SME/SPIRE

Metadata and Data validation for INSPIRE

Authors: Giacomo Martirano, Stefania Morrone, Fabio Vinci (EPSILON ITALIA).
www.epsilon-italia.it

Introduction

This self-learning module provides examples of metadata and data validation against the requirements of the applicable Implementing Rules and Technical Guidelines of INSPIRE.

Using different tools, examples are given on how to validate existing metadata and/or create compliant metadata according to INSPIRE Implementing Rules for Metadata (Commission Regulation (EC) N° 1205/2008).

Examples are also given on how to integrate your metadata with the six additional metadata elements for interoperability required by INSPIRE Implementing Rules for interoperability of spatial data sets and services (Commission Regulation (EU) N° 1089/2010).

This module shows how to assess the degree of conformity to the requirements specified by Commission Regulation (EU) No 1089/2010 relevant to a GML dataset belonging to INSPIRE Annex I/II/III data themes. Conformity is assessed through an Executable Test Suite (ETS), i.e. physical implementation of the Abstract Test Suite (ATS) defined in the Annex A of the Data Specifications.

Learning outcomes: After the module, the participant will be able to validate existing metadata, create and validate INSPIRE compliant metadata, assess the conformity of an INSPIRE GML dataset.

Intended Audience: GIS and ICT professionals aiming to validate their metadata and datasets against INSPIRE requirements.

Pre-requisites: Basic knowledge of INSPIRE.
Module: **“**Procedures for Data and Metadata Harmonization”.

Referenced files:

- *eu_IT_Calabria_Arcfuel_FCM_metadata_Conformity.xml:* metadata file generated within the ArcFUEL EU-founded project
- *eu_IT_Calabria_Arcfuel_FCM.gml: d*ataset file generated within the ArcFUEL EU-founded project

Summary

1. Metadata validation
2. Create INSPIRE compliant metadata
3. “Discovery Metadata” validation
4. “Metadata for interoperability” validation
5. Data validation: ATS and Conformance classes
6. From ATS to ETS

Metadata validation

Reference Legislations:

- Commission Regulation (EC) N° 1205/2008
- Commission Regulation (EC) N° 1089/2010

Technical Reference document:

- INSPIRE Metadata Technical Guidelines (INSPIRE Metadata Implementing Rules: Technical Guidelines based on EN ISO 19115 and EN ISO 19119)

Metadata validation

To claim INSPIRE metadata conformance, two steps are required:

1. "Discovery Metadata" validation:

Conformance to Commission Regulation (EC) N° **1205/2008** also referred to as "**Implementing Rules for Metadata**".

2. "Metadata for interoperability" validation:

Conformance to Commission Regulation (EC) No **1089/2010** also referred to as "**Implementing Rules for Interoperability of Spatial Datasets and Services** " or ISDSS Regulation.

Discovery 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	

Metadata for interoperability

8.2 Metadata elements for interoperability

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.

Summary

1. Metadata validation
2. Create INSPIRE compliant metadata
3. “Discovery Metadata” validation
4. “Metadata for interoperability” validation
5. Data validation: ATS and Conformance classes
6. From ATS to ETS

Create INSPIRE compliant metadata

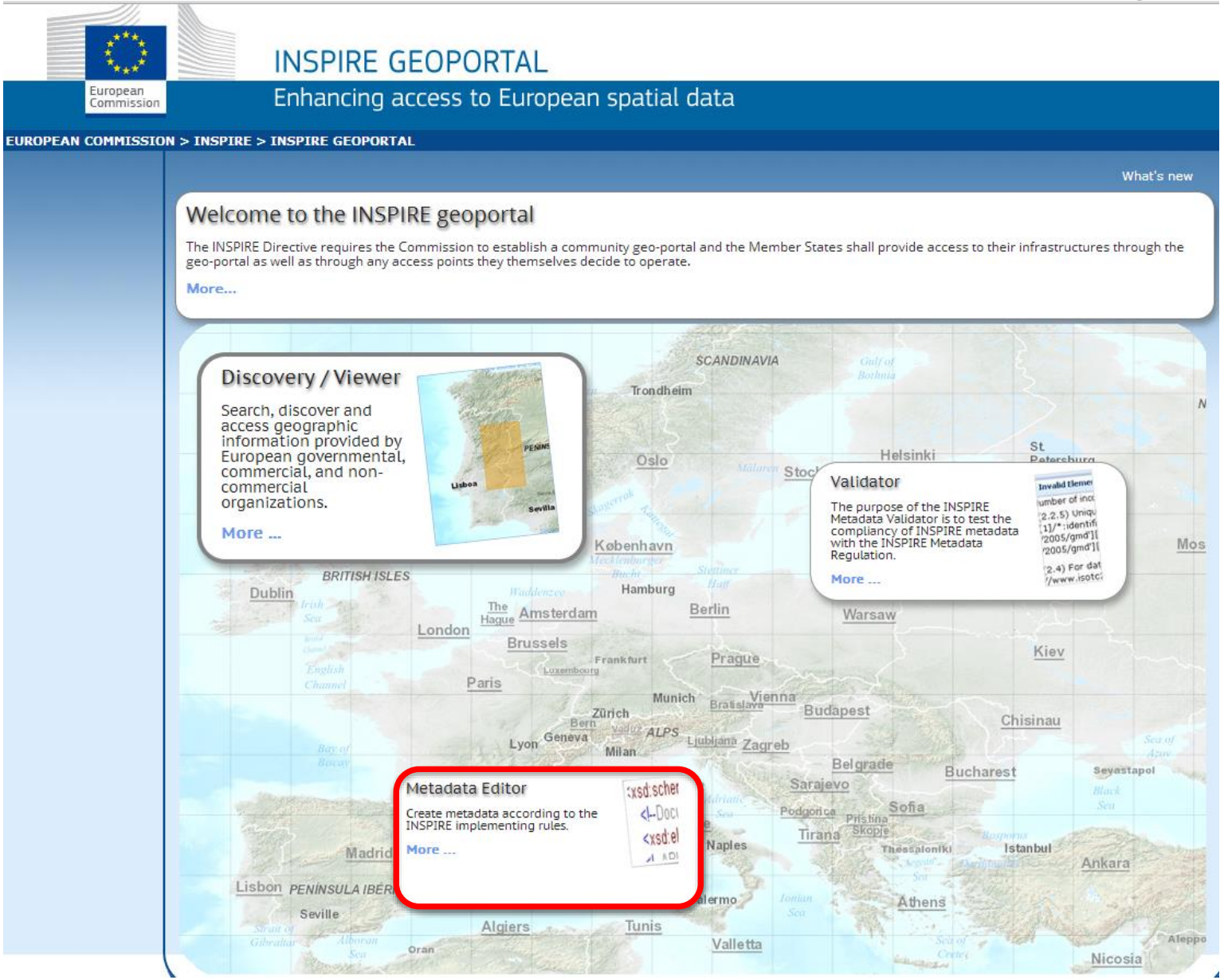
In order to create INSPIRE compliant metadata, the INSPIRE Geoportal Metadata Editor can be used. It is an implementation of the INSPIRE Metadata Technical Guidelines published on the INSPIRE website, whose aim is to define how the requirements of the Implementing Rules for Metadata stated in Commission Regulation (EC) N° 1205/2008 can be implemented using EN ISO 19115 and EN ISO19119.

The INSPIRE Geoportal Metadata Editor is available from the INSPIRE EU Geoportal at http://inspire-geoportal.ec.europa.eu/.

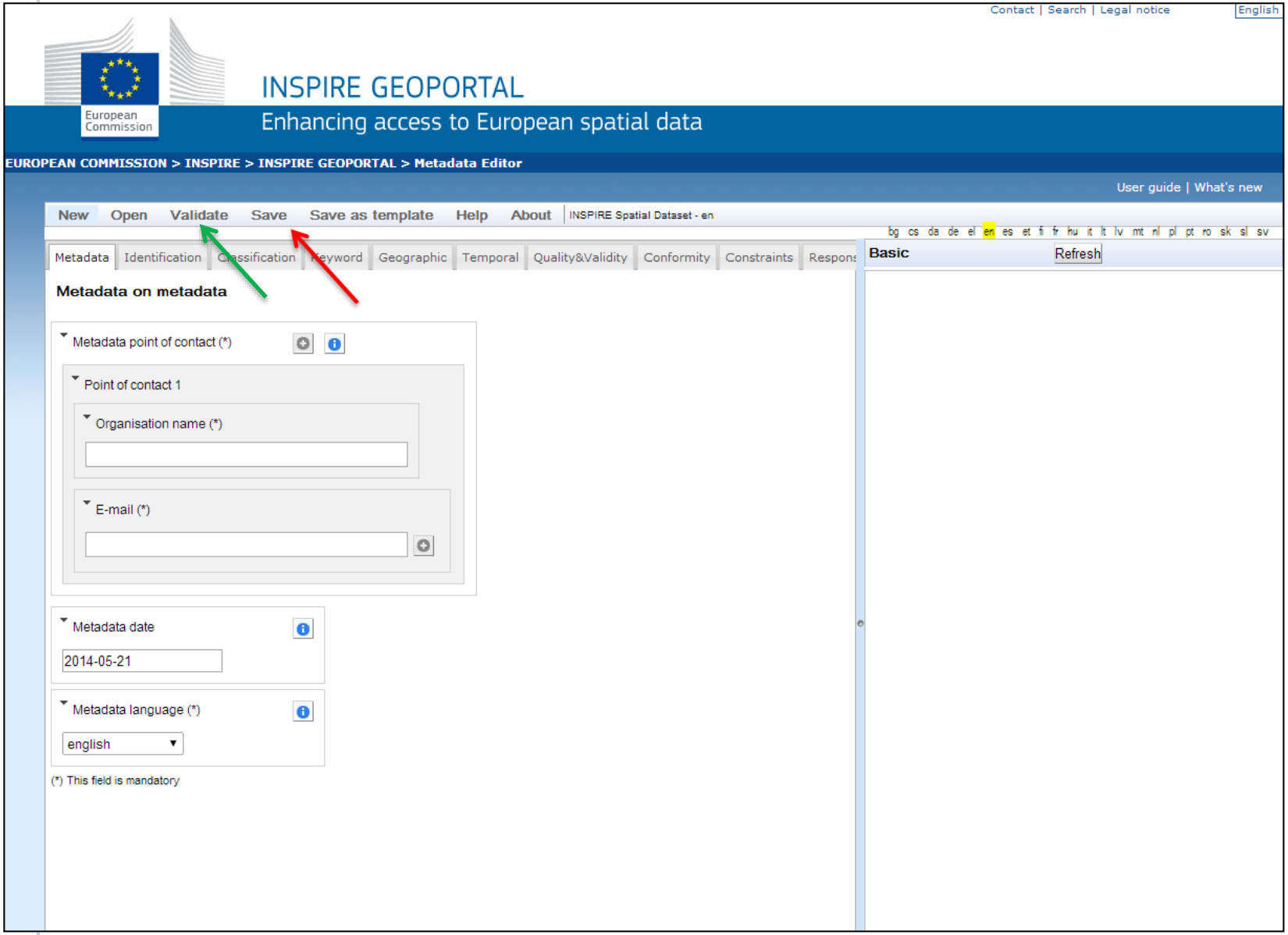
By means of the INSPIRE Metadata Editor it is possible to insert the metadata information into the related fields, validate the metadata and save them as xml file.

Compliance is assessed for the **discovery metadata**

The INSPIRE Geoportal



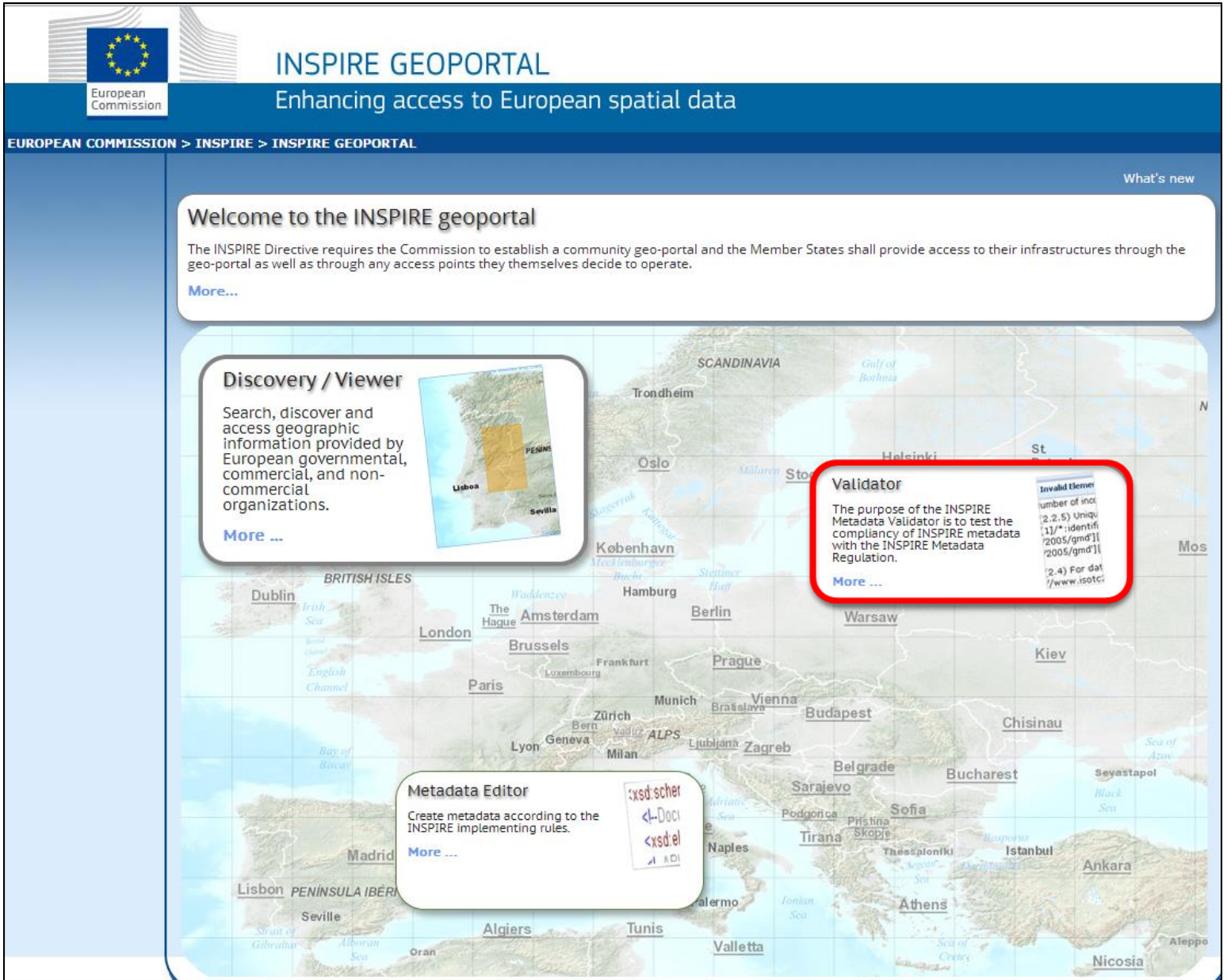
The INSPIRE Geoportal Metadata editor



Summary

1. Metadata validation
2. Create INSPIRE compliant metadata
3. “Discovery Metadata” validation
4. “Metadata for interoperability” validation
5. Data validation: ATS and Conformance classes
6. From ATS to ETS

Discovery Metadata validation with the INSPIRE Metadata validator



Discovery Metadata validation with the INSPIRE Metadata validator

Summary

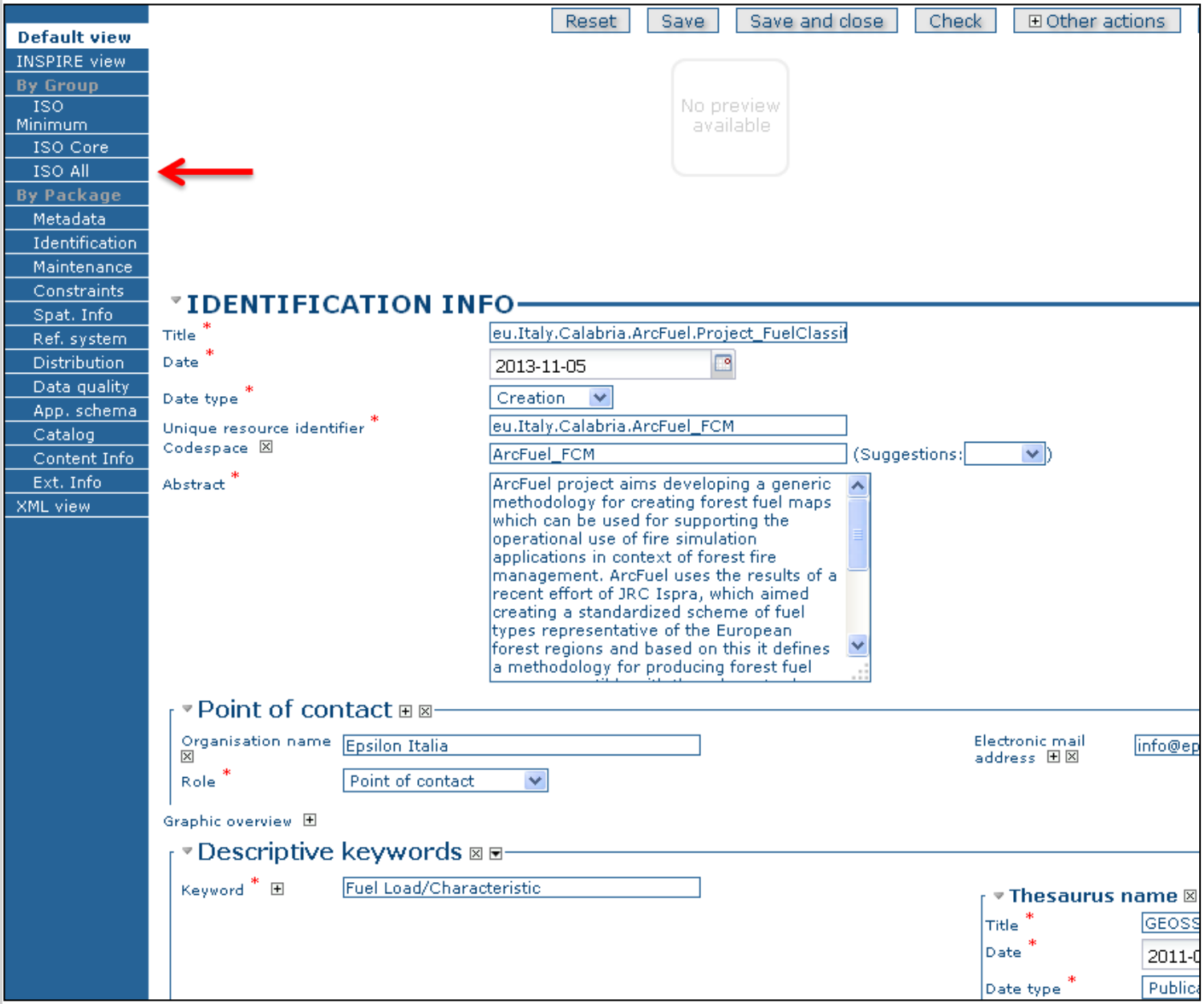
1. Metadata validation
2. Create INSPIRE compliant metadata
3. “Discovery Metadata” validation
4. “Metadata for interoperability” validation
5. Data validation: ATS and Conformance classes
6. From ATS to ETS

Metadata for interoperability validation

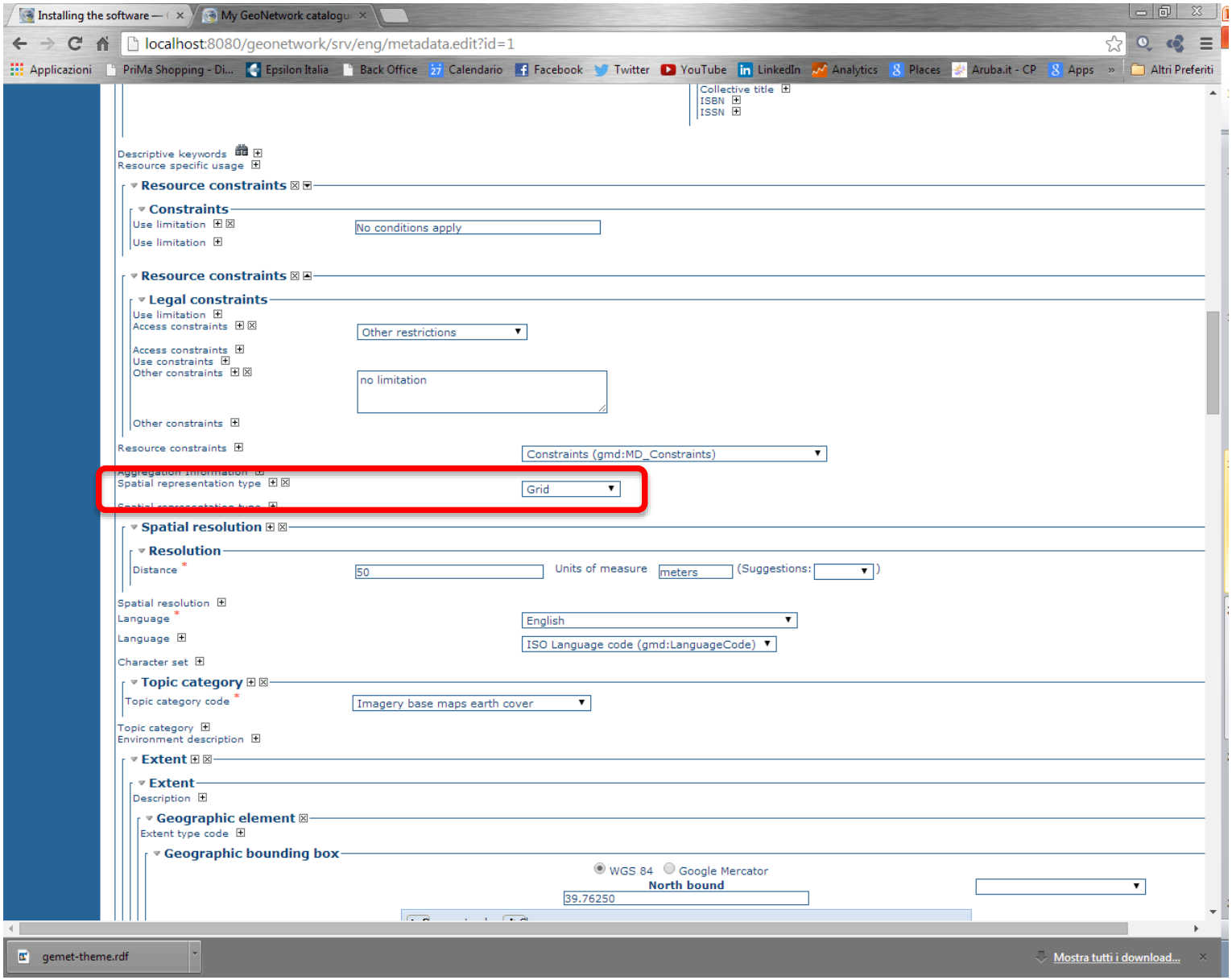
In order to be conformant to Commission Regulation (EC) N° 1089/2010, the metadata describing a spatial data set shall include the following metadata elements:

1. Coordinate reference system (mandatory)
2. Temporal reference system (conditional)
3. Encoding (mandatory)
4. Character encoding (conditional)
5. Spatial representation type (mandatory)
6. Data Quality – Logical consistency – Topological consistency (conditional)

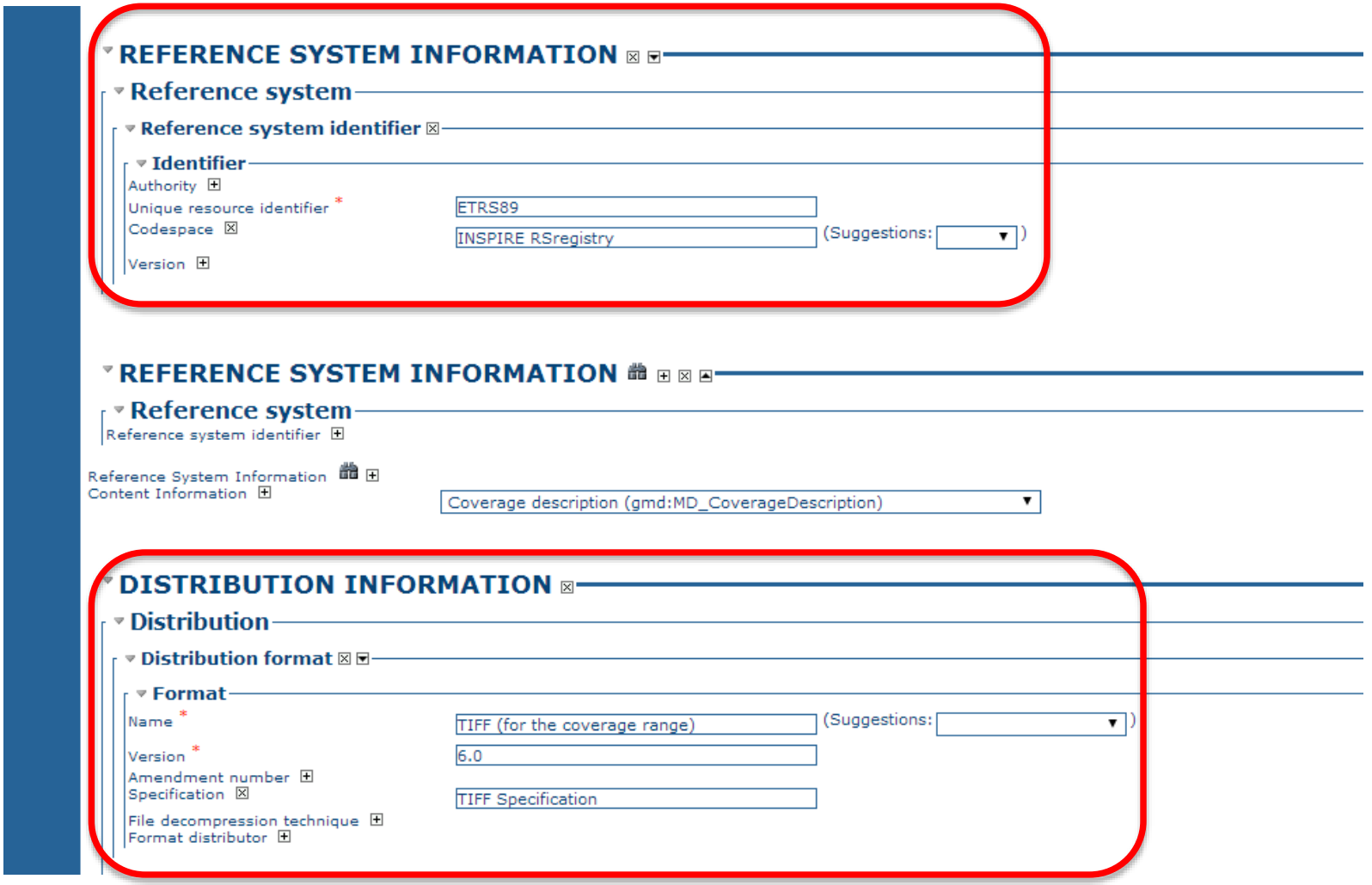
GeoNetwork tool



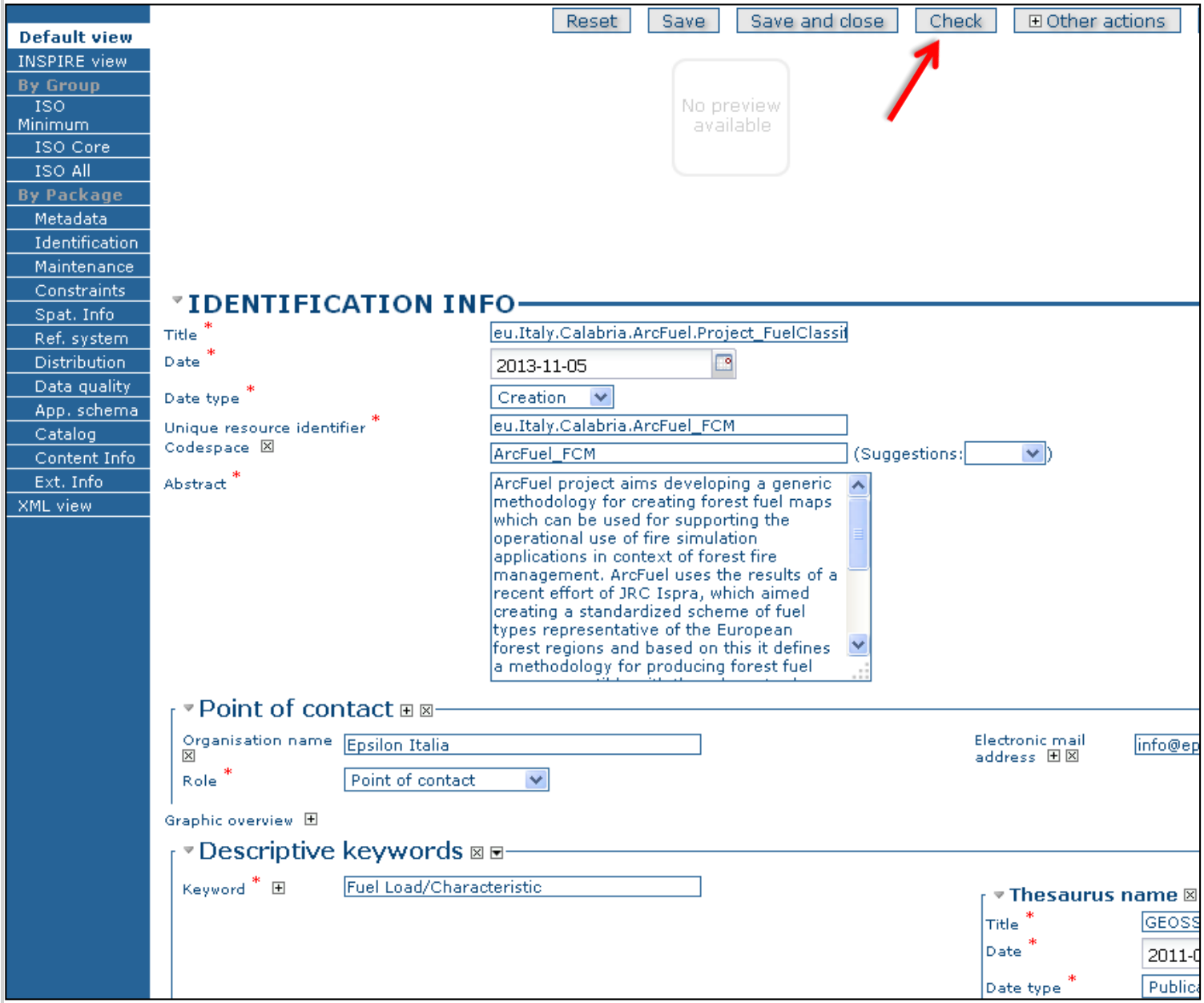
GeoNetwork tool



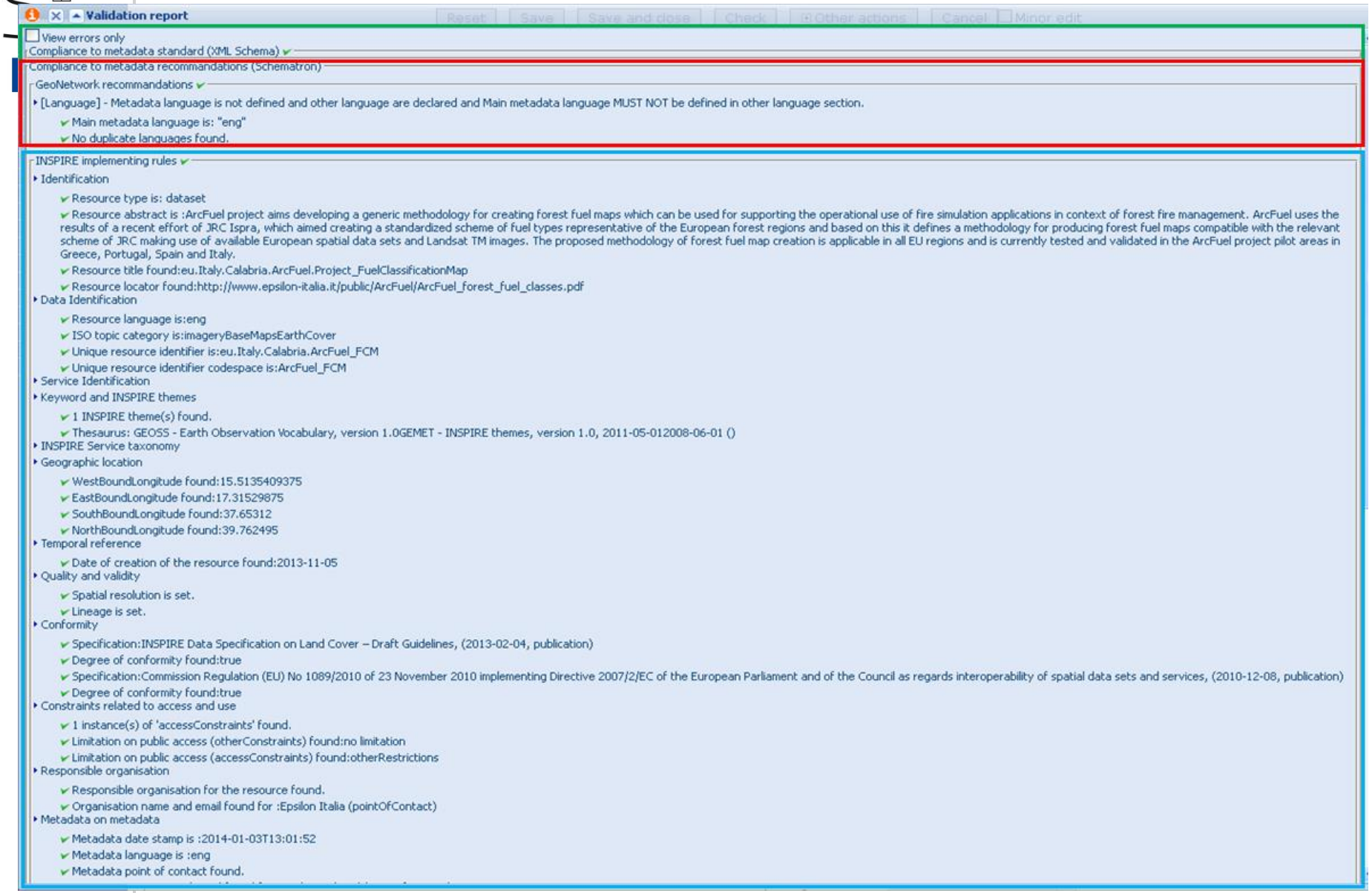
GeoNetwork tool



GeoNetwork tool



GeoNetwork Validation



GeoNetwork Validation

Summary

1. Metadata validation
2. Create INSPIRE compliant metadata
3. “Discovery Metadata” validation
4. “Metadata for interoperability” validation
5. Data validation: ATS and Conformance classes
6. From ATS to ETS

Data Validation

Abstract Test Suite (ATS) included in the Annex A of the INSPIRE Data Specifications is the starting point for the conformance testing process of datasets.

Annex A - Part 1: includes tests aiming at assessing the conformity of GML datasets to “COMMISSION REGULATION (EU) No 1089/2010 of 23 November 2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services” and its successive amendment “COMMISSION REGULATION (EU) No 1253/2013 of 21 October 2013”.

Annex A - Part 2: includes tests aiming at assessing conformity of GML datasets to relevant INSPIRE Data Specifications - Technical Guidelines (TG) requirements.

Data Validation

The requirements to be tested are grouped in several conformance classes. Each of these classes covers a specific aspect: one conformance class contains tests reflecting the requirements on the application schema, another on the reference systems, etc …

If a dataset is not yet conformant with all requirements of the data specification, conformity to individual conformance classes can be claimed. In order to be conformant to a specific conformance class, a data set has to pass all tests defined for that conformance class.

Data Validation: ATS - Part 1

Conformance Class	Tests
A.1 Application Schema Conformance Class	A.1.1 Schema element denomination test
	A.1.2 Value type test
	A.1.3 Value test
	A.1.4 Attributes/associations completeness test
	A.1.5 Abstract spatial object test
	A.1.6 Constraints test
	A.1.7 Geometry representation test
A.2 Reference Systems Conformance Class	A.2.1 Datum test
	A.2.2 Coordinate reference system test
	A.2.3 Grid test
	A.2.4 View service coordinate reference system test
	A.2.5 Temporal reference system test
	A.2.6 Units of measurements test
A.3 Data Consistency Conformance Class	A.3.1 Unique identifier persistency test
	A.3.2 Version consistency test
	A.3.3 Life cycle time sequence test
	A.3.4 Validity time sequence test
	A.3.5 Update frequency test
A.4 Data Quality Conformance Class	A.4.1 Data quality target results test
A.5 Metadata IR Conformance Class	A.5.1 Metadata for interoperability test
A.6 Information Accessibility Conformance Class	A.6.1 Code list publication test
	A.6.2 CRS publication test
	A.6.3 CRS identification test
	A.6.4 Grid identification test
A.7 Data Delivery Conformance Class	A.7.1 Encoding compliance test
A.8 Portrayal Conformance Class	A.8.1 Layer designation test

Data Validation: ATS - Part 2

Conformance Class	Tests
A.9 Technical Guideline Conformance Class	A.9.1 Multiplicity test
	A.9.1 CRS http URI test
	A.9.2 Metadata encoding schema validation test
	A.9.3 Metadata occurrence test
	A.9.4 Metadata consistency test
	A.9.5 Encoding schema validation test
	A.9.6 Coverage multipart representation test
	A.9.7 Coverage domain consistency test
	A.9.8 Style test

Summary

1. Metadata validation
2. Create INSPIRE compliant metadata
3. “Discovery Metadata” validation
4. “Metadata for interoperability” validation
5. Data validation: ATS and Conformance classes
6. From ATS to ETS

From ATS to ETS :

an example of how to assess the conformity of a gml dataset

For the purpose of this tutorial, we consider a single conformance class, namely:

A.1 Application Schema Conformance Class

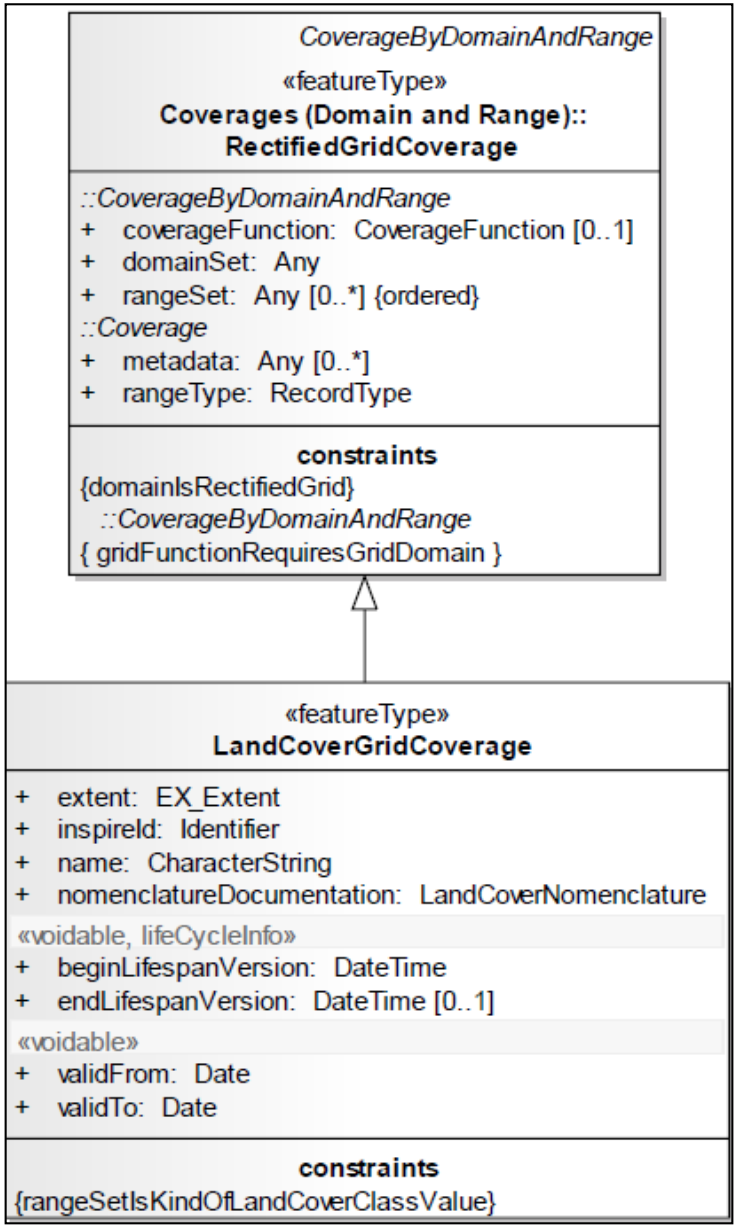
and we describe how to implement the abstract tests associated to this conformance class with reference to a gml dataset, in order to evaluate that it fulfils the requirements included in the relevant data specification.

More specifically in the following we describe the steps applied to test the dataset generated within the ArcFUEL EU-founded project. The ArcFUEL project output dataset consists of a raster file containing a Fuel Type classification dataset, obtained after a quite complex workflow based on the processing of multi-source remote sensing data.

The relevant INSPIRE Data Specification is Land Cover, and, in particular, the relevant application schema is LandCoverRaster.

For more details see Annex A of the INSPIRE_DataSpecification_LC_v3.0 downloadable from the INSPIRE webportal.

Land cover raster application schema



Tests in the A.1 Application Schema Conformance Class

A brief description of the tests to be executed to claim conformance to the A.1 Application Schema Conformance Class is provided in the following.

(For more details see Annex A of the INSPIRE_DataSpecification_LC_v3.0).

A.1.1 Schema element denomination test

Test Method: Examine whether the corresponding elements of the source schema (spatial object types, data types, attributes, association roles, code lists, and enumerations) are mapped to the target schema with the correct designation of mnemonic names.

A.1.2 Value type test

Test Method: Examine whether the value type of each provided attribute or association role adheres to the corresponding value type specified in the target specification

A.1.3 Value test

Test Method: When an attribute / association role has an enumeration or code list as its type, compare the values of each instance with those provided in the application schema.

A.1.4 Attributes/associations completeness test

Test Method: Examine whether all attributes and association roles defined for a spatial object type or data type are present for each instance in the dataset.

Tests in the A.1 Application Schema Conformance Class

A.1.5 Abstract spatial object test

Test Method: Examine that there are NO instances of abstract spatial object / data types in the dataset provided.

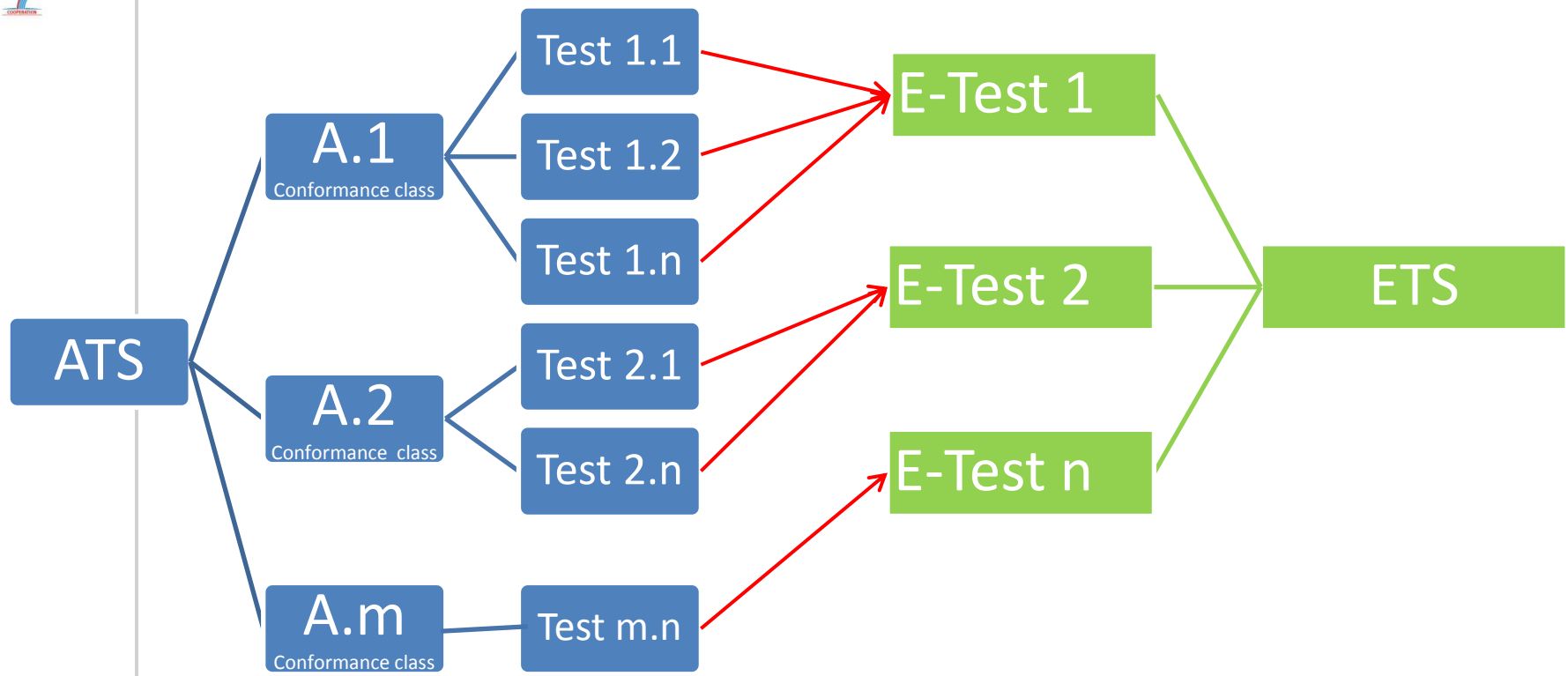
A.1.6 Constraints test

Test Method: Examine all instances of data for the constraints specified for the corresponding spatial object / data type. Each instance shall adhere to all constraints specified in the target application schema(s).

A.1.7 Geometry representation test

Test Method: Check whether all spatial properties only use 0, 1 and 2-dimensional geometric objects that exist in the right 2-, 3- or 4-dimensional coordinate space, and where all curve interpolations respect the rules specified in the reference documents.

From **A**bstract **T**est **S**uite to **E**xecutable **T**est **S**uite



Tests in the A.1 Application Schema Conformance Class

Some of the tests required in the conformance classes can be automated by means of xml schema validation tools such as open source tool HALE (HUMBOLDT Alignment Editor) or proprietary software tools such as for example GoPublisher or FME.

In our example, for A.1 conformance class, tests from A.1.1 to A.1.5 have been executed by means of the xml schema validation tool HALE. In the Hale project the raster file *Italy_Calabria.tiff* has been transformed into the harmonised gml file *eu_IT_Calabria_Arcfuel_FCM.gml* which has been validated against LandCoverRaster application schema.

Example of dataset validation using the HALE open source tool can be found in training Module 2: 'Examples of Data Transformation'

Tests A.1.6 and A.1.7 have been executed manually.

Tests A.1.6: constraints test

To identify the constraints the datasets have to comply with, the INSPIRE Data Specification on the related theme must be considered.

In the case of our example, to identify the constraints of the ArcFUEL dataset, the INSPIRE Data Specification on Land Cover and the LandCoverRaster application schema have been considered. For the ArcFUEL dataset, three constraints must be fulfilled:

• *rangeSetIsKindOfLandCoverClassValue* constraint which states that the values in the range set shall belong to a single classification code.

Here follows a snippet of the ArcFuel project gml file showing our implementation of the rangeSet element as a link to the file Italy_Calabria.tiff.

```
<gml:rangeSet>
<gml:File>
<gml:rangeParameters xlink:href="http://www.epsilon-italia.it/public/ArcFuel/Italy_Calabria.tiff"/>
<gml:fileReference>Italy_Calabria.tiff</gml:fileReference>
<gml:fileStructure>Record Interleaved</gml:fileStructure>
</gml:File>
</gml:rangeSet>
```

According to the constraint requirements, all the pixels values in the tiff file belong to the FCM codelist defined in the ArcFuel project and referenced through the nomenclatureCodeList attribute of the LandCoverGridCoverage class.

This can be verified using, for instance, the GIS software.

Tests A.1.6: constraints test

Other two constraints

- *domainIsRectifiedGrid* which states that the domain shall be a rectified grid.
- *gridFunctionRequiresGridDomain* which states that the grid function shall only be valid for domains that are grids.

Here is an extract of the ArcFuel project gml file showing our implementation of the constraint *domainIsRectifiedGrid*.

```
<gml:domainSet>
<gml:RectifiedGrid dimension="2" gml:id="tiff_domain">
<gml:limits>
<gml:GridEnvelope>
……
</gml:RectifiedGrid>
</gml:domainSet>
```

The *gridFunctionRequiresGridDomain* constraint is not applicable in our case as we have no function defined.

Tests A.1.7: geometry test

The only geometry used in the dataset is the one specified in the envelope definition, i.e. the point of origin of the rectified grid, which is described by means of latitude and longitude attributes (2-dimensional geometric objects). This way we adhere to the requirement that all spatial properties only use 0, 1 and 2-dimensional geometric objects.

Here follows a snippet of the ArcFuel project gml file showing our implementation of the relevant element:

```
<gml:axisLabels>x y</gml:axisLabels>
<gml:origin>
<gml:Point gml:id="grid_origin_tiff"
srsName="http://www.opengis.net/def/crs/EPSG/0/3045">
<gml:pos>550780.00 4452960.00</gml:pos>
</gml:Point>
</gml:origin>
```

The part of the test requiring that “all curve interpolations respect the rules specified in the reference documents” is not applicable in our case, because our dataset is a raster.

The Conformity metadata element in the ArcFuel project metadata

<gmd:specification>
<gmd:CI_Citation>
<gmd:title>
<gco:CharacterString>INSPIRE Data Specification on Land Cover – TG - AS - LandCoverRaster</gco:CharacterString>
</gmd:title>
<gmd:date>
<gmd:CI_Date>
<gmd:date>
<gco:Date>2013-12-10</gco:Date>
</gmd:date>
<gmd:dateType>
<gmd:CI_DateTypeCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/ML_gmxCodelists.xml#CI_DateTypeCode" codeListValue="publication"/>
</gmd:dateType>
</gmd:CI_Date>
</gmd:date>
</gmd:CI_Citation>
</gmd:specification>
<gmd:explanation>
<gco:CharacterString>Conformance has been claimed to A.1 Application Schema Conformance Class (http://inspire.ec.europa.eu/conformance-class/ir/lc/as/LandCoverRaster). Tests from A.1.1 to A.1.5 have been executed by means of the xml schema validation tool GoPublisher, whilst tests A.1.6 and A.1.7 have been executed manually</gco:CharacterString>
</gmd:explanation>
<gmd:pass>
<gco:Boolean>true</gco:Boolean>
</gmd:pass