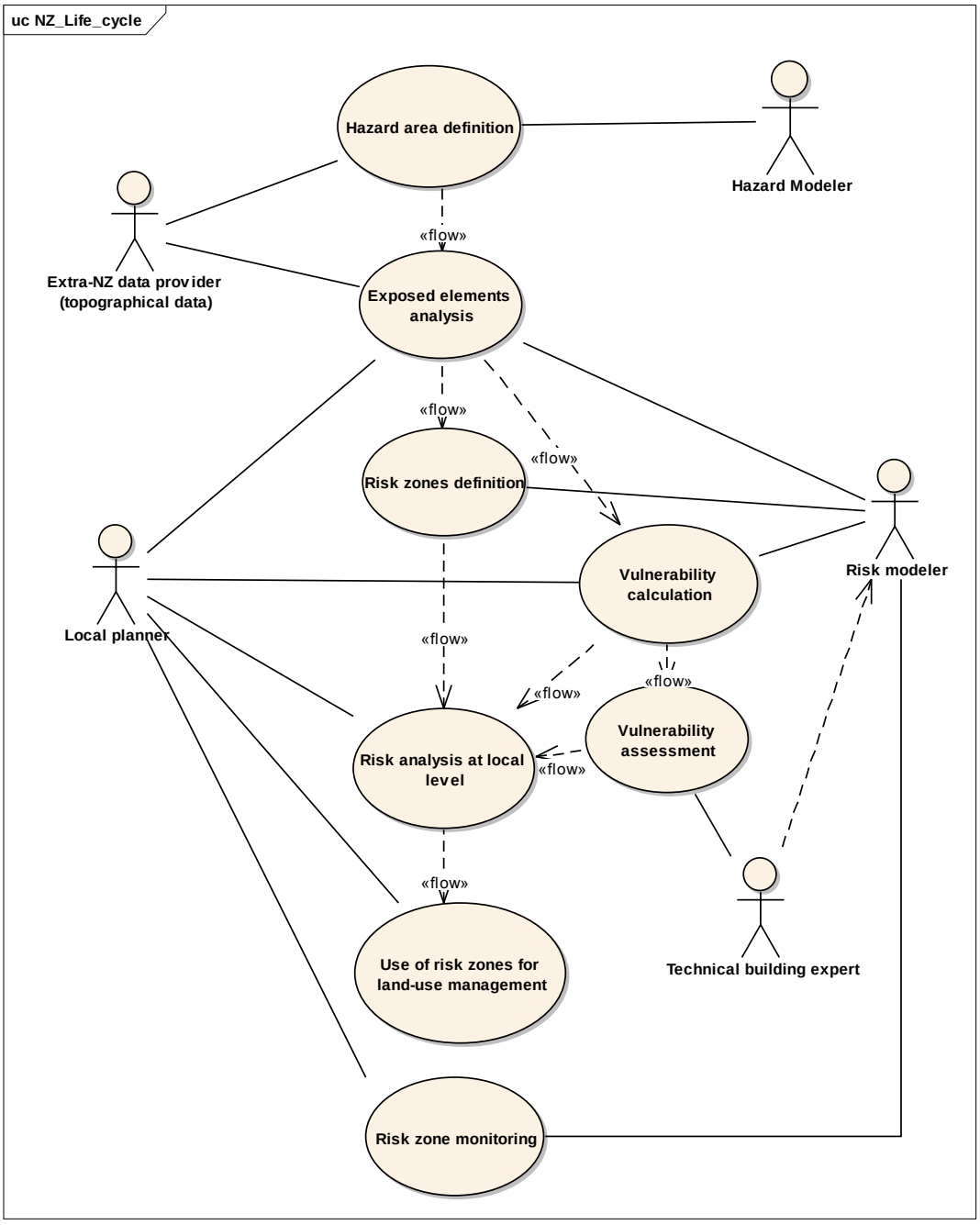
point out existing linkages to other INSPIRE-relevant themes (for example Annex I theme Protected Sites, Annex III theme Production and Industrial Facilities).

Please note that domain specific terms of 2007/60/EC and of Dataspecification NZ are not necessarily identical because TWG NZ has to cover all categories of hazards respectively risks.
To illustrate how the terms/contents that are used in Floods Directive (2007/60/EC) are addressed in Core-Datamodel NZ or related with other INSPIRE themes TWG NZ provides following overview (which will be updated for version 3.0):

FD terminology	NZ terminology	Other Inspire theme(s) / TWG(s)
UoM – Unit of Management Units of management may be individual river basins and/or certain coastal areas, and may be entirely within national borders or may be part of an international unit of management or international river basin district.	-	Area management, Hydrography
Flood Location Location of past significant floods or where potential future significant floods could occur, could be a town or other area that was flooded, or stretches of rivers /coastal areas	HazardArea and/orRiskZone	Hydrography, Administrative Units etc.
SpecificArea locality, river basin, sub-basin and/or coastal area or other areas associated with article 4	-	Hydrography, Administrative Units, Area Management
AreasOfFloodRisk Areas with potential significant flood risk (APSFR), can be indicated as entire or stretches of river/coastal areas, areas, polygons, entire river basins.	HazardArea and/orRiskZone	Hydrography
TypeOfFlood	SpecificRiskOrHazardType	
TypeOfPotentialConsequences	TypeOfExposedElements	Production and Industrial Facilities, Protected Sites, Hydrography, Land Use, Human Health and Safety, Transport Networks, Buildings etc
Recurrence	LikelihoodOfOccurence	
Frequency	LikelihoodOfOccurence	
Fatalities	LevelOfHazard	
Degree_TotalDamageHumanHealth	LevelOfHazard	
Degree_TotalDamageXYZ	LevelOfHazard	

12 Risk Management scenario in France

12.1.1 Actors



12.1.2 Narrative description

In France, the Ministry of Environment is in charge of making the natural risks analysis (including hazard area definition). Usually, a natural risk zone analysis for a certain type of natural hazard over a certain territory is done at most once every 10 years.
The central level defines the methodology as well as the territories for which risk analysis must be made. Then, the risk analysis itself is made in each region, still by the Ministry.
Once the risk analysis is done, the Ministry of Environment makes their official release.

The vulnerability calculation is seldom carried out by the Ministry of Equipment. When it is done, it is done most of the time at a low-scale level. The risk modeler calculates the vulnerability of a territory (a city, or a block) to a specific hazard.
For some very high-risk areas (such as the earthquake risk over the city of Grenoble, or earthquake / volcano risks in the West Indies), the Ministry triggers a high-scale vulnerability assessment of infrastructure and buildings. In this case, the assessment of the vulnerability is done by an expert (with architectural background), after a field investigation.

Once released, risk zones and hazard areas can then be used and analyzed at a local level. Local planners will then use those risk zones to define their policies for risk mitigation and disaster management. Those risk zones have a legal value.

Due to the fact that local planners may have more accurate and / or more up-to-date data (if hazard areas may not change in 10 years -the natural environment and the methodology do not change that often-, the exposed elements, that are a representation of human activities evolve much faster), they overlay the risk zones and hazard areas with topographical databases that might be other than those used by the central level of Ministry of Equipment. Besides, data of lowest level of government are not included in INSPIRE framework.

The local planners eventually calculate the vulnerability of what they consider as exposed elements to the natural hazard that is considered.

Local planners may also link those risks zones into their land-use management plans. They also may plan to set natural hazards monitoring facilities.

12.1.3 Detailed and structured description

Color code for detailed description:

- Hazard modeler
- Topographical data provider
- Risk modeler
- Technical vulnerability expert
- Local planner

Use case description	
Name	Life cycle of natural risk analysis in France
Priority	High
Description	
Pre-condition	
Flow of events – Basic path	Hazard area definition
Step 1	The topographical, environmental and other data providers spread all kind of data
Step 2	The hazard modeler takes a methodology to define hazard areas
Step 3	The hazard modeler discover and get external data, and use them as a source for hazard area definition
Step 4	The hazard modeler applies the methodology, and produces hazard areas
Data source: name	BDTOPO (Elevation model), Meteorological data, Geologic data, soil data, etc.
Delivery	Hazard areas
Flow of events – Basic path	Exposed elements analysis
Step 5	The topographical, environmental and other data providers spread all kind of data
Step 6	The risk modeler takes a methodology to define risk zones
Step 7	The risk modeler gets the produced hazard areas
Step 8	According to the types of hazard areas he is working on, the risk

	modeler selects low-scale environment data or topographical data that he considers as being exposed elements to the hazard area (the methodology previously given details the general types of elements of interest to be analysed)
Data source: name	BDTOPO (buildings, road networks, industrial facilities, census data, forests, monuments...
Delivery	Exposed elements
Flow of events – Alternative path	The risk modeler makes vulnerability calculation
Step 8 -a	The risk modeler takes a methodology to calculate vulnerability
Step 8 – b	The risk modeler calculates the vulnerability for exposed territories.
Step 8 -c	The risk modeler can also ask for a technical expert to make an assessment of vulnerability of buildings, infrastructures, communities, people, etc, to a given hazard.
Step 8 - d	The risk modeler spreads the vulnerability values
Data source: name	Exposed territories, Exposed elements, Hazard areas
Delivery	Vulnerability values
Flow of events – Basic path	Risk zones definition
Step 9	The risk modeler produces the risk zones
Step 10	The risk modeler complete the metadata of risk zones with the name of databases he used as sources (hazard areas, environment low-scale data, topographical data, etc)
Step 11	The risk modeler spreads the risk zones
Delivery	Risk zones
Flow of events – Alternative path	The risk modeler monitors the hazard area
Step 11 –a	The risk modeler monitors the hazard area with environmental monitoring facilities
Flow of events – Basic path	Risk analysis at local level
Step 12	The local land-use planner gets the risk zones
Step 13	The local land-use planner overlays the risk zones with the sources databases quoted in the Metadata
Step 14	The local land-use planner overlays the risk zones with his database of topographical data. These data may be more accurate than the ones used by the risk manager, and are likely to be more up-to-date.
Delivery	Exposed elements
Flow of events – Alternative path	The land-use planner calculates vulnerability at a local level
Step 14 – a	The local land-use planner sharpens the vulnerability of his territory with high-scale topographical data to the hazard area.
Delivery	Vulnerability values
Flow of events – Basic path	Use of risk zones analysis at the local level
Step 15	The local decision-makers use these analyses as input for risk mitigation (consolidation of buildings, construction of embankments, public awareness, reforestation, implementing local development plans, implementing deterrent measures, implementing insurance/reassurance measures).
Step 16	The local decision-makers use these analyses as input for risk disaster management (creation of crisis management plans)
Data source: name	Environmental facilities, Land-Use data, risk zones
Flow of events – Alternative path	The land-use planner monitors the hazard

Step 17	The local land-use planner monitors the hazard area with environmental monitoring facilities

This annex describes the use cases that were used as a basis for the development of this data specification.

B.3 Forest Fires

Introduction

Forest fires are a major concern especially for southern Member States of the EU. As reported by the European Forest Fire Information System (EFFIS) an average of 70 000 fires take place every year burning more than half a million hectares in Europe. Although no clear trend regarding the areas burnt by forest fires could be detected in the last decades, fire events show increased intensity and impacts with a high number of fatalities and large economic losses. To address the increasing risks of forest fires, forest fire management has been improved in an integrated way. Thereby, a particular focus is being placed on forest fire prevention measures.

Specific forest fire policies exist in most EU Member States, but a harmonisation of these policies at the European level has not yet been achieved. At EU level a first regulation on forest fire prevention was issued in 1992. Since there several European initiatives have taken place. The European Commission has developed since 1998 the European Forest Fire Information System (EFFIS) which includes a module for forecasting and assessing the risks of forest fire at European level. The EFFIS[18] established by the Joint Research Centre and the Directorate General for Environment, is the EU focal point for information on forest fires addressing fire prevention, fire fighting and post fire evaluations. The wide range of available data and models covers among others fire danger forecast, fire emission and fire damage assessment, post-fire vegetation recovery.

In the last years the Commission put forest fires higher on the political agenda, focusing not only on fire fighting but also on prevention and adapting forest management to climate change. In these fields, preparatory work on two Council conclusions was carried out, the Commission adopted the Green Paper on forest protection and information and the European Parliament took initiatives in forest fire prevention. Furthermore the Commission supported the setting-up of the EU Forest Fires Tactical Reserve (EUFFTR), which aims at stepping up Member States cooperation to reinforce the overall EU fire-fighting capacity.

Template to describe use cases

This template is from D2.6 Methodology for the Development of Data Specifications. The D2.6 contains the common methodology for the development of data specifications for the INSPIRE Annex spatial data themes. Document D2.6 facilitates the process of creating harmonised data specifications for the INSPIRE themes and it is intended to assist the facilitators, editors and experts who get involved in the development of data specifications for Annex themes.

In D2.6 there are 3 parts to describe a use case:
- Overview and involved actors
- Narrative description (text)
- Detailed and structured description

[18] http://effis.jrc.ec.europa.eu/

Overview and involved actors

There is lack of consensus in the literature on the meaning of the term "forest fire risk". Allgöwer et al. (2003) identified two main approaches to this term. First, the "wildland fire community" has defined fire risk by looking at the chances of having a fire event. For instance, FAO[19] defines forest fire risk as "the probability of fire initiation due to the presence and activity of a causative agent". This approach neglect the outcome (damage potential) of a possible fire event (Allgöwer et al., 2003; Chuvieco et al., 2010). Second, the "structural fire community" has implemented a fire risk approach that is more in line with the approach followed in other natural hazards, where risk is a function of probability of occurrence and consequence. In this document we follow the second approach because of its comprehensiveness and the inclusion of the two main components of forest fire risk: fire danger and vulnerability. Within this approach fire risk is the probability of a fire to happen and its consequences, fire danger considers the potential that a fire ignites and propagates, and vulnerability relates to the potential damages caused by the fire. It is noteworthy that the term exposure is not common in the forest fire literature. Being not exhaustive the table below illustrates the terminology used in the Forest Fires Use Case and compares it with the terminology adopted in Chapter 2.

Figure **2** shows the framework adopted in this document and the interlinks between the factors of forest fire risk.

<table>
<tr><th>Data Specification on Natural Risk Zones</th><th>Forest Fires Use Case</th></tr>
<tr><td>Hazard: A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.</td><td>Forest fire danger can be defined as the probability that a fire with a given intensity ignites and propagates.</td></tr>
<tr><td>Exposure: People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses.</td><td rowspan="2">Forest fire vulnerability is a notion referring to potential fire damage and impact. Hence, within the approach adopted in this Use Case, the vulnerability factor assesses potential damage and impact caused by the fire.</td></tr>
<tr><td>Vulnerability: The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.</td></tr>
<tr><td>Risk: the combination of the consequences of an event (hazard) and the associated likelihood/probability of its occurrence.</td><td>Forest fire risk is a function of probability of occurrence and consequence.</td></tr>
</table>

[19] http://www.fao.org/forestry/firemanagement/13530/en/

In addition to the general conceptual framework, there are several perspectives from which forest fire risk assessments can be addressed. From the time-scale of the factors included in the assessment, fire risk can be classified into long-term and short term (San-Miguel-Ayanz et al., 2003). Long-term indices are based on variables that change relatively little in the short to medium term (e.g. topography, fuel). This type of assessment is useful for supporting management procedures such as long-term sustainable land management, rural planning, fire prevention and preparation of fire fighting strategies. Short term fire risk indices are based on variables that change nearly continuously over time, such as weather conditions. They are usually operationally implemented for early warning and preparedness support.

This use case describes the process for setting up the geographic data relevant for assessing forest fires risk (Figure 3). The modelling aspects behind fire danger, vulnerability or risk are out of the scope of the use cases in this document.

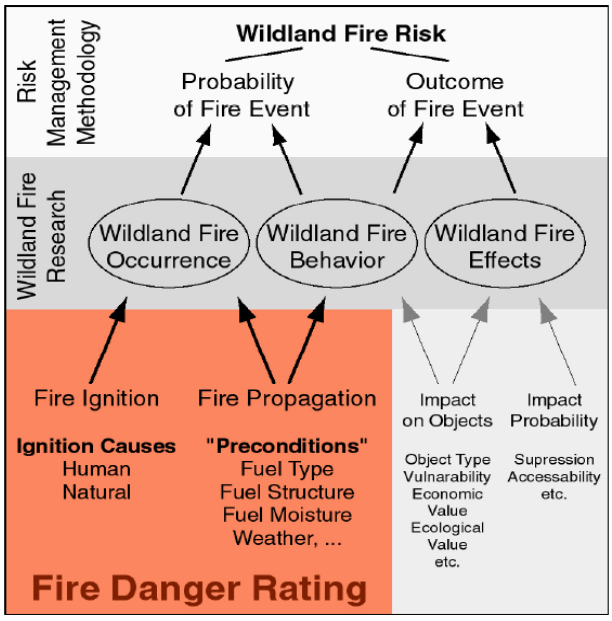


Figure 2: Forest fire risk analysis framework. Source: Allgöwer et al. (2003).

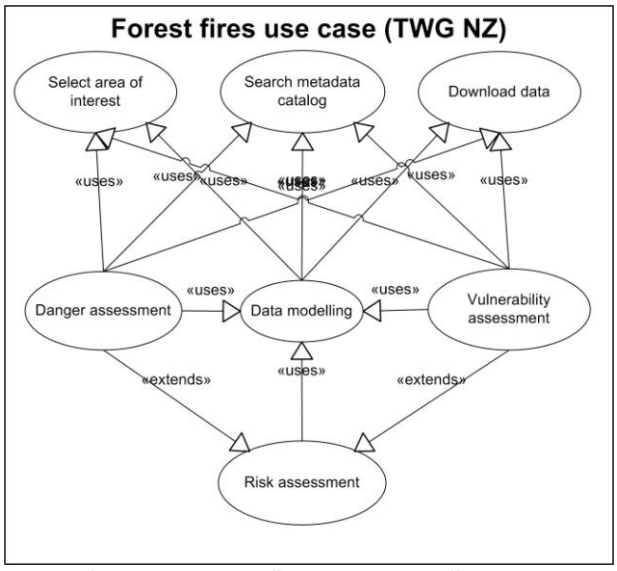


Figure 3: Forest fires use case diagram.

B.3.1 Forest fires danger mapping

Narrative description

Forest fire danger can be defined as the probability that a fire with a given intensity ignites and propagates. Hence fire danger is a function of ignition danger and propagation danger. The two main causes of ignition i.e. human and natural, and the moisture content of plants are considered for assessing ignition danger. Propagation danger is dealt with assessing fire spread potential, which is the result of fuel properties and amount, terrain characteristics and weather conditions, including strong winds that may exacerbate fire propagation.

. The mentioned approach is well addressed for short-term systems. Long-term risk assessments would need to incorporate climatic data for assessing the long-term spatial-temporal setting that facilitates ignition and propagation.

Most short-term fire early warning systems assess fire danger using numerical indices not producing a probability *per se*. An example of this approach is the Fire Weather Index (FWI) system from the Canadian Forest Service[20]. The Canadian FWI consists of six components that account for the effects of fuel moisture and wind on fire behaviour. This is the approach adopted in EFFIS fire danger module. Short term fire danger rating systems are included in
Figure 2 under the "Fire Danger Rating" box. These indices are commonly used by forest services and civil protection services in charge of fire prevention and fighting.

For assessing ignition danger several georreferenced datasets can be used (depending on the model):

- Forest fire occurrence (human and natural) georreferenced time-series
- Fuel moisture content - moisture content of vegetation (live and dead components): usually from remotely sensed imagery
- Infrastructure (transport networks, electric lines, hotels, camp sites, etc)
- Land use/land cover, urban/wildland interface
- Population density and/or other relevant census data
- Lighting occurrence
- Climate or bio-climate datasets
- Terrain (DEM)
- Meteorological datasets (temperature, relative humidity, wind, rain)

For assessing propagation danger several georreferenced datasets can be used (depending on the model):

- Fuel types
- Fuel moisture content (live and dead component)
- Meteorological datasets (temperature, relative humidity, wind, rain)
- Terrain (DEM)
- Forest fire mitigative measures (e.g. fire breaks)

This use case describes the main data needed for preparing forest fire danger maps either for short-term or long-term assessments. Notice that this is a live document resulting from a wide literature review and attempts to be as comprehensive as possible. However it could be the case that some specific approaches or methods are not included here.

Detailed description

Use case description	

[20] http://cwfis.cfs.nrcan.gc.ca/background/summary/fwi

Name	Accessing data to assess forest fire danger
Priority	
Description	The user selects a geographic area and a search for relevant forest fire danger data is conducted
Pre-condition	Relevant forest fire danger data is available for the selected area
Flow of events – Basic path	
Step 1	The user selects the area of interest and searches in a metadata catalogue for relevant data (topography, meteorological, climatic, fuel, vegetation…)
Step 2	The user accesses the requested data and downloads it
Step 3	When needed, downloaded data is processed to obtain derived information (fuel type from vegetation or aspect from DEM, for instance)
Step 4	The user matches original and derived data to produce danger zones
Flow of events – Alternative path	
Post-conditions	
Post-condition	Forest fire danger zones map is achieved
Description	
Data provider	Each Member State
Geographic scope	All EU Member States, with appropriate cross border cooperation where necessary
Thematic scope	Natural Risk Zones (Forest fires)
Scale, resolution	Scale relevant to the application: from local/regional to continental (tbd)
Delivery	
Documentation	

Requirements from the use case

The analysis of the use case indicates that it would be necessary to provide, at least, the following objects and attributes:

Forest fires occurrence (georreferenced time-series) and causes (human and natural)
- Number of fires
- Burnt area

Fuel data
- Fuel moisture content - moisture content of vegetation (live and dead components)
- Fuel types

Topographic data from DEM
- Slope and aspect

Infrastructure and land use/cover
- Transport networks, electric lines, hotels, camp sites, etc
- Land use/land cover, urban/wildland interface
- Population density and census data

Climate and meteorological datasets
- Lighting occurrence
- Climate datasets (temperature, relative humidity, wind, rain) or bio-climate dataset
- Meteorological datasets (temperature, relative humidity, wind, rain)

B.3.2 Forest fire vulnerability mapping

Narrative description

Forest fire vulnerability is a notion referring to potential fire damage and impact. Hence, within the approach adopted in this use case, the vulnerability factor assesses potential damage and impact caused by the fire. For example, negative effects of fire have been classified in Chuvieco et al. (2010) in three main aspects:

- Socio-economic values (properties, wood resources, recreational value, carbon stocks, etc)
- Environmental degradation potential (soil erosion, vegetation conditions/vulnerability), and
- Landscape value (uniqueness, conservation status, legal protection, etc).

This use case describes how these datasets can be accessed so that a vulnerability map could be derived from them.

Detailed description

Use case description	
Name	Accessing data to assess vulnerability to forest fires
Priority	
Description	The user selects a geographic area and a search for relevant vulnerability data is conducted
Pre-condition	Relevant vulnerability data is available for the selected area
Flow of events – Basic path	
Step 1	The user selects the area of interest and searches in a metadata catalogue for relevant data
Step 2	The user accesses the requested data and downloads it
Step 3	When needed, downloaded data is reclassified to obtain derived information
Step 4	The user matches original and derived data to produce a vulnerability zones map
Post-conditions	
Post-condition	Forest fires vulnerability map is achieved
Description	
Data provider	Each Member State
Geographic scope	All EU Member States, with appropriate cross border cooperation where necessary
Thematic scope	Natural Risk Zones (forest fires)
Scale, resolution	Scale relevant to the application: from local/regional to continental (tbd)
Delivery	
Documentation	

Requirements from the use case

The analysis of this use case shows that many datasets used for vulnerability mapping are the result of external models to the forest fire risk assessment. For instance, soil erosion potential is usually implemented using the Universal Soil Loss Equation (ULSE) approach. Tangible resources are usually evaluated using direct methods such as market price (e.g. wood resources). And intangible resources (recreational value) are usually evaluated using indirect methods such as travel-cost methods or contingency value methods. Therefore, considering the large number of methods and models usually involved in the implementation of forest fire vulnerability maps, in this section we provide a non-

comprehensive general overview of the main datasets used in some operational systems (e.g. Chuvieco et al., 2010):

Economic values
- Properties (value of properties)
- Infrastructures and its value (buildings, housing, transport networks, distribution networks, utilities, land use, other infrastructures)
- Wood resources (market value per ha)
- Recreational value of forested areas (economic value per ha/year)
- Carbon stocks (market value)
- Etc

Environmental degradation potential (index)
- Soil erosion (e.g. ULSE approach)
- Vegetation conditions/vulnerability
- Etc

Landscape value (economic value e.g. Euro/ha/year from indirect valuation methods)
- Uniqueness
- Conservation status
- Legal protection
- Etc

B.3.3 Forest fire risk mapping

Narrative description

Forest fire risk is a function of probability of occurrence and consequence. Hence fire risk is the outcome of the assessment as shown in
Figure 2. The integration of the fire danger factor (ignition and propagation potential) and the vulnerability factor (potential damage) may follow different approaches/methods and thus the resulting risk map can be represented using different configurations. The ideal model would follow a probabilistic approach in which for each place the probability of occurrence and severity of the fire is related with the potential consequence of fire. However, the large amount of data and techniques needed for implementing a probabilistic approach limits their operational implementation. Therefore often forest fire risk is represented in a qualitative scale from low or very low to high or very high fire risk.

The implementation of this use case follows the results of the previous use cases on fire danger and vulnerability. Hence we show briefly how fire danger and vulnerability data is accessed for implementing forest fires risk.

Detailed description

Use case description	
Name	Accessing data to assess forest fires risk
Priority	
Description	The user selects a geographic area and searches for fire danger and fire vulnerability maps, then integrates the maps in an forest fire risk map
Pre-condition	Danger and vulnerability maps are available for the selected area
Flow of events – Basic path	
Step 1	The user selects the area of interest and searches in a metadata catalogue fire danger and fire vulnerability maps
Step 2	The user defines methods for integrating danger and vulnerability maps into a forest fire risk map
Step 3	The user produces a forest fires risk map (short or long-term)
Post-conditions	
Post-condition	A forest fires risk map is produced
Description	
Data provider	Each Member State
Geographic scope	All EU Member States, with appropriate cross border cooperation where necessary
Thematic scope	Natural Risk Zones (forest fires)
Scale, resolution	Scale relevant to the application: from local/regional to continental (tbd)
Delivery	
Documentation	

Requirements from the use case

The analysis of the use case shows that there is a need to provide the following objects and attributes for forest fire risk assessment:

- Forest fire danger
- Forest fires vulnerability

References

Allgöwer, B., Carlson, J.D. and van Wagtendonk, J.W., 2003. Introduction to Fire Danger Rating and Remote Sensing — Will Remote Sensing Enhance Wildland Fire Danger Rating? In: E. Chuvieco (Editor), Wildland fire danger estimation and mapping - The Role of Remote Sensing Data. Series in Remote Sensing. World Scientific Publishing, Singapore, pp. 1-19.

Chuvieco, E. et al., 2010. Development of a framework for fire risk assessment using remote sensing and geographic information system technologies. Ecological Modelling, 221(1): 46-58.

FAO, 1986. Wildland Fire Management Terminology. FAO Forestry Paper n. 70, p. 257.

San-Miguel-Ayanz, J. et al., 2003. Current methods to assess fire danger potential. In: E. Chuvieco (Editor), Wildland fire danger estimation and mapping - The Role of Remote Sensing Data. Series in Remote Sensing. World Scientific Publishing, Singapore, pp. 22-61.

B.4 Landslides

Currently a number of different landslide inventories exist in various databases and each uniquely addresses a specific purpose (for example we refer here to CSIRO *https://www.seegrid.csiro.au/twiki/bin/view/Geohazards/LandSlides*, or *http://www.landslides.usgs.gov* among others). These databases range in scale and detail, and although some similarities and a number of common themes are apparent between databases, the method in which information is organised and described varies considerably. This means information cannot readily be compared or aggregated with other sources. Furthermore, these inventories are generally only accessible to a small number of individuals and subsequently, it is possible there is significant duplication of effort among landslide researchers independently attempting to fill information gaps. Landslide inventories are fundamental for developing rigorous hazard and risk assessments.

[This is only an example of use case description, to show what it is, the link with examples of use, and what the impact is on the data model]

B.4.1 Landslide hazard mapping

Overview and involved actors

The hazard is often defined as the probability of occurrence of a potentially damaging phenomenon of a given intensity within a given area and a given period of time. To define this probability the geologist or engineer has to access datasets of climate, lithology, earthquake activity, and topography, physical, chemical, mechanical properties of rocks or soils, hydrological, hydrogeological data etc.

The objective is to develop a practical method for site prediction and movement assessment of rapid and long run-out landslides. Among various landslide types, the rapid, and long run-out landslides, especially those that occur in urbanizing areas often cause catastrophic damage to the community.

The goal of this use case is to deliver historical and possible occurrence of a landslide in a given area for the creation of appropriate landslide risk preparedness plans. Benefits of adopting an interoperable approach for landslide inventories Interoperability will enable landslide information to be accessed in real time by all levels of government, geotechnical professionals, emergency managers, land use planners, academics and the general public regardless of where it is hosted. It provides direct access to spatial-enabled data and allows users to simultaneously search and query the most up-to-date information available in geographically distributed databases through a single website. The search results can be displayed as reports, graphs, maps, statistics or tables, and data can be queried against background datasets, such as topography, geology and geomorphology.

Actors:

- Geological surveys to provide geological information (Geological Surveys represent the Member States)
- Engineers responsible for establishing risk maps using the geological information in combination with other data.
- Authorities for managing appropriate llandslide risk preparedness plans.

- geotechnical professionals,
- emergency managers,
- land use planners,
- academics and
- the general public

Narrative description

Landslides are various types of gravitational mass movements of the Earth's surface that pose the Earth-system risk. A classification of landslides according to material type and type of movement is schematically shown in Fig. 1.

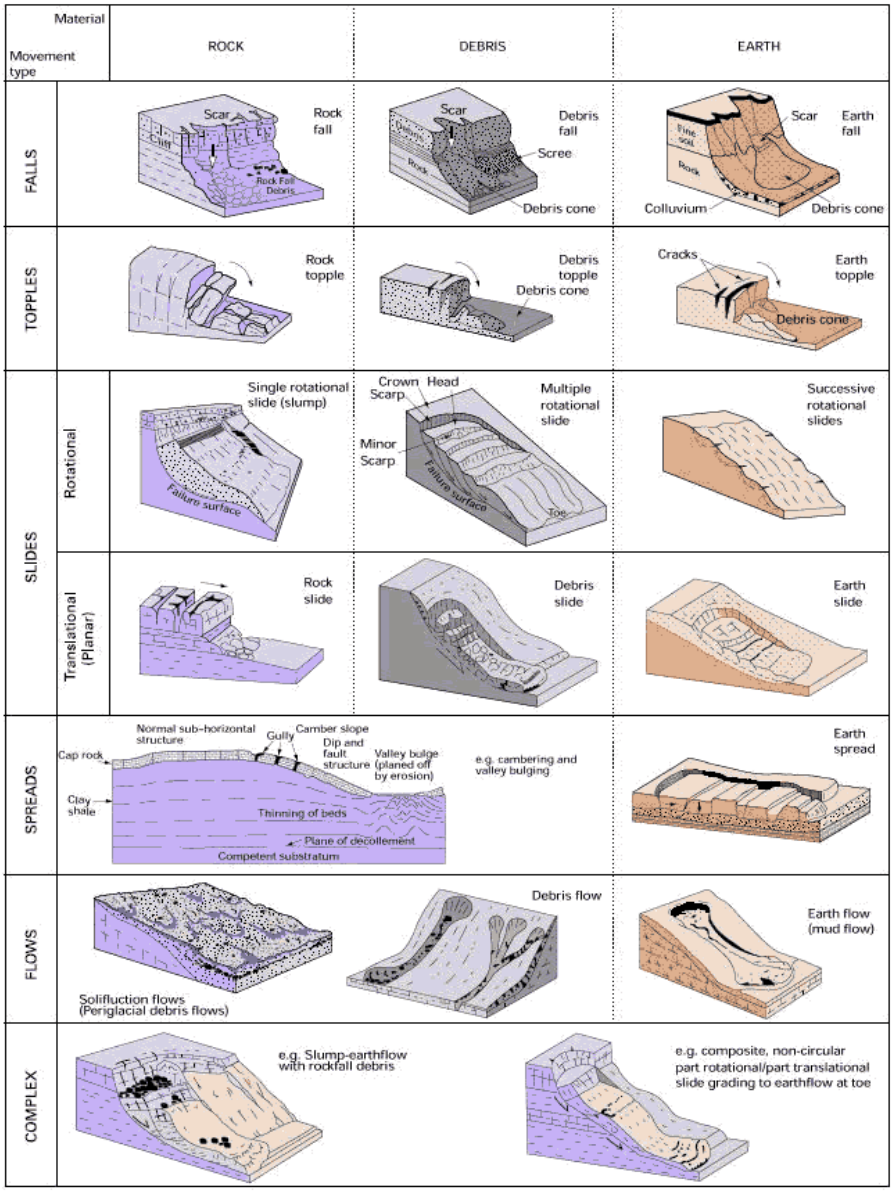


Figure 2 Classification of type of landslip (modified after Varnes, 1978 and DoE., 1990).

Falls mass detached from steep slope/cliff along surface with little or no shear displacement, descends mostly through the air by free fall, bouncing or rolling.
Topples forward rotation about a pivot point.
Rotational slides sliding outwards and downwards on one or more concave-upward failure surfaces.
Translational (planar) slides sliding on a planar failure surface running more-or less parallel to the slope.
Spreads fracturing and lateral extension of coherent rock or soil materials due to liquefaction or plastic flow of subjacent material.
Flows slow to rapid mass movements in saturated materials which advance by viscous flow, usually following initial sliding movement. Some flows may be bounded by basal and marginal shear surfaces but the dominan movement of the displaced mass is by flowage.
Complex slides slides involving two or more of the main movement types in combination.

''Landslides'' are a complex-disaster phenomenon triggered by earthquakes, heavy rainfall (typhoons, hurricanes), sustained rainfall, volcanic eruptions and heavy snowmelt, unregulated anthropogenic development, mining, tunnelling and others (Fig. 2a). Landslides cause many deaths and injuries and great economic loss to society by destroying buildings, roads, life lines and other infrastructures; they also pose irrecoverable damage to our cultural and natural heritage. Large and small landslides occur almost every year in nearly all regions of the world. Large-scale coastal or marine landslides are known to cause tsunami waves that kill many people; an example was the 1792 UNZEN-

Mayuyama landslide, which caused a devastating tsunami that resulted in 16,000 fatalities from the landslides and the tsunami in Japan. Also large-scale landslides on volcanoes can dislocate the mountain tops and trigger volcanic eruptions; such was the case for the 1980 eruption of Mount St. Helens in the USA and presumably for Mt.Bandai in Japan. Landslides also may occur without earthquakes, heavy rains, volcanic eruptions, or human activities due to progress of natural weathering; therefore, they occur almost everywhere in the world. Landslides most commonly impact residents living on and around slopes.

Landslides are a natural phenomenon which can only be effectively studied in an integrated, multidisciplinary fashion, including contribution from different natural and engineering sciences (earth and water sciences), and different social sciences. This is also the case because landslides are strongly related to cultural heritage and the environment (Fig. 2b). Landslides should be jointly managed by cooperation of different ministries and departments of government including some representing education, science and technology, construction and transportation, agriculture, forestry, and the environment, culture and vulnerable groups (the poor, aged, handicapped, or children). As landslides are highly localized phenomena it is crucial to seek the contribution of local governments or autonomous communities (Fig. 2c).

The disasters caused by landslides are of very complex nature wherever they occur around the world. Research on landslides should be integrated into a new multi-disciplinary science field of landslide study. Landslide risk preparedness is to be managed by multi-ministries

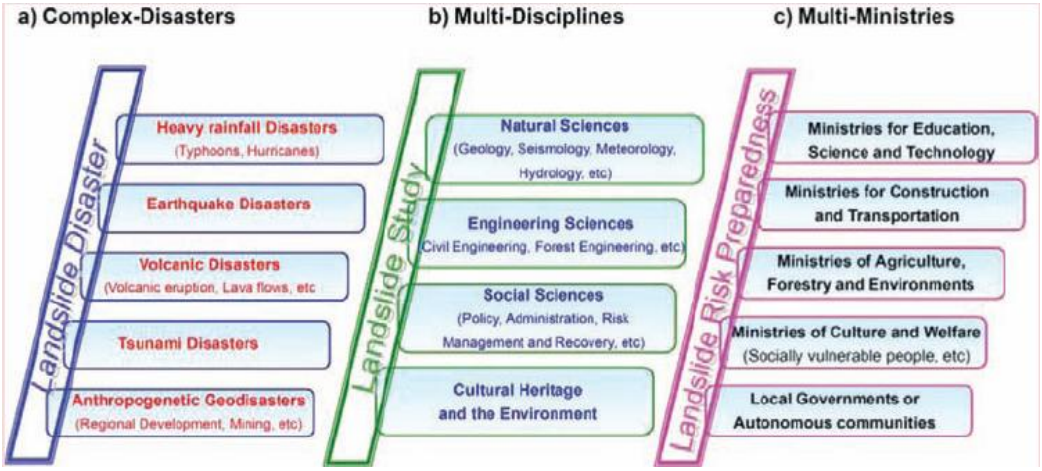


Fig. 2 Characteristics of landslide disasters

Water has a major role in triggering of landslides. Fig. 3 shows the relative contribution of various landslides triggering events factor in Italy. Heavy rainfall is the main trigger for mudflows, the deadliest and most destructive of all landslides.

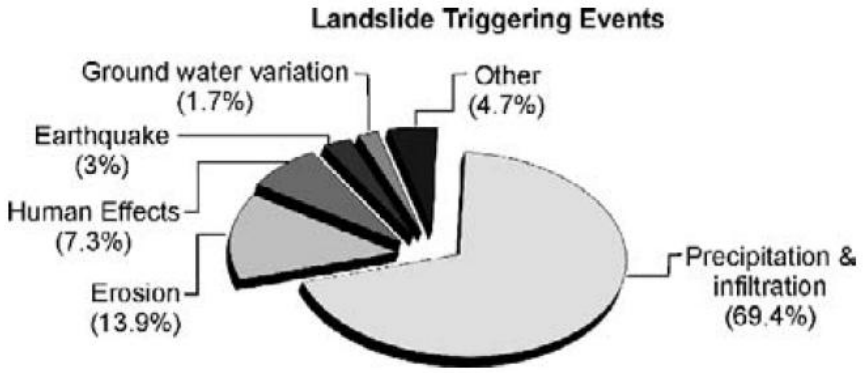


Fig. 3 Landslide triggers in Italy (CNR-GNDCI AVI Database of areas affected by landslides and floods in Italy)

The socio-economic impact of landslides is underestimated because landslides are usually not separated from other natural hazard triggers, such as extreme precipitation, earthquakes or floods. This underestimation contributes to reducing the awareness and concern of both authorities and general public about landslide risk.

Landslide inventories are fundamental for developing rigorous hazard and risk assessments. However, an agreed, systematic way of developing these inventories is presently not available neither is there an example of 'best practise' that could be used as a guideline in EU.

Detailed description

Use case description	
Name	Landslides
Priority	High
Description	The user selects the relevant geographic area and searches for historical landslide data (time, type, magnitude, and activity), geomorphological, geological, geotechnical, monitoring data etc as well as existing hazard analysis data for future landslide occurrences.
Pre-condition	Landslide data are available in line with INSPIRE specifications. A specific vocabulary related to the user requirements is available with a "mapping" between all relevant landslide description terms and user's terms.
Flow of events – Basic path	
Step 1	The user selects the area of interest and searches in a metadata catalogue for past landslide maps as well as hazard maps and other relevant information (i.e. geomorphological, geological-geotechnical & monitoring data, nearby activities that may trigger landslides such as mining or large excavations etc).
Step 2	The user displays the landslides historical and future hazard maps and accesses detailed information.
Step 3	The user may use his/her own models to create new hazard maps based on accessed information as above and compare model results with possible already available hazard maps.

Post-conditions	
Post-condition	The user has a set of data and predictions related to the landslide occurrence potential of the selected area.
Description	Landslide historical data from national sources.
Data provider	Each Member State
Geographic scope	All EU Member States, with appropriate cross border cooperation where necessary
Thematic scope	Natural Risk Zones (Landslides)
Scale, resolution	Scale relevant to the application (tbd)
Delivery	INSPIRE Landslide GML Application schema
Documentation	INSPIRE Landslide Data Specification

Requirements from the use case

Analyzing the use case, there is a need to provide the following **objects** and **attributes**:

Geological units with:

- their related polygons
- lithology

Geological faults with:
- their surfaces in 3D space
- type of fault: normal, thrust, shear
- attribute: active or non-active

Borehole data with:
- geologic unit thickness and depth
- water level
- any other properties (physical and chemical) measured

Geotechnical data with:
- physical, chemical and engineering data related to the geological units (from measurements: porosity, grain size, permeability, compressibility etc)

Monitoring data:
- Type of monitoring instrumentation
- Location of sampling measurements
- Type and record of measurements

`Landslide past record:`
- Activity State
- Last Recorded Occurrence Time
- Recurrences
- Representative Location
- Shape
- Total Volume
- Typical Movement Type

`Landslide Event:`
- Volume
- Causative Factor
- Movement Type
- Triggering Factor

`Damage Assessment Report:`
- Reported Cost

- Affected Entity Type
- Number Affected
- Report Date
- Damage Type
- Severity Code

This use case has some relationships with the following INSPIRE data themes:

B.4.2 *Landslide vulnerability assessment*

Narrative description

The aim is the vulnerability assessment, considering human life, land resources, structures, infrastructure, and cultural heritage. Vulnerability is a key parameter in risk estimation. Vulnerability to natural hazards from the social science perspective has been defined by several authors. Blaikie et al. (1994), for instance, provided the following definition: "… the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist and recover from the impacts of natural or man-made hazards". The main focus in this perspective is society. For this reason, such vulnerability is termed social vulnerability (e.g. Rashed and Weeks, 2003; Glade, 2003) or societal vulnerability (e.g. Lee and Jones, 2004) in the natural hazards literature. The ISSMGE Glossary of Risk Assessment Terms defines vulnerability as "The degree of loss to a given element or set of elements within the area affected by a hazard…" (*http://www.engmath.dal.ca/tc32/*). This approach to vulnerability estimation, in which vulnerability is expressed on a scale of 0 (no loss) to 1 (total loss), is referred to as "technical" or "physical", as it addresses the effects of the interaction of a damaging agent and the physical environment. An important distinction between the social and technical perspectives on vulnerability is that physical vulnerability is scenario-specific, while social vulnerability is not (Fell, 1994). Phoon (2004) provided a detailed discussion of the perspectives on vulnerability analysis.

Use case description	
Name	Landslides
Priority	High
Description	The user selects the relevant geographic area and searches for historical landslide data, terrain, geological, geotechnical and monitoring data as well as hazard and risk analysis data for future landslide occurrences.
Pre-condition	Landslide data are available in line with INSPIRE specifications. A specific vocabulary related to the user requirements is available with a "mapping" between all relevant landslide description terms and user's terms.
Flow of events – Basic path	
Step 1	The user selects the area of interest and searches in a metadata catalogue for past landslide maps as well as hazard maps and other relevant information (i.e. geomorphological, geological-geotechnical & monitoring data, nearby activities that may trigger landslides such as mining or large excavations etc). Also, the user searches in a metadata catalogue for elements at risk such as population, buildings and infrastructures
Step 2	The user displays the landslides historical and future hazard maps and accesses detailed information.
Step 3	The user may use his/her own models to create hazard and risk maps based on accessed information as above and compares model results with possible available hazard or risk maps.
Post-conditions	
Post-condition	The user has a set of data and predictions related to the landslide occurrence potential of the selected area.
Description	Landslide historical data from national sources.
Data provider	Each Member State

Geographic scope	All EU Member States, with appropriate cross border cooperation where necessary
Thematic scope	Natural Risk Zones (Landslides)
Scale, resolution	Scale relevant to the application (tbd)
Delivery	INSPIRE Landslide GML Application schema
Documentation	INSPIRE Landslide Data Specification

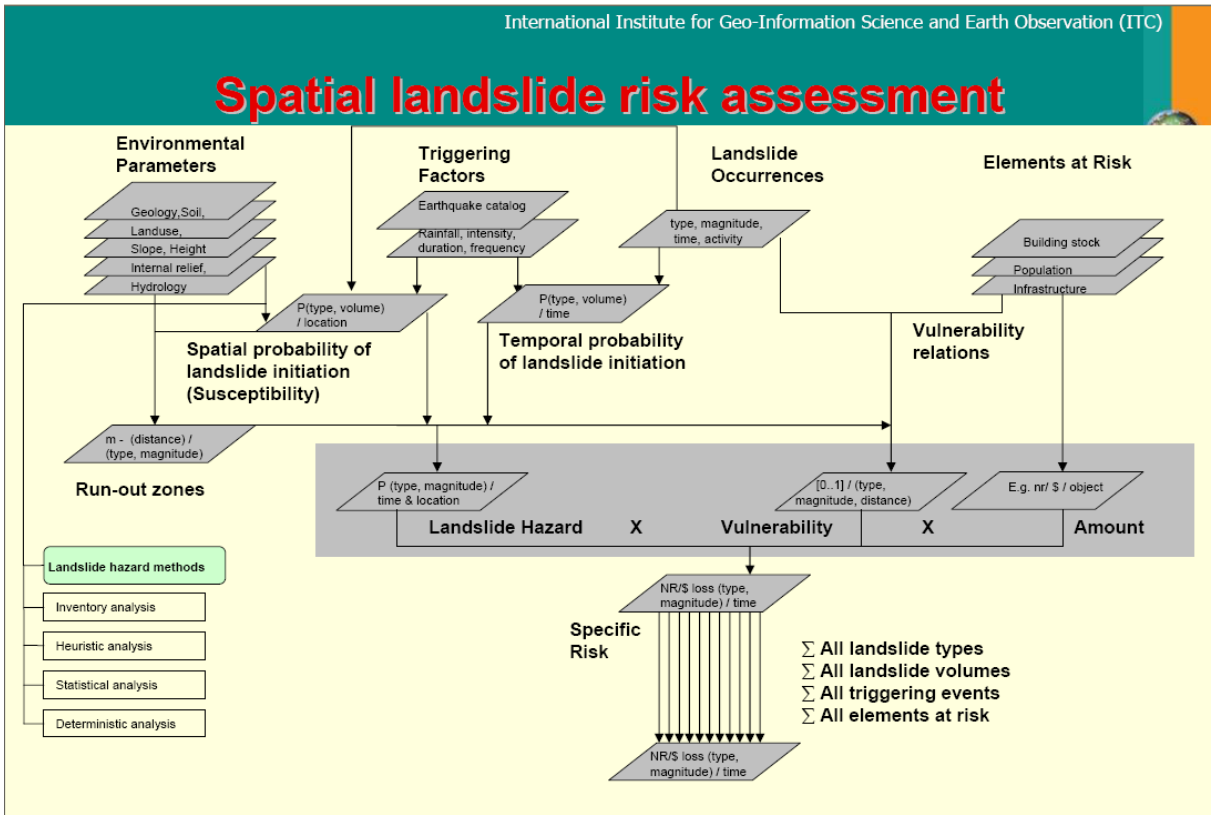
B.4.3 *Landslide Risk assessment*

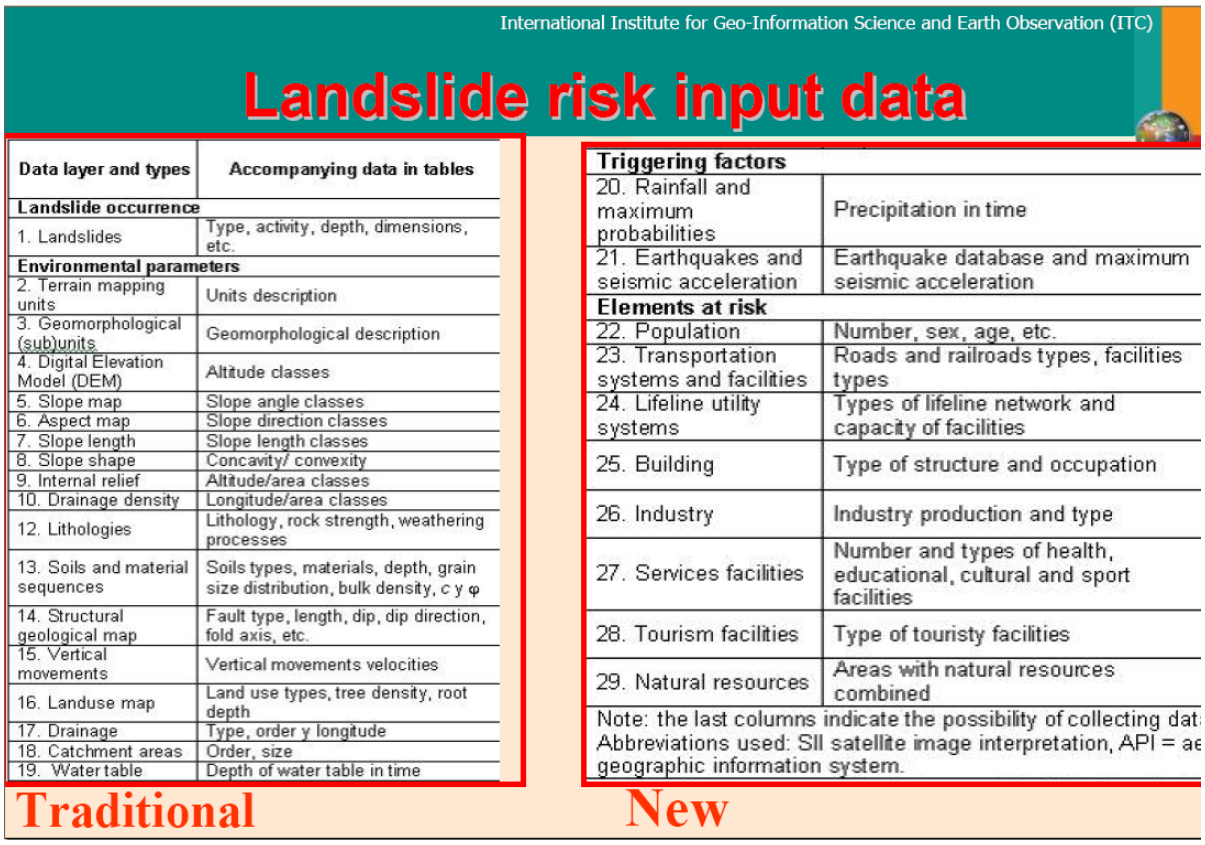
Narrative description

Risk is the measure of the probability and severity of an adverse event to life, health, property or the environment. Quantitatively, risk is the probability of an adverse event times the consequences if the event occurs, where the consequences are obtained from the elements at risk and their vulnerability. Mitigation of risk can be done by reducing the frequency (probability) of the adverse event or by reducing the vulnerability and/or exposure of the elements at risk, or even reducing both hazard and consequence.

As a consequence of climate change and increase in exposure in many parts of the world, the risk associated with landslides is growing. In areas with high demographic density, protection works often cannot be built because of economic or environmental constraints, and is it not always possible to evacuate people because of societal reasons. **One needs to forecast the occurrence of landslide and the hazard and risk associated with them.** Climate change, increased susceptibility of surface soil to instability, anthropogenic activities, growing urbanization, uncontrolled land-use and increased vulnerability of population and infrastructure as a result, contribute to the growing landslide risk. According to the **European Union Strategy for Soil Protection (COM232/2006)**, landslides are one of the main eight threats to European soils. Also, as a consequence of climatic changes and potential global warming, an increase of landslide activity is expected in the future, due to increased rainfalls, changes of hydrological cycles, more extreme weather, concentrated rain within shorter periods of time, meteorological events followed by sea storms causing coastal erosion and melting of snow and of frozen soils in the Alpine regions. The growing hazard and risk, the need to protect people and property, the expected climate change and the reality for society to live with hazard and risk and the need to manage risk to set the agenda for the profession to assessing and mitigating landslide risk.

Risk assessment and communicating risk should be performed in an easily understood manner.





Data layer and types	Accompanying data in tables
Landslide occurrence	
1. Landslides	Type, activity, depth, dimensions, etc.
Environmental parameters	
2. Terrain mapping units	Units description
3. Geomorphological (sub)units	Geomorphological description
4. Digital Elevation Model (DEM)	Altitude classes
5. Slope map	Slope angle classes
6. Aspect map	Slope direction classes
7. Slope length	Slope length classes
8. Slope shape	Concavity/ convexity
9. Internal relief	Altitude/area classes
10. Drainage density	Longitude/area classes
12. Lithologies	Lithology, rock strength, weathering processes
13. Soils and material sequences	Soils types, materials, depth, grain size distribution, bulk density, c y φ
14. Structural geological map	Fault type, length, dip, dip direction, fold axis, etc.
15. Vertical movements	Vertical movements velocities
16. Landuse map	Land use types, tree density, root depth
17. Drainage	Type, order y longitude
18. Catchment areas	Order, size
19. Water table	Depth of water table in time

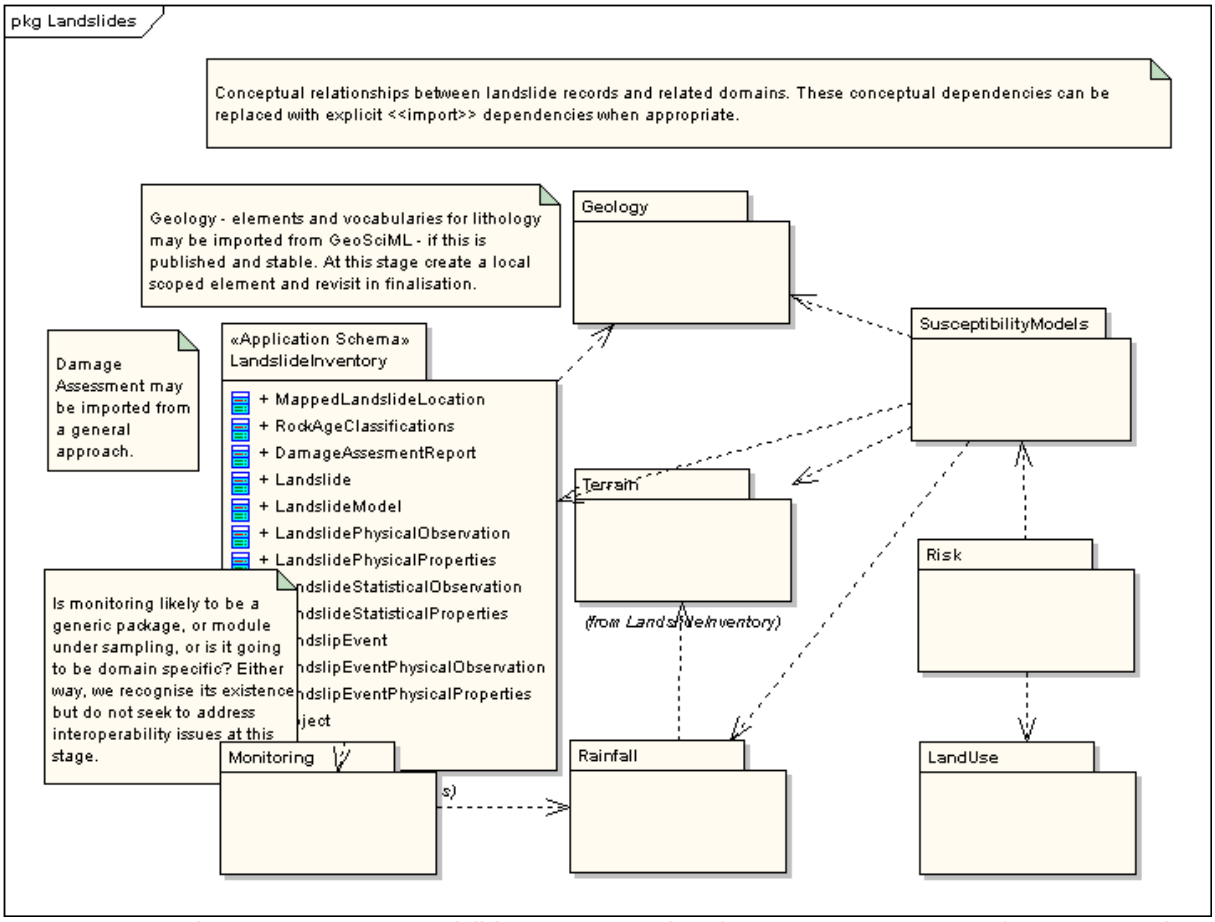
Triggering factors	
20. Rainfall and maximum probabilities	Precipitation in time
21. Earthquakes and seismic acceleration	Earthquake database and maximum seismic acceleration
Elements at risk	
22. Population	Number, sex, age, etc.
23. Transportation systems and facilities	Roads and railroads types, facilities types
24. Lifeline utility systems	Types of lifeline network and capacity of facilities
25. Building	Type of structure and occupation
26. Industry	Industry production and type
27. Services facilities	Number and types of health, educational, cultural and sport facilities
28. Tourism facilities	Type of touristy facilities
29. Natural resources	Areas with natural resources combined
Note: the last columns indicate the possibility of collecting dat	
Abbreviations used: SII satellite image interpretation, API = ae	
geographic information system.	

Detailed description

Use case description	
Name	Landslides
Priority	High
Description	The user selects the relevant geographic area and searches for hazard and vulnerability data for future landslide occurrences.
Pre-condition	Hazard and vulnerability data are available in line with INSPIRE specifications. A specific vocabulary related to the user requirements is available with a “mapping” between all relevant landslide description terms and user’s terms.
Flow of events – Basic path	
Step 1	The user selects the area of interest and searches in a metadata catalogue for hazard maps and vulnerability data.
Step 2	The user accesses detailed information.
Step 3	The user may use his/her own models to create risk maps based on accessed information as above and compares model results with possible available risk maps.
Post-conditions	
Post-condition	The user has a set of data and predictions related to the landslide risk map of the selected area.
Description	Landslide historical data from national sources.
Data provider	Each Member State
Geographic scope	All EU Member States, with appropriate cross border cooperation where necessary
Thematic scope	Natural Risk Zones (Landslides)
Scale, resolution	Scale relevant to the application (tbd)

Delivery	INSPIRE Landslide GML Application schema
Documentation	INSPIRE Landslide Data Specification

APPENDIX



UML Diagram: Landslides related to other themes. https://www.seegrid.csiro.au/twiki/bin/view/Geohazards/LandSlides

References

http://www.ukgeohazards.info/pages/eng_geol/landslide_geohazard/eng_geol_landslides_classification.htm
http://geology.com/usgs/landslides/
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Phoon, K.-K., 2004. Risk and vulnerability for geohazards — vulnerability in relation to risk management of natural hazards. ICG Report 2004-2-3, Oslo.

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B.5 Earthquake insurance

Narrative description

The building Code of European countries prepared a special earthquake Hazard map for the purpose of seismically resilient civil engineering and construction. An extensive study could be found in http://eurocodes.jrc.ec.europa.eu/doc/EUR23563EN.pdf:
"A review of the seismic hazard zone in national building codes in the context of Eurocode 8"

In this map, places with the key parameter- awaited maximal level of earthquake– peak ground acceleration in a given interval - is projected as an area of equal seismic hazard. The territory (of Bulgaria) is presented as set of multi-polygons, where each multi-polygon corresponds to some specific interval of peak ground acceleration/ awaited level of seismic reaction.

The Insurance implementation of this earthquake risk map is based on the following:

- The reality is that a substantial number of existing dwellings (in some areas – more than 50%) are "pre code", i.e. are not resistant to potential maximal local seismic impact
- Less than 20% of dwellings comply with the latest building code i.e. is constructed to be resistant to maximal awaited seismic phenomena for their territory.

The general insurance practice uses different tariffs for insurance premium calculation depending on the location of the insured building/property in the different zones of the earthquake hazard map from the building Code. The more strong seismic motion is awaited – higher insurance premium is calculated. In addition, other key parameters, related to seismic resilience, such as Building material and Building height are also considered.

There is an unofficial exception for new buildings of less than 20 years (the new building code) for which the smallest seismic level tariff is applied indifferently of their location

Detailed description

Use case description	
Name	Accessing data to assess potential earthquake damage
Priority	Medium
Description	The user selects a geographic area and search for relevant data on earthquake hazard. After that the user searches for relevant construction related data on buildings, Installations or any assets to be insured
Pre-condition	Relevant earthquake hazard data is available for the selected area, et least in the volume available from (doc 1)
Flow of events - Basic path	
Step 1	The user selects the area of interest and searches in a metadata catalogues for the relevant data (Hazard , assets specific parameters)
Step 2	The user accesses the relevant data and downloads the necessary portion on the target object of interest
Step 3	The user calculates the risk coefficient and determines the risk premium for the requested risk cover
Description	
Data provider	Each member State
Geographic scope	All EU Member States
Thematic scope	
Scale, resolution	Scale relevant to the application, requiring at least any village position in the earthquake hazard map
Delivery	
Documentation	

Requirements from the use case

Analysing the use case, there is a need to provide the following objects and attributes

Earthquake hazard map
- Hazard repeating period (50, 475, 1000 years)
- awaited peak ground acceleration
- Information on earth faults if any (for utility infrastructure, transport infrastructure)

Buildings, Production and industrial facilities
- Type of construction (material)
- Year of construction (applied anti-seismic Code)
- height of construction

Utility infrastructure
- type of infrastructure (e.g. pipeline, underground cable etc)
-Type of construction (material)
- Year of construction (applied anti-seismic Code)
- height of construction

Annex C

(informative)

Inspire Natural Risk Zones and the Floods Directive

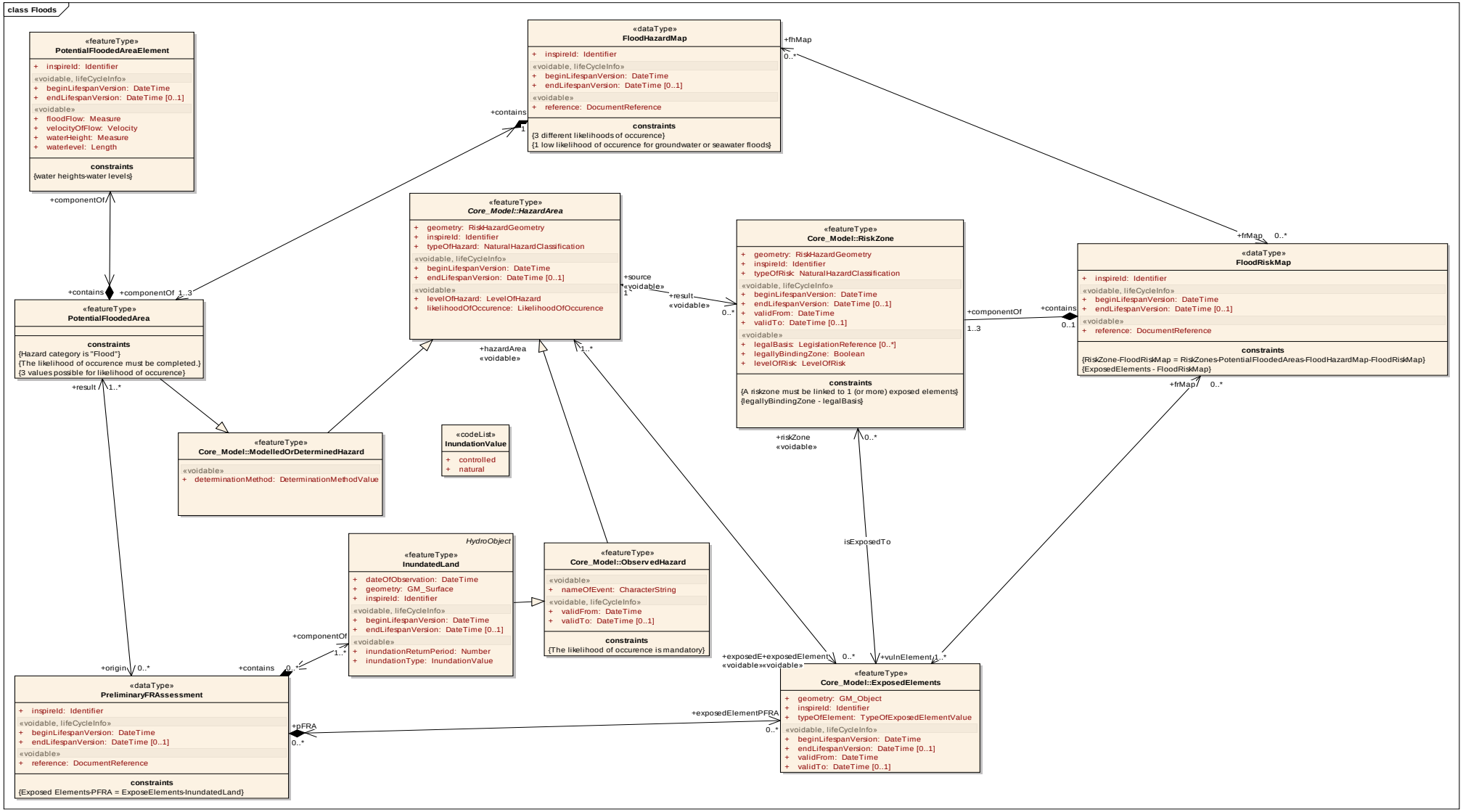
Include additional information (e.g. use cases, examples) that helps the reader understand the data specification here.

Add/delete further annexes as required.

Explanation:
The model for Floods (“Floods Model”) is an example to illustrate how the Core Model could be extended for a specific Hazard Category – in this case “Flood” - by a Dataprovider.
Some constraints reflect requirements which are mentioned in Reporting Sheets of Floods Directive (2007/60/EC). Please note that these respectively this model are no primature fixation in terms of Floods Directive (FD) reporting but TWG NZ took care to integrate contents respectively requirements of Floods Directive and also candidate types from Annex I theme Hydrography as far as possible.
TWG NZ also tried to consider different steps of implementing FD. For first step (lower left corner in model: “PreliminaryFRAssessment”) TWG NZ assumes that Preliminary Flood Risk Assessment could be carried out for areas for which it is known that they are prone to inundations (as featureType “Inundated land” and InundationValue were set by TWG HY). Due to this “PreliminaryFRAssessment” as dataType contains featureType “InundatedLand” or the other way round “InundatedLand” could be one component of “PreliminaryFRAssessment”. TWG NZ assumes further that the knowlegde about inundation prone areas is derived from (documented) observation of flood events (“ObservedHazard”) happened in the recently past (in FD terminology = “past flood events”). An observed hazard that is worth to be documented with an extent is commonly named (e.g. fictionally “flood of Paris 1998”) but not necessarily (“nameOfEvent” therefore is voidable). To reflect FD-requirements TWG NZ put the constraint “The likelihood of occurrence is mandatory” (in terms of FD this is addressed by “Recurrence” respectivley “Frequency” in other context terms like “return period” or “probability” are used).
Another featureType for “PreliminaryFRAssessment” is “PotentialFloodedArea” as the general result of calculation (“ModelledOrDeterminedHazard”, the information which of both method was used should be provided by indicating DeterminationMethodValue). In this example TWG NZ also considered FD-requirements (“PotentialFloodedArea” in FD are named “Areas with potential significant flood risk”) by setting the constraints “The likelihood of occurrence must be completed” and “3 values possible for likelihood of occurrence” to refer to the requested scenarios mentioned in FD Reporting Sheet “Flood Hazard and Risk Maps”. The link to featureType “ExposedElements” is explained in last paragraph of the explanation.
The specific flood extents for each scenario are considered as featureType “PotentialFloodedAreaElement” which requests (voidable) informations about FloodFlow (e. g. measured in m^3/s), velocityOfFlow (e.g. m/s), waterHeigth (e.g. in cm) and waterLevel (e.g. in cm). The constraint “water heights-water levels”refers to the request of FD to provide water height or water level).
Second step in terms of FD-implementation is the preparation of Flood Hazard Maps and Flood Risk Maps. Input in each case are the specific flood extents for each scenario (featureType “PotentialFloodedAreaElement” as component of “PotentialFloodedArea”) while Flood Hazard Maps are the basis for Flood Risk Maps. Therefore in the model there is a direct link between “PotentialFloodedArea” and “FloodHazardMap” and a direct link between “FloodHazardMap” and “FloodRiskMap” but no direct link between “PotentialFloodedArea” and “FloodRiskMap”. The constraints in the undermost box in “FloodHazardMap” are reflecting the given possibility to limit scenarios for flooding due to groundwater or seawater to extreme event scenario respectively low probability) while the constraints in the undermost box in “FloodRiskMap” are reflecting the FD-requirement to show “potential adverse consequences” to different subjects of protection which could occur in the case of flooding - and this for each flood scenario. FD requests to indicate for example the “indicative number of inhabitants potentially affected”, “type of economic activity of the area potentially affected” etc. .
Due to the need that Dataspecification NZ has to cover all hazard/risk categories TWG NZ used “exposed elements” as a more neutral term. “Potential Adverse Consequences” and also “Adverse Consequences” (see below) are considered in NZ-CoreDatamodel as “exposedElements” which are components respectively content of other INSPIRE-Dataspecifications.

One IR-requirement in DS NZ is that a risk zones contains at least one exposed element which is in danger to be injured or damaged. This is fully in line with the philosophy of FD.
In NZ-Model featureType “ExposedElements” has links to generic featureTypes “HazardArea” and “RiskZone” because not in every case respectivley for all hazard/risk categories there are both featureTypes available. Furthermore featureType “ExposedElements” has a direct link to dataType PreliminaryFRAssessment. This is necessary to integrate the FD-requirement to provide information about appeared damage/losses/injuries/fatalities for past (flood) events. In FD-terminology therefore these are named “Past Adverse Consequences” (in contrast to “Potential Adverse Consequences” with foresight).

C.1 Example Floods Model


class Floods
«featureType»
PotentialFloodedAreaElement
+ inspireId: Identifier
«voidable, lifeCycleInfo»
+ beginLifespanVersion: DateTime
+ endLifespanVersion: DateTime [0..1]
«voidable»
+ floodFlow: Measure
+ velocityOfFlow: Velocity
+ waterHeight: Measure
+ waterlevel: Length
constraints
{water heights-water levels}
«dataType»
FloodHazardMap
+ inspireId: Identifier
«voidable, lifeCycleInfo»
+ beginLifespanVersion: DateTime
+ endLifespanVersion: DateTime [0..1]
«voidable»
+ reference: DocumentReference
constraints
{3 different likelihoods of occurence}
{1 low likelihood of occurence for groundwater or seawater floods}
+fhMap
0..*
+contains
1
+componentOf
«featureType»
Core_Model::HazardArea
+ geometry: RiskHazardGeometry
+ inspireId: Identifier
+ typeOfHazard: NaturalHazardClassification
«voidable, lifeCycleInfo»
+ beginLifespanVersion: DateTime
+ endLifespanVersion: DateTime [0..1]
«voidable»
+ levelOfHazard: LevelOfHazard
+ likelihoodOfOccurence: LikelihoodOfOccurence
+source
«voidable»
1
+result
«voidable»
0..*
«featureType»
Core_Model::RiskZone
+ geometry: RiskHazardGeometry
+ inspireId: Identifier
+ typeOfRisk: NaturalHazardClassification
«voidable, lifeCycleInfo»
+ beginLifespanVersion: DateTime
+ endLifespanVersion: DateTime [0..1]
+ validFrom: DateTime
+ validTo: DateTime [0..1]
«voidable»
+ legalBasis: LegislationReference [0..*]
+ legallyBindingZone: Boolean
+ levelOfRisk: LevelOfRisk
constraints
{A riskzone must be linked to 1 (or more) exposed elements}
{legallyBindingZone - legalBasis}
+componentOf
1..3
+contains
0..1
«dataType»
FloodRiskMap
+ inspireId: Identifier
«voidable, lifeCycleInfo»
+ beginLifespanVersion: DateTime
+ endLifespanVersion: DateTime [0..1]
«voidable»
+ reference: DocumentReference
constraints
{RiskZone-FloodRiskMap = RiskZones-PotentialFloodedAreas-FloodHazardMap-FloodRiskMap}
{ExposedElements - FloodRiskMap}
+frMap
0..*
+contains
+componentOf
1..3
«featureType»
PotentialFloodedArea
constraints
{Hazard category is "Flood"}
{The likelihood of occurence must be completed.}
{3 values possible for likelihood of occurence}
+result
1..*
+hazardArea
«voidable»
1..*
«featureType»
Core_Model::ModelledOrDeterminedHazard
«voidable»
+ determinationMethod: DeterminationMethodValue
«codeList»
InundationValue
+ controlled
+ natural
+riskZone
«voidable»
0..*
isExposedTo
HydroObject
«featureType»
InundatedLand
+ dateOfObservation: DateTime
+ geometry: GM_Surface
+ inspireId: Identifier
«voidable, lifeCycleInfo»
+ beginLifespanVersion: DateTime
+ endLifespanVersion: DateTime [0..1]
«voidable»
+ inundationReturnPeriod: Number
+ inundationType: InundationValue
«featureType»
Core_Model::ObservedHazard
«voidable»
+ nameOfEvent: CharacterString
«voidable, lifeCycleInfo»
+ validFrom: DateTime
+ validTo: DateTime [0..1]
constraints
{The likelihood of occurence is mandatory}
+componentOf
1..*
+origin
0..*
+contains
0..*
+exposedE+exposedElement
«voidable»«voidable»
0..*
+vulnElement
1..*
«dataType»
PreliminaryFRAssessment
+ inspireId: Identifier
«voidable, lifeCycleInfo»
+ beginLifespanVersion: DateTime
+ endLifespanVersion: DateTime [0..1]
«voidable»
+ reference: DocumentReference
constraints
{Exposed Elements-PFRA = ExposeElements-InundatedLand}
+pFRA
0..*
+exposedElementPFRA
0..*
«featureType»
Core_Model::ExposedElements
+ geometry: GM_Object
+ inspireId: Identifier
+ typeOfElement: TypeOfExposedElementValue
«voidable, lifeCycleInfo»
+ beginLifespanVersion: DateTime
+ endLifespanVersion: DateTime [0..1]
+ validFrom: DateTime
+ validTo: DateTime [0..1]