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Forest Fuel Mapping Service

INSPIRE Land Cover Data Specifications to model fuel maps in Europe: the experience of the ArcFUEL LIFE+ project

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Summary

- The problem targeted
- FCM (Fuel Classification Maps) for Forest Fire Management
- The ArcFUEL methodology
- An INSPIRE implementation for FCM

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The problem targeted

- ArcFUEL “Mediterranean Fuel Maps Geodatabase for Wildland & Forest Fire Safety” (www.arfuel.eu) is a LIFE+ EU project aiming at developing a methodology for Fuel Classification Mapping (FCM) for the Mediterranean Region, applied and tested through pilots in Greece, Portugal, Italy and Spain.
- Forest Fire (FF) Management requires knowledge of Fuel Classification Maps (FCMs) that are poorly available in Mediterranean countries since they are produced only at local or regional scale, without any regular updates and/or using standardized methodologies.
- Therefore available FCMs cannot support the systematic use of FF modeling at operational levels (prevention, suppression planning) of FF management.

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FCMs for FF Management

- Forest vegetation is considered as a “fuel” and its structure and status govern the dynamics of a fire.
- This is the reason why Fuel Models and their spatial patterns (i.e. FCMs) are significant for FF Management Actions during all four phases of the FF lifecycle:
  - 1 (Awareness phase - prior to the fire)
  - 2 (Emergency phase - during the fire)
  - 3 (Impacts phase - after the fire)
  - 4 (Dissemination phase - lesson learnt).

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The ArcFUEL methodology

- It consists of cascaded steps based on the use of multi-temporal LANDSAT Thematic Mapper (TM) images for the distinction of fuel classes with different seasonal characteristics and further refinement based on ancillary data, such us burned areas, and canopy cover density data derived from satellite observations.

An INSPIRE implementation for FCM

- A preliminary fit-for-purpose analysis has been conducted in order to identify the most applicable INSPIRE data theme within the ArcFUEL context.
- Among the 34 INSPIRE data themes, the following three have been identified as candidate and the relevant Data Specification (DS) analysed: Natural Risk Zones, Land Cover and Land Use.
- The Land Cover (LC) data theme has been selected as the most applicable and the relevant DS has been deeply analysed.

INSPIRE Land Cover Data Specification

- The Directive (2007/2/EC) defines Land cover as the Physical and biological cover of the earth's surface including artificial surfaces, agricultural areas, forests, (semi-)natural areas, wetlands, water bodies.
- The LC data specification does not prescribe or recommend any particular land cover nomenclature for use in INSPIRE. There is a multitude of different ways to describe land cover. This is partly due to the wide range of aspects of the environment embraced by land cover, but also due to the many different uses of land cover data. There is only one "real world" but many different descriptions of this world depending on the aims, methodology and terminology of the observer. The approach taken by LC DS is instead to allow many different land cover nomenclatures to coexist in the context of INSPIRE.

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INSPIRE Land Cover Data Specification

The LC DS defines the following application schemas:

- LandCoverNomenclature application schema;
- LandCoverVector application schema;
- LandCoverRaster application schema.

In addition, a LandCoverExtension application schema is defined in order to support requirements from specific use cases and/or may be used to provide additional information.

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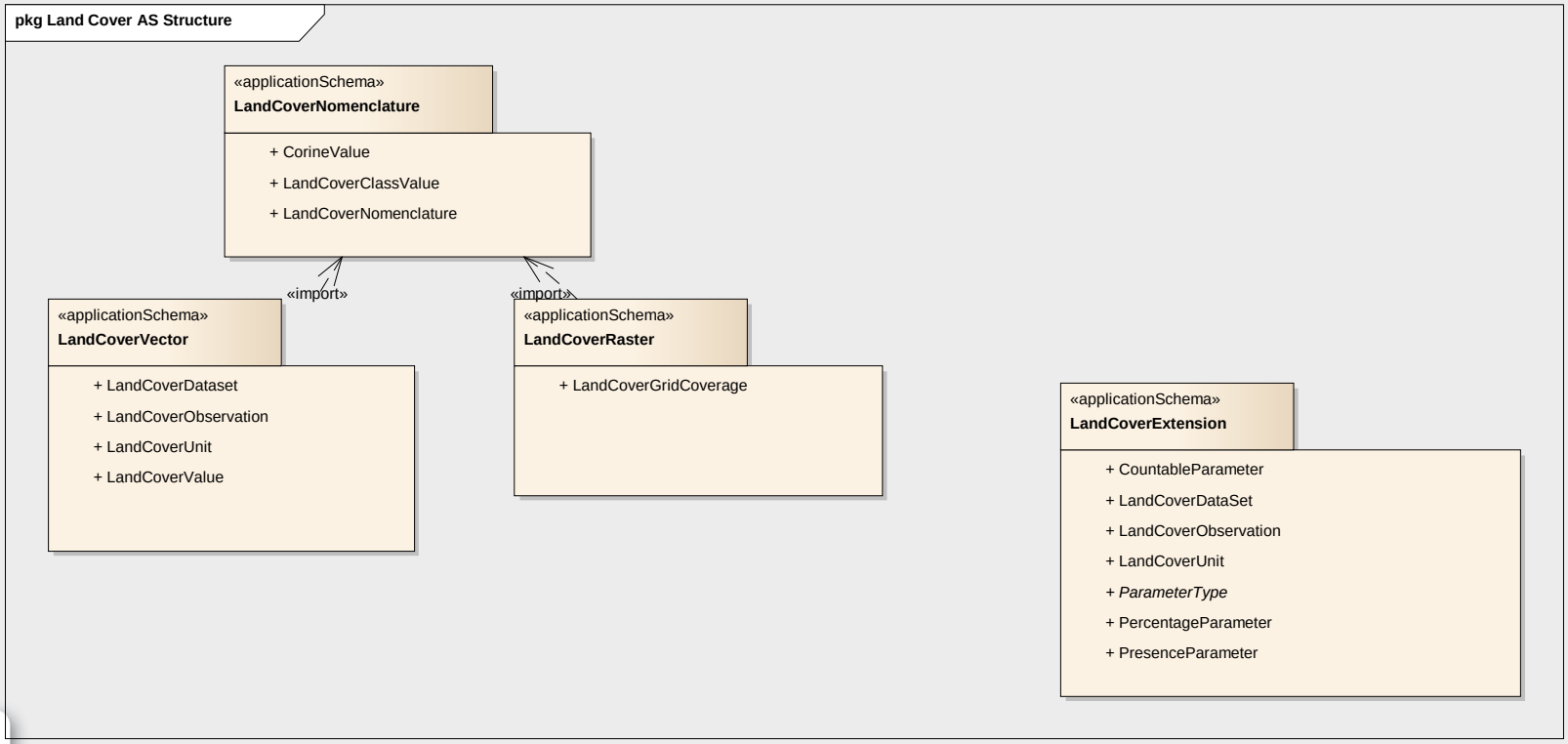
INSPIRE Land Cover Data Specification



LC UML Packages

INSPIRE Land Cover Data Specification

LC data shall be modeled trough one of the two core applications schemas:

- LandCoverVector defines a vector representation (i.e. points or surfaces) to support Land Cover data.
- LandCoverRaster defines a raster representation to support Land Cover data.

The two schemas differ only for technical reasons, related to implementation aspects:

- only one classification code is allowed per raster cell for the raster representation (multiple codes are allowed in the vector representation in order to follow LC changes).
- no mosaic description allowed for the raster representation.

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- The first important decision was the selection of the application schema to be applied within the ArcFUEL context.
- Considering the ArcFUEL end-user requirements, consisting in using the final ArcFUEL output (i.e. the FCM - Fuel Classification Map) as input for Fire Simulators processes, the LandCoverRaster application schema has been selected disregarding the LandCoverVector one.

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- Following the selection of the LandCoverRaster application schema, the use of the external file option for the encoding of the FCM values has been investigated.
- In order to physically implement this option, the indications contained in the Section 9.4 (Options for delivering coverage data)and in Annex I (Encoding rules for TIFF and JPEG 2000 file formats) of the “D2.8.II.2 Data Specification on Land Cover – Draft Technical Guidelines, version 3.0rc3” and in point 4 of the Annex D of “D2.7: Guidelines for the encoding of spatial data, Version 3.3rc2” have been followed.

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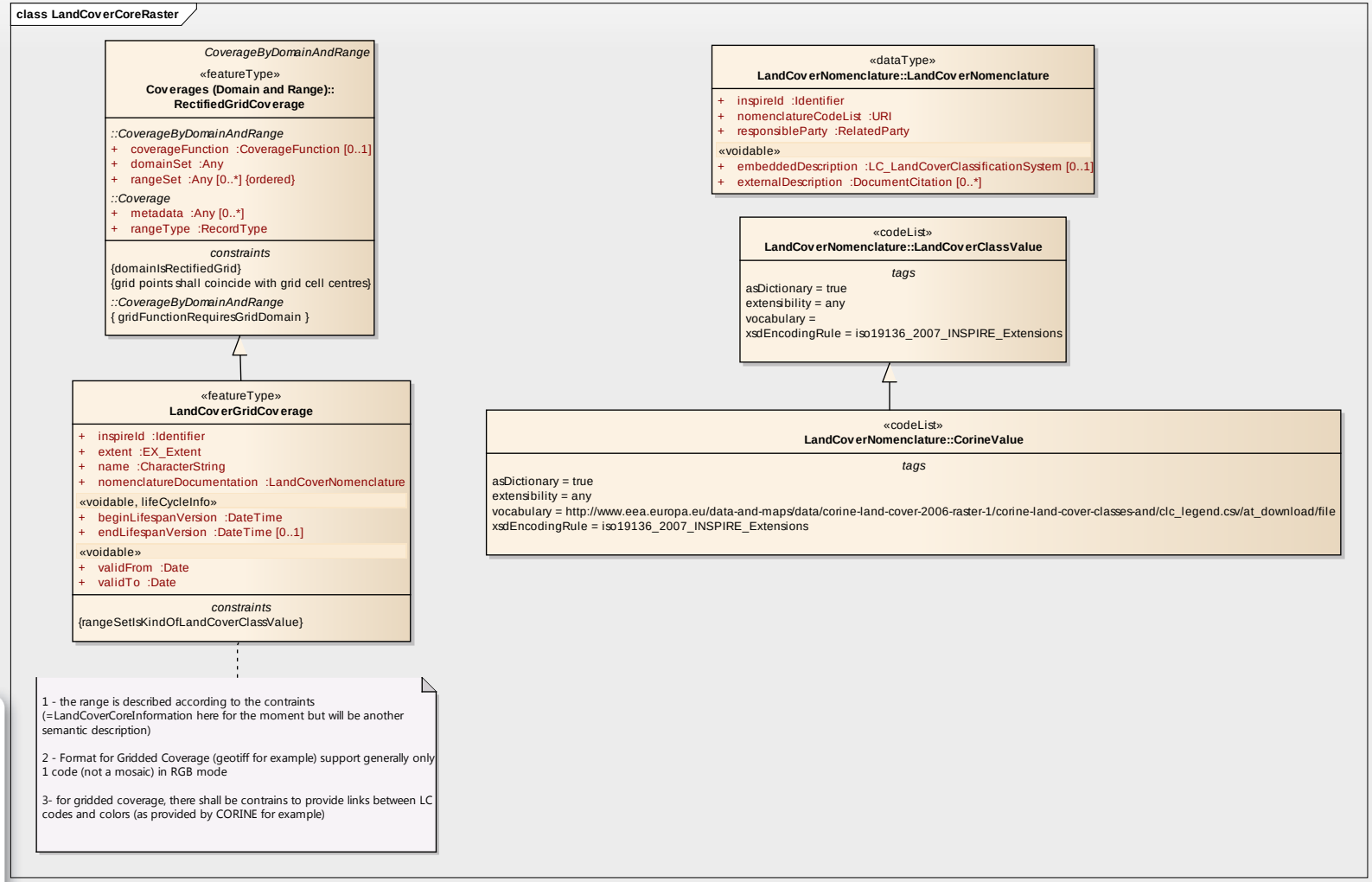
LandCoverRaster Class diagram



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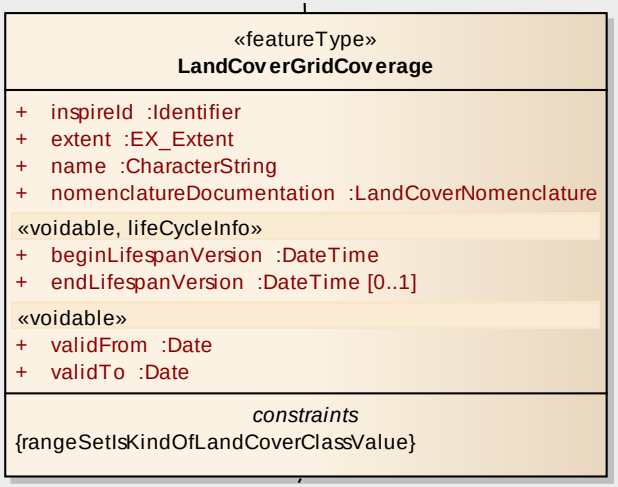
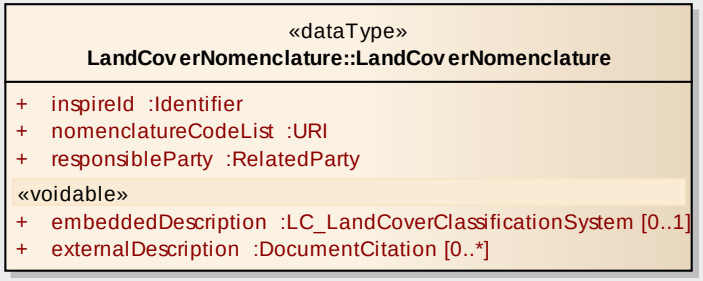
- Regarding the FCM nomenclature, the element *nomenclatureDocumentation* of the featureType LandCoverGridCoverage is used.
- Within its LandCoverNomenclature dataType, the attribute *nomenclatureCodeList* is used to document the 20-classes Fuel Types classification defined by ArcFUEL, through its encoding as an URI.





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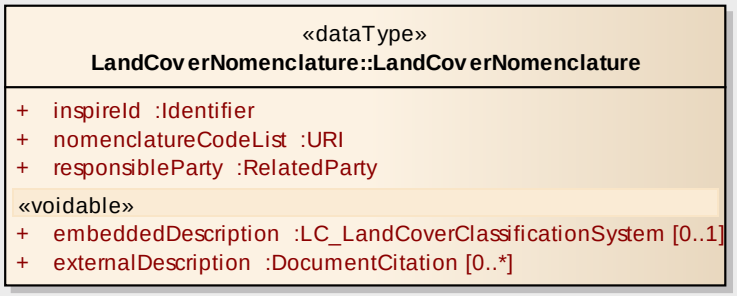
Nomenclature (codes and names) of the ArcFuel FCM

1	Evergreen Broadleaved Scrub forest	11	Deciduous Coniferous open forest
2	Evergreen Broadleaved open forest	12	Deciduous Coniferous Dense forest
3	Evergreen Broadleaved Dense forest	13	Evergreen Mixed Scrub forest
4	Deciduous Broadleaved Scrub forest	14	Evergreen Mixed open forest
5	Deciduous Broadleaved open forest	15	Evergreen Mixed Dense forest
6	Deciduous Broadleaved Dense forest	16	Deciduous Mixed Scrub forest
7	Evergreen Coniferous Scrub forest	17	Deciduous Mixed open forest
8	Evergreen Coniferous open forest	18	Deciduous Mixed Dense forest
9	Evergreen Coniferous Dense forest	19	Shrubs
10	Deciduous Coniferous Scrub forest	20	Grasses

An INSPIRE implementation for FCM

- In addition, for the FCM nomenclature documentation it is used the attribute “externalDescription” of the LandCoverNomenclature dataType instead of the attribute ”embeddedDescription”, which should require using LCML metalanguage.



An INSPIRE implementation for FCM

- A FCM *xml* metadata profile is under creation, comprising three groups of metadata elements, as required in the section 8 of the LC DS:
  - Metadata elements defined in INSPIRE Metadata Regulation, required by Regulation 1205/2008/EC (implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata);
  - Metadata elements for interoperability, required by Article 13 of IR;
  - Recommended theme-specific metadata elements, useful for reporting of maintenance information and data quality results.

An INSPIRE implementation for FCM

Metadata elements defined in INSPIRE Metadata Regulation, required by 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	

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Metadata elements for interoperability, required by Article 13 of IR;

IR Requirement
Article 13
Metadata required for Interoperability

The metadata describing a spatial data set shall include the following metadata elements required for interoperability:

1. Coordinate Reference System: Description of the coordinate reference system(s) used in the data set.
2. Temporal Reference System: Description of the temporal reference system(s) used in the data set.

   This element is mandatory only if the spatial data set contains temporal information that does not refer to the default temporal reference system.
3. Encoding: Description of the computer language construct(s) specifying the representation of data objects in a record, file, message, storage device or transmission channel.
4. Topological Consistency: Correctness of the explicitly encoded topological characteristics of the data set as described by the scope.

   This element is mandatory only if the data set includes types from the Generic Network Model and does not assure centreline topology (connectivity of centrelines) for the network.
5. Character Encoding: The character encoding used in the data set.

   This element is mandatory only if an encoding is used that is not based on UTF-8.
6. Spatial Representation Type: The method used to spatially represent geographic information.

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Recommended theme-specific metadata elements, useful for reporting of maintenance information and data quality results.

Section	Metadata element	Multiplicity
8.3.1	Maintenance Information	0..1
8.3.2	Completeness – Commission	0..*
8.3.2	Completeness - Omission	0..*
8.3.2	Logical Consistency – Conceptual Consistency	0..*
8.3.2	Logical Consistency – Domain Consistency	0..*
8.3.2	Logical consistency – Format Consistency	0..1
8.3.2	Logical consistency – Topological consistency	0..*
8.3.2	Positional accuracy – Absolute or External Accuracy	0..*
8.3.2	Thematic accuracy – Classification Correctness	0..*
8.3.2	Positional accuracy – Relative or Internal Accuracy	0..*
8.3.2	Temporal accuracy – Temporal Consistency	0..*
8.3.2	Temporal accuracy – Temporal Validity	0..*
8.3.2	Thematic accuracy – Non-quantitative Attribute Accuracy	0..*
8.3.2	Thematic accuracy – Quantitative Attribute Accuracy	0..*

Thank you!

Questions?

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