

9 Delivery

9.1 Updates

IR Requirement

Article 8

Updates

1. Member States shall make available updates of data on a regular basis.
2. All updates shall be made available at the latest 6 months after the change was applied in the source data set, unless a different period is specified for a specific spatial data theme in Annex II.

NOTE In this data specification, no exception is specified, so all updates shall be made available at the latest 6 months after the change was applied in the source data set.

9.2 Delivery medium

According to Article 11(1) of the INSPIRE Directive, Member States shall establish and operate a network of services for INSPIRE spatial data sets and services. The relevant network service types for making spatial data available are:

- *view services* making it possible, as a minimum, to display, navigate, zoom in/out, pan, or overlay viewable spatial data sets and to display legend information and any relevant content of metadata;
- *download services*, enabling copies of spatial data sets, or parts of such sets, to be downloaded and, where practicable, accessed directly;
- *transformation services*, enabling spatial data sets to be transformed with a view to achieving interoperability.

NOTE For the relevant requirements and recommendations for network services, see the relevant Implementing Rules and Technical Guidelines¹.

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 provided 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:

¹The Implementing Rules and Technical Guidelines on INSPIRE Network Services are available at <http://inspire.jrc.ec.europa.eu/index.cfm/pageid/5>

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.

It should be noted here that the actual INSPIRE Download Service implementation details and guidance is out-of-scope of this document. This section only aims to provide guidance and requirements on the content of the delivered INSPIRE AC-MF data sets.

The O&M model, as well as the large and frequently changing gridded data sets typical for AC-MF themes, require specific technical guidance by the INSPIRE Network Services Drafting Team. Without such clear guidance it will be difficult to achieve the INSPIRE interoperability goals in issues like

- recommended Download Service protocols,
- the use of effective binary encodings for large gridded data sets, and
- the data instance level discovery of frequently updated data, such as weather forecasts.

As of writing this document, this kind of guidance has not been provided in the existing versions of Download Service Technical Guidance documents, so unfortunately a reference to it cannot be provided here.

9.3 Encodings

The IRs contain the following two requirements for the encoding to be used to make data available.

IR Requirement

Article 7

Encoding

1. Every encoding rule used to encode spatial data shall conform to EN ISO 19118. In particular, it shall specify schema conversion rules for all spatial object types and all attributes and association roles and the output data structure used.
2. Every encoding rule used to encode spatial data shall be made available.

NOTE ISO 19118:2011 specifies the requirements for defining encoding rules used for interchange of geographic data within the set of International Standards known as the “ISO 19100 series”. An encoding rule allows geographic information defined by application schemas and standardized schemas to be coded into a system-independent data structure suitable for transport and storage. The encoding rule specifies the types of data being coded and the syntax, structure and coding schemes used in the resulting data structure. Specifically, ISO 19118:2011 includes

- requirements for creating encoding rules based on UML schemas,
- requirements for creating encoding services, and
- requirements for XML-based encoding rules for neutral interchange of data.

While the IRs do not oblige the usage of a specific encoding, these Technical Guidelines propose to make data related to the spatial data theme Atmospheric Conditions and Meteorological Geographical Features available at least in the default encoding(s) specified in section 0. In this section, a number of TG requirements are listed that need to be met in order to be conformant with the default encoding(s).

The proposed default encoding(s) meet the requirements in Article 7 of the IRs, i.e. they are conformant with ISO 19118 and (since they are included in this specification) publicly available.

As defined in the Implementing Rules of INSPIRE Download Services, there are two possibilities for implementing an INSPIRE Download Service: offering pre-defined data sets for download or providing

a "direct access" download service with query capabilities. In either case the data sets in the INSPIRE Atmospheric Conditions and Meteorological Geographical Feature themes are collections of Specialised Observation features as defined in the INSPIRE Specialised Observations GML Application Schema.

IR Requirement

Annex IV, Section 13.3

Theme-specific Requirements

Data related to the themes Atmospheric Conditions or Meteorological Geographical Features shall be made available using the types defined in Specialised Observations package in Annex I, the OM_Observation spatial object type or sub-types thereof.

These collections served using an INSPIRE Download Service can be either pre-defined using semantic grouping (like all measurement events with all measured properties from a single meteorological observation station within one day), or be created ad-hoc as a result of the given selection criteria for the Get Spatial Objects function of a direct-access Download Service.

The following table gives examples of which type of Specialised Observations is most appropriate to be used with typical of meteorological and atmospheric data sets:

Specialized Observation Type	AC-MF data examples
GridObservation	Gridded measurement & forecast data with regular (rectified) or non-regular (referenceable) grid coverage result for a single (nominal) instance of time. A gridded forecast produced by a numerical weather model for a single instance of time. A gridded precipitation measurement for a single (nominal) time instant based on weather radar data.
PointObservation	Measurement or forecast data for single spatial location and for a single (nominal) instance of time. A SYNOP station observation for a set of basic observable properties (temperature, pressure, etc.)
ProfileObservation	An (nominally) instantaneous measurement or forecast made at various points along a vertical profile in atmosphere. Radiosonde sounding or a simulated, numerical weather model based sounding (if considered instantaneous and directly up). Atmospheric profile data produced by various remote sensing instruments.
TrajectoryObservation	A measurement or simulation result providing data at various points along a curve geometry in atmosphere, each made at or simulating a different instant of time. The time instances along the geometry form a monotonous series. Radiosonde or other airborne measurement with a spatial and temporal values for each point along the curve.
PointTimeSeriesObservation	Measurement or forecast data for single spatial location and multiple (nominal) instances of time (a time series). Time series of an automatic weather station (AWS) observation for a set of basic observable properties (temperature, pressure, etc.)

Specialized Observation Type	AC-MF data examples
GridSeriesObservation	Gridded measurement & forecast data with regular (rectified) or non-regular (referenceable) grid coverage result for multiple (nominal) instances of time. A gridded forecast produced by a numerical weather model with more than one time step. A gridded precipitation measurement for more than one (nominal) time instances based on weather radar data and with corrections based on ground observation data.
MultiPointObservation	Measurement or forecast data for multiple spatial locations and for a single (nominal) instance of time. A collection of SYNOP station observations for a single country or other region for a set of basic observable properties (temperature, pressure, etc.)
PointObservationCollection	A collection of separately made PointObservations grouped semantically (same instrument, same measurement campaign etc.). Note that in most cases this is not needed, because the Get Spatial Objects operation must always return a collection of OM_Observation instances. If used, that collection contains sub-collections of PointObservation instances.

9.3.1 Default Encoding(s)

9.3.1.1. Specific requirements for GML encoding

This data specification proposes the use of GML as the default encoding, as recommended in sections 7.2 and 7.3 of [DS-D2.7]. GML is an XML encoding in compliance with ISO 19118, as required in Article 7(1). For details, see [ISO 19136], and in particular Annex E (UML-to-GML application schema encoding rules).

The following TG requirements need to be met in order to be conformant with GML encodings.

TG Requirement 1 Data instance (XML) documents shall validate without error against the provided XML schema.

NOTE 1 Not all constraints defined in the application schemas can be mapped to XML. Therefore, the following requirement is necessary.

NOTE 2 The obligation to use only the allowed code list values specified for attributes and most of the constraints defined in the application schemas cannot be mapped to the XML sch. They can therefore not be enforced through schema validation. It may be possible to express some of these constraints using other schema or rule languages (e.g. Schematron), in order to enable automatic validation.

9.3.1.2. Default encoding(s) for application schema Atmospheric Conditions and Meteorological Geographical Features

Name: Atmospheric Conditions and Meteorological Geographical Features GML Application Schema

Version: 3.0,

Specification: D2.8.III.13-14 Data Specification on Atmospheric Conditions and Meteorological Geographical Features – Technical Guidelines

Character set: UTF-8

All the AC-MF data offered using INSPIRE Download Services must follow this GML Application Schema for encoding the Observation instances within the feature collection results of the Get Spatial Objects operations.

The xml schema document is available on the INSPIRE website <http://inspire.ec.europa.eu>

Name: Atmospheric Conditions and Meteorological Geographical Features GML Application Schema (for the coverage domain)

Version: version 3.0, OGC Coverages version 1.0.0

Specification: D2.8.III.13-14 Data Specification on Atmospheric Conditions and Meteorological Geographical Features – Technical Guidelines; OGC GML Application Schema – Coverages [OGC 09-146r2]

Character set: UTF-8

All the AC-MF data offered using INSPIRE Download Services providing data using the Specialised Observation types with coverage valued results, must follow this GML Application Schema for encoding at least the domain parts of those coverages.

The xml schema document is available from <http://schemas.opengis.net/gmlcov/1.0/>.

9.3.1.2.1. Encoding rules used

Introducing encoding formats other than GML for representing coverage elements requires the definition of encoding rules to map the **Atmospheric Conditions and Meteorological Geographical Features** application schema to the resulting specific data structure unambiguously.

Recommendation 1 The encoding of coverage components in the file formats specified above should conform to the rules specified in <reference to Annex or (later) D2.7>.

NOTE The GeoTiff format, as a specific extension of the Baseline TIFF Format, is also covered by these encoding rules.

9.3.2 Recommended Encoding(s)

No recommendations for alternative encodings are offered in the data specification, due to resource limitations available. However, the benefit of having a pure binary encoding for AC-MF data is acknowledged, and it is hoped that in the future the community will develop best practice for a small number of such encoding; specifically, netCDF and GRIB. NetCDF already offers the possibility of directly adding the INSPIRE metadata to the file, as an additional metadata convention. Work is currently underway to develop a GRIB3 standard, which it is hoped can be made O&M (and INSPIRE) compliant.

9.4 Options for delivering coverage data

For coverages, different encodings may be used for the domain and the range of the coverage. There are several options for packaging the domain and range encoding when delivering coverage data through a download service, as discussed below².

Multipart representation

² Further details and examples will be included in a future version of the Guidelines for the encoding of spatial data [DS-D2.7].

For performance reasons, binary file formats are usually preferred to text-based formats such as XML for storing large amounts of coverage data. However, they cannot directly constitute an alternative to pure GML, since their own data structure might often not support all the ISO 19123 elements used to describe coverages in the conceptual model.

The OGC standard GML Application Schema for coverages [OGC 09-146r2] offers a format encoding which combines these two approaches. The first part consists of a GML document representing all coverage components except the range set, which is contained in the second part in some other encoding format such as 'well known' binary formats'. Some information in the second part may be redundant with the GML content of the first part. In this case, consistency must be necessarily ensured, for example by defining a GML mapping of the additional encoding format.

The advantage of this multipart representation is that coverage constituents are not handled individually but as a whole. This is not really the case with GML which also allows the encoding of the value side of the coverage in external binary files, but via references to remote locations.

TG Requirement 2 Coverage data encoded as multipart messages shall comply with the multipart representation conformance class defined in GML Application Schema for Coverages [OGC 09-146r2].
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NOTE The GML Application Schema for Coverages establishes a one-to-one relationship between coverages and multipart document instances.

Reference to an external file

The range set can be encoded within the XML structure as an external binary file using the gml:File element. This has the benefit of efficiently storing the range set data within an external file that is of a well-known format type, for example TIFF or GeoTIFF. This method of encoding is of most use for the storage of large files.

Encoding the range inline

This option encodes the range set data within the XML inline. This is encoded as a DataBlock element. This encoding provides much greater visibility for the range set values, however, this comes at the cost of reduced efficiency. This method of encoding would therefore only be suitable for small datasets.

Encoding the domain inside a JPEG 2000 file

This option consists in packaging all the components of one or several coverages, including the domain expressed in GML, in a single JPEG 2000 file. It is based on the OGC standard GML in JPEG 2000 for Geographic Imagery [OGC 05-047r2], also known as GMLJP2, which specifies how to use GML within the XML boxes of JPEG 2000 files.

TG Requirement 3 Coverage data encoded in standalone JPEG 2000 files shall comply with the OGC standard GML in JPEG 2000 for Geographic Imagery [OGC 05-047r2].
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TG Requirement 3 implies that all the encoding rules presented in GMLJP2 shall be strictly followed for including GML within JPEG 2000 data files correctly. For the sake of harmonization, the encoding rules adopted for the multipart message encoding should also apply to the GMLJP2 encoding.

The encoding of coverage components in GMLJP2 within a JPEG 2000 file should conform to the rules specified in the Guidelines for the encoding of spatial data [DS-D2.7].