Experience Transforming Coverage-data

Jordi Escriu

ICGC
Institut
Cartogràfic i Geològic
de Catalunya

Generalitat
de Catalunya

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Context
Our Organization

Institut Cartogràfic i Geològic de Catalunya (ICGC)

- ***Catalan Geoinformation Agency*** *and reference public service for the application of geo-scientific knowledge (Government of Catalonia)*
- ***Aim****: Deliver to users valued geographic and geological information and services.*
- Creation: 2014
- Merger of 2 Orgs.: ICC (1982) + IGC (2005)
- Location: Barcelona

Institutional and commercial activities

International background

Multidisciplinary knowledge fields

- Geodesy, Geomatics, Cartography, SDI, Geology, Geophysics

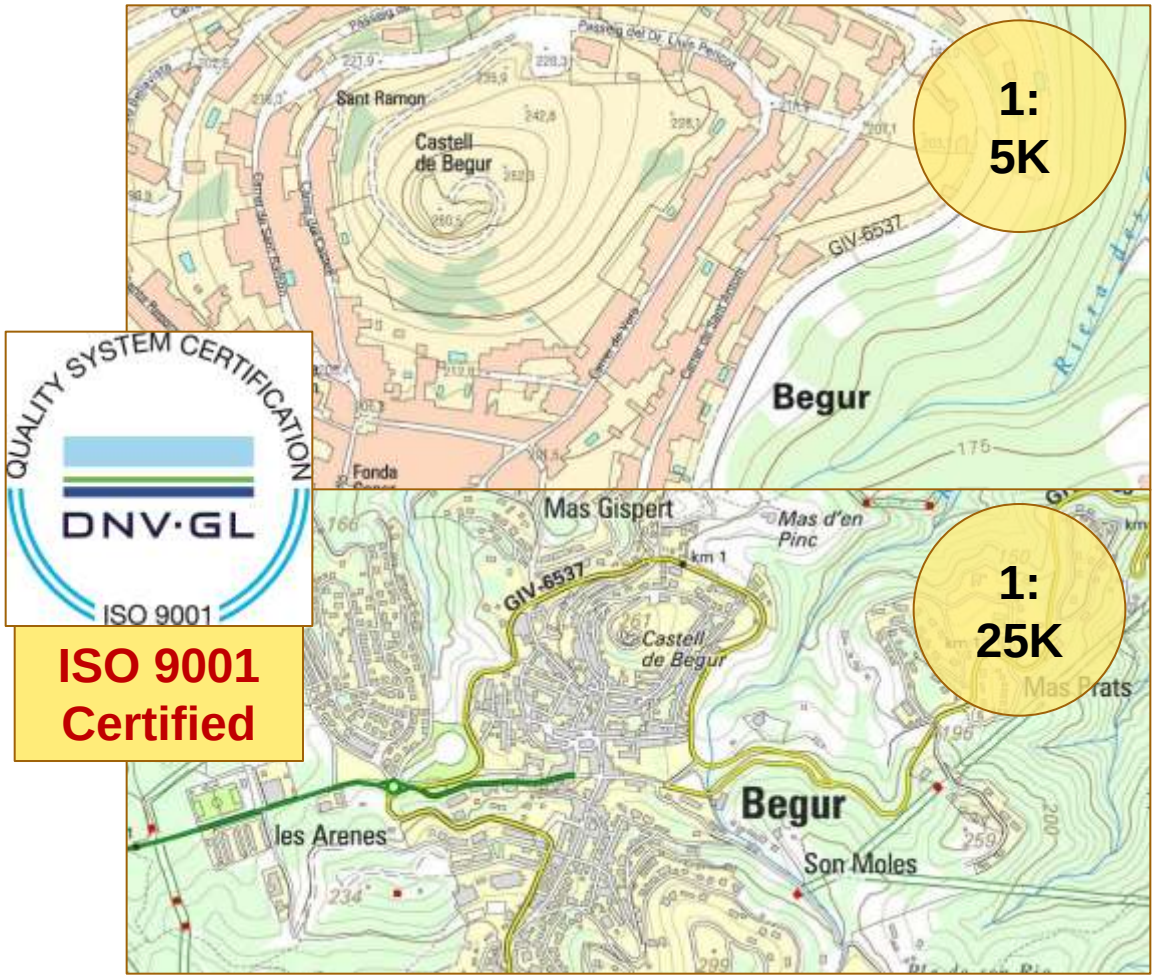
Context
Main products

Large scale data

- **Vector data**
  - Topographic databases

    1: 5K scale

    1: 25K scale



QUALITY SYSTEM CERTIFICATION
DNV·GL
ISO 9001

ISO 9001 Certified

Context
Main products

Large scale data

- **Raster data**
  - Orthoimagery

Products: RGB, IR

GSDs: 10 cm / Specific coverage (coastline, etc.)

25, 50 cm, 2.5 m / Full coverage of Catalonia

Delivery: File download[1]/ WMS[2]/ User Support Centre[3]

Formats: MrSid[1]/ PNG[2], JPEG[2]/ GeoTIFF[3]

QUALITY SYSTEM CERTIFICATION
DNV·GL
ISO 9001

ISO 9001 Certified

Context
Main products

Large scale data

- **Raster data**
  - DEMs

Cell-sizes: 1x1m, 2x2m	Cell-sizes: 5x5m, 15x15m
Accuracy: 15 cm	Accuracy: 0.9 m
Lineage: LIDAR data	Lineage: 1:5K Topographic DB
Delivery: User Support Centre	Delivery: File download, WCS
Formats: ESRI ASCII Grid	Formats: ESRI ASCII Grid

OI & EL Raster
INSPIREable Products

- **Orthoimagery**

  Orthophoto RGB & IR

  GSDs 25cm & 50cm

- **Elevation**

  DEM 5x5m & 15x15m

INSPIRE Delivery options
EL & OI raster data

- **Coverage, except Range Set**
  - OGC GML Application Schema for Coverages [OGC 09-146r2]
- **Coverage Range Set**

OPTION 1: Multipart representation *More Efficient options*

1st Part: GML Part (gmlcov:RectifiedGridCoverage)

2nd Part: Range Set encoded using a well-known binary format (embedded in 1st Part) – **EL**: TIFF / GeoTIFF (*); **OI**: TIFF / GeoTIFF / JPEG2000

OPTION 2: External file encoding

1st Part: GML Part (gmlcov:RectifiedGridCoverage)

2nd Part: Range Set, encoded using an external well-known binary format (gml:File) – **EL**: TIFF / GeoTIFF (*); **OI**: TIFF / GeoTIFF / JPEG2000

- **OPTION 3: Inline encoding**
  - Range Set is encoded within the XML inline (DataBlock)

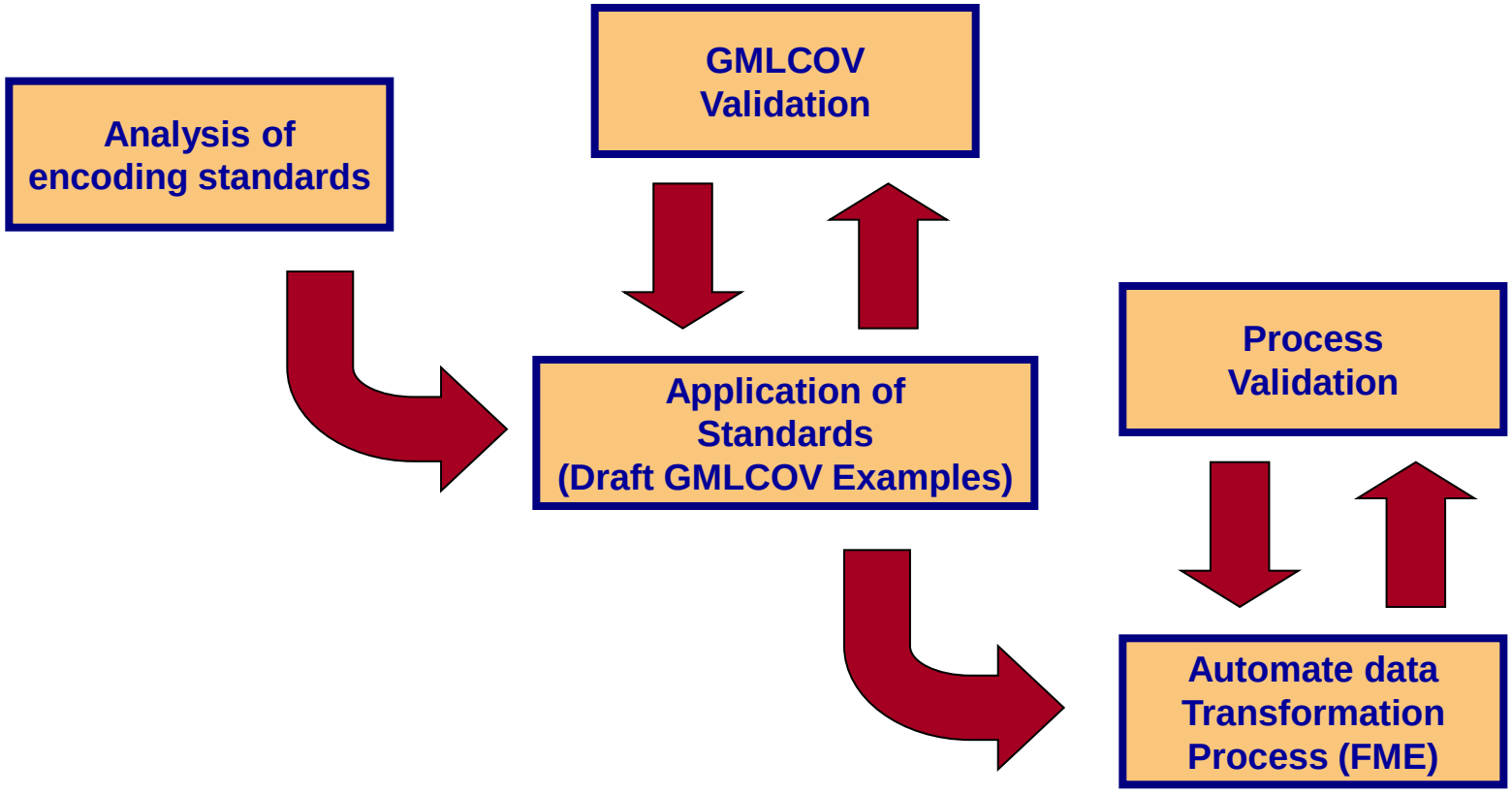
(*) Alternatively, the **BAG format** for Hydrographic bathymetry data

Current situation

- All options available in INSPIRE are (partially or totally) based on a GML structure.
- This is a new approach for mapping agencies, which often use ‘well-known formats’.
- Our case:

  GeoTIFF / ESRI ASCII Grid
- Need for and update and get to know the applicable standards.

Transformation plan



Analysis of standards
Learning path

- OGC 07-036 GML
- OGC 09-146r2 GML Application Schema - Coverages
- OGC 08-094r1 SWE Common Data Model
- Formats
  - TIFF / GeoTIFF
  - JPEG2000

Analysis of standards

OGC 07-036
GML v3.2.1

- **Defines XML grammar & base schema components for the transportation and storage of geographic information** (GML schemas).
- Specific and standardized XML encodings for some of the conceptual classes defined in the ISO 19100 standards.
- Extendable by designers.
- **Section 19 – Defines the specific components for encoding GML Coverages** (conformant to ISO 19123).
- A coverage is represented as a description of a:
  - a spatio-temporal domain (domainSet) **– Usually a rectified grid.**
  - set of values (rangeSet) **– Encoded inline or externally referenced.**
  - method or rule assigning values from the range to each position in the domain.

Analysis of standards

OGC 09-146r2
GML Application Schema - Coverages

- **GML 3.2.1 has turned out not enough to describe coverage instances** in a flexible, interoperable and harmonized way.
- **GML Application Schema – Coverages has been defined to remedy this situation**, until a future version of GML appear:
  - New '**rangeType**' mandatory element, which carries information describing the range set data structure **– Based on the "DataRecord" type defined in SWE Common Data Model (OGC 08-094r1).**
  - New '**metadata**' component, allowing the provision of application-specific supplementary information within the coverage.
  - '**coverageFunction**' property is moved up in the hierarchy established in GML, promoted to 'AbstractCoverage'.
  - **Grid coverage types** become subtypes of 'AbstractCoverage', rather than being subtypes of 'DiscreteCoverage' classes.

Analysis of standards
OGC 08-094r1
SWE Common Data Model

- **Main goals**
  - Define and package sensor related data in a self-describing and semantically enabled way.
  - Achieve syntactic and semantic interoperability.
- **Application in the case of coverages**
  - Defines the '**DataRecord**' type (Section 7.3).
  - According to GML Application Schema Coverages (OGC 09-146r2), this **shall be the type used for the 'rangeType'** mandatory component.

Analysis of standards

UML version of application schemas

- **Result of importing the related GML application schemas to a UML representation**
  - OGC 07-036 - GML v3.2.1
  - OGC 09-146r2 - GML Application Schema - Coverages
- **OGC_09-146r2_GML_APP.SCHEMA_COVERAGES.eap**
- **Helpful to graphically show the components which are necessary to encode GML Coverages**

Application of standards
Drafting of GMLCOV examples

- **GMLCOV Example** (Externally referenced EL coverage)

```
<?xml version="1.0" encoding="UTF-8"?>
<el-cov:ElevationGridCoverage xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:gml="http://www.opengis.net/gml
    <gml:boundedBy>
        <gml:Envelope srsName="EPSG:4258" srsDimension="2">
            <gml:lowerCorner>41.831955426 2.478775815</gml:lowerCorner>
            <gml:upperCorner>41.916895878 2.645765735</gml:upperCorner>
        </gml:Envelope>
    </gml:boundedBy>
    <gml:domainSet>
        <gml:RectifiedGrid dimension="2" gml:id="gridmet15v20as0f0333Am1r100-SW-20140701">
            <gml:limits>
                <gml:GridEnvelope>
                    <gml:low>0 0</gml:low>
                    <gml:high>927 624</gml:high>
                </gml:GridEnvelope>
            </gml:limits>
            <gml:axisLabels>x y</gml:axisLabels>
            <gml:origin>
                <gml:Point gml:id="origin_idmet15v20as0f0333Am1r100-SW-20140701" srsName="http://www.opengis.net/def/crs/EPSG/0/25831">
                    <gml:pos>456720 4640610</gml:pos>
                </gml:Point>
            </gml:origin>
            <gml:offsetVector srsName="http://www.opengis.net/def/crs/EPSG/0/25831">15 0</gml:offsetVector>
            <gml:offsetVector srsName="http://www.opengis.net/def/crs/EPSG/0/25831">0 -15</gml:offsetVector>
            <!-- Origin coordinates and offset vectors are expressed in the native CRS -->
        </gml:RectifiedGrid>
    </gml:domainSet>
    <gml:rangeSet>
        <gml:File>
            <gml:rangeParameters>
                <gml:CompositeValue>
                    <gml:valueComponents>
                        <Elevation uom="http://www.opengis.net/def/uom/OGC/1.0/metre">template</Elevation>
                        <!-- Alternative to avoid use of URNs:  uom="urn:x-ai:v1999:uom:metre" -->
                    </gml:valueComponents>
                </gml:CompositeValue>
            <gml:rangeParameters/>
            <gml:fileReference xlink:href="http://geoserveis.icc.cat/icc_mdt/wcs/service?SERVICE=WCS&REQUEST=GetCoverage&VERSION=1.0.0&CRS=EPSG:25831&COVERAGE=icc:m
            <gml:fileStructure>inapplicable</gml:fileStructure>
            <!-- Encoding proposal using gml:file external reference (WCS request) - To be discussed and validated -->
            <!-- WCS getCoverage request providing a coverage in ESRI ARCII Grid format, referenced to the native reference systems EPSG:25831 and national vertical
            <!-- Current WCS service is not INSPIRE compliant -->
        </gml:File>
    </gml:rangeSet>
    <gml:coverageFunction>
        <gml:GridFunction>
            <gml:sequenceRule axisOrder="+1 +2">Linear</gml:sequenceRule>
            <gml:startPoint>0 0</gml:startPoint>
        </gml:GridFunction>
```

Next steps

- **GMLCOV Validation**
  - According applicable XML schemas.
  - Comparison with other options / examples from other data providers.
- **Automate data transformation process in FME**
  - Import a bundle of original coverage data.
  - Make data conformant according INSPIRE provisions (IR&TGs).
    - Thematic provisions (e.g. transform EL values to EVRS)
    - Encoding provisions (e.g. GMLCOV + GeoTIFF)
  - Get a bundle of transformed INSPIRE-compliant data.
- **Process Validation**

Aspects for discussion
Hopefully today

- **Agree on valid INSPIRE GMLCOV examples** (EL & OI), from those available:
  - Pier-Yves Curtinot (IGN-France) – Orthoimagery

    https://themes.jrc.ec.europa.eu/file/view/23990/oi-example-data-set
  - Julián Delgado (IGN-Spain) / Jordi Escriu (ICGC- Spain) - Elevation

    https://themes.jrc.ec.europa.eu/discussion/view/42326/
  - Any others you may provide
- **Cover all INSPIRE delivery options**, as possible:
  - Multipart representation
  - External file encoding
  - Inline encoding

Aspects for discussion

Tomorrow – Thematic Clusters Session

- **Coverage encoding aspects already identified in the Thematic Clusters**
- **General thread** (cross-cluster, but focused on EL & OI) - "Encoding of Elevation and Orthoimagery coverages": https://themes.jrc.ec.europa.eu/discussion/view/2843/encoding-of-elevation-and-orthoimagery-coverages
- **How to encode the extent of coverages** - "domainExtent vs gml:boundedBy (EL & OI coverages encoding)": https://themes.jrc.ec.europa.eu/discussion/view/12901/domainextent-vs-gmlboundedby-el-oi-coverages-encoding
- **Use of OGC SWE Quantity constraint**

  https://themes.jrc.ec.europa.eu/discussion/view/12893/use-of-ogc-swe-quantity-constraint
- **Misalignments between coverages produced by different data providers**

  https://themes.jrc.ec.europa.eu/discussion/view/3731/misalignments-between-coverages-produced-by-different-data-providers-eg-orthoimages

Aspects for discussion

Tomorrow – Thematic Clusters Session

- **Coverage encoding aspects already identified in the Thematic Clusters**
- **OI coverages sample data** - "Example data in accordance with OI application schema (for Copernicus guidelines)": https://themes.jrc.ec.europa.eu/discussion/view/23508/example-data-in-accordance-with-oi-application-schema-for-copernicus-guidelines
- **INSPIRE Data Specification on OI** - "Inconsistencies/errors found in the INSPIRE TGs on orthoimagery": https://themes.jrc.ec.europa.eu/discussion/view/32920/inconsistencieserrors-found-in-the-inspire-tgs-on-orthoimagery
- **INSPIRE Data Specification on EL** - "Need more guidance for Elevation encoding and correct example (for ElevationGridCoverage) on the basis of GMLCOV schema": https://themes.jrc.ec.europa.eu/discussion/view/42326/need-more-guidance-for-elevation-encoding-and-correct-example-for-elevationgridcoverage-on-the-basis-of-gmlcov-schema

Aspects for discussion

- **Draft a list of potential changes to the EL & OI Technical Guidelines** (Today & Tomorrow)
  - Correction of known errors and ‘typos’.
  - New items identified that need to be addressed to achieve data interoperability.
  - Introduce GMLCOV coverages examples in the TGs.
  - Identify gaps / Complete:
    - Guidelines for encoding of coverages (e.g. ‘rangeType’ content and structure)
    - Specific encoding rules in a specific format (e.g. GeoTIFF / JPEG2000)

Institut Cartogràfic i Geològic de Catalunya

Parc de Montjuïc,
E-08038 Barcelona

41º22’12” N, 2º09’20” E (ETRS89)

www.icgc.cat
icgc@icgc.cat
twitter.com/ICGCat
facebook.com/ICGCat

Tel. (+34) 93 567 15 00
Fax (+34) 93 567 15 67