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# OGC® EO Data Access Best Practice



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# Abstract

This OGC Best Practice document details proposed configuration and instantiation conventions for access to Earth Observation (EO) data developed in the European Space Agency (ESA) funded project Evolution of EO Online Data Access Services (EVO-ODAS).

It defines how to utilize WCS with EO products including generic conventions and recommendations for data and metadata mapping and conversion which are to be used in concrete tailoring for specific missions. It further considers how to link to other services like CSW, WMS, and WPS.

Suggested additions, changes, and comments on this draft document are welcome and encouraged. Such suggestions may be submitted by email message, by creating an issue or a pull request at the GitHub repository, or by making suggested changes in an edited copy of this document.

# Keywords

ogcdoc, eo, earth observation, data access, wcs, eo-wcs

# Submitting organizations

The following organizations have submitted this Best Practice to the Open GeoSpatial Consortium, Inc.:

- EOX IT Services GmbH
- German Aerospace Center (DLR)
- GeoSolutions S.A.S.
- European Space Agency (ESA)

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All questions regarding this document should be directed to the editor or the contributors.

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# Changes to the OGC ® Abstract Specification

The OGC ® Abstract Specification does not require any changes to accommodate the technical contents of this (part of this) document.

# Future Work

Please send any suggestions for future work to the document editor or contributors named above.

# Foreword

This OGC Best Practice document details proposed configuration and instantiation conventions for access to Earth Observation (EO) data developed in the European Space Agency (ESA) funded project Evolution of EO Online Data Access Services (EVO-ODAS).

It defines how to utilize WCS with EO products including generic conventions and recommendations for data and metadata mapping and conversion which are to be used in concrete tailoring for specific missions. It further considers how to link to other services like CSW, WMS, and WPS.

Suggested additions, changes, and comments on this draft document are welcome and encouraged. Such suggestions may be submitted by email message, by creating an issue or a pull request at the GitHub repository, or by making suggested changes in an edited copy of this document.

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# Introduction

TODO

# OGC® EO Data Access Best Practice

# Chapter 1. Scope

This OGC Best Practice document details configuration and instantiation conventions for access to Earth Observation (EO) data. It defines how to utilize WCS with EO products including generic conventions and recommendations for data and metadata mapping and conversion which are to be used in concrete tailoring for specific missions. It further considers how to link to other services like CSW, WMS, and WPS.

TODO

# Chapter 2. Normative references

The following normative documents contain provisions that, through reference in this text, constitute provisions of this specification. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the normative document referred to applies.

OGC 06-121r9, *OGC Web Services Common Standard*, version 2.0

TBD OGC 09-146r2, *Coverages Implementation Schema / GML 3.2.1 Application Schema for Coverages*, version 1.1
Conformance classes used: *gml-coverage*

TBD OGC 09-110r4, *OGC® Web Coverage Service 2.1 Interface Standard Core*, version 2.1
Conformance classes used: *core*

TBD OGC 10-140r1, *OGC® Web Coverage Service 2.0 Interface Standard - Earth Observation Application Profile*, version 1.1
Conformance classes used: *eowcs*, *eowcs_geteocoverageset*, *eowcs_get-kvp*, *eowcs_soap*,

OGC 11-053r1, *OGC® Web Coverage Service Interface Standard - CRS Extension*, version 1.0
Conformance classes used: *crs*, *crs-gridded-coverage*

OGC 12-039, *OGC® Web Coverage Service Interface Standard - Scaling Extension*, version 1.0
Conformance classes used: *scaling*

OGC 12-040, *OGC® Web Coverage Service Interface Standard - Range Subsetting Extension*, version 1.0
Conformance classes used: *record-subsetting*

OGC 12-049, *OGC® Web Coverage Service Interface Standard - Interpolation Extension*, version 1.0
Conformance classes used: *interpolation*

OGC 09-147r3, OGC® *WCS 2.0 Interface Standard - KVP Protocol Binding Extension*, version 1.0
Conformance classes used: *get-kvp*

OGC 09-149r1, OGC® *WCS 2.0 Interface Standard - SOAP Protocol Binding Extension*, version 1.0
Conformance classes used: *soap*

OGC 12-100r1, *OGC® GML Application Schema - Coverages - GeoTIFF Coverage Encoding Profile*, version 1.0
Conformance classes used: *geotiff-coverage*

OGC 14-100r2, *OGC® CF-netCDF 3.0 encoding using GML Coverage Application*, version 2.0
Conformance classes used: *CF-netCDF-1.6 GML encoding*, *CF-netCDF-1.6 data format*, *CF-netCDF-1.6 multipart data encoding*

OGC 12-108, *OGC® GML Application Schema - Coverages JPEG2000 Coverage Encoding Extension*, version 1.0
Conformance classes used: *jpeg2000-coverage*

OGC 10-157r4, *Earth Observation Metadata Profile of Observations and Measurements*, version 1.1.0
Conformance classes used: *eop*, *sar*, *opt*

# Chapter 3. Terms and definitions

This document uses the standard terms defined in Subclause 5.3 of [OGC 06-121r9], which is based on the ISO/IEC Directives, Part 2, Rules for the structure and drafting of International Standards. In particular, the word "shall" (not "must") is the verb form used to indicate a requirement to be strictly followed to conform to this standard.

For the purposes of this document, the terms and definitions given in the above references, particularly EO-WCS [10-140r1], apply. In addition, the following terms and definitions apply. An arrow "→" indicates that the following term is defined in this Clause.

## 3.1. Coverage

digital representation of a spatio-temporally varying phenomenon as defined in

## 3.2. Dataset

2-D → EO Coverage

A Dataset usually represents observations obtained by satellite instruments.

## 3.3. Dataset Series

collection of → EO Coverages

## 3.4. EO Coverage

Rectified Grid → Coverage or Referenceable Grid → Coverage having an → EO Metadata record and a WGS84 bounding box

## 3.5. EO Metadata

→ EO Coverage's metadata record

## 3.6. Stitched Mosaic

→ EO Coverage composed from subsets of one or more co-referenced → Datasets

## 3.7. EO Product

An EO Product contains one or more related → EO Product Datasets plus metadata and

optionally auxiliary data like → EO Product Quicklooks.

## 3.8. EO Product Dataset

One or more files each containing one or more → EO Coverages.

## 3.9. EO Product Quicklook

A visual representation of a usually reduced → EO Product Dataset encoded in an image format. The → EO Product Dataset may combine different bands.

## 3.10. Lineage record

Data structure documenting an operation that has been applied to the → coverage it is part of

## 3.11. refers to

contains, in its → EO Metadata element as defined in [OGC 10-157r4], the → EO Metadata element of

# Chapter 4. Conventions

## 4.1. UML notation

Unified Modeling Language (UML) static structure diagrams appearing in this specification are used as described in Subclause 5.2 of OGC Web Services Common [OGC 06-121r9].

## 4.2. Data dictionary tables

The UML model data dictionary is specified herein in a series of tables. The contents of the columns in these tables are described in Subclause 5.5 of [OGC 06-121r9]. The contents of these data dictionary tables are normative, including any table footnotes.

## 4.3. Namespace prefix conventions

The following namespaces are used in this document. The prefix abbreviations used constitute conventions used here, but are **not** normative. The namespaces to which the prefixes refer are normative, however.

**Table 1. Namespace mappings**

| Prefix | Namespace URI | Description |
|---|---|---|
| xsd | http://www.w3.org/2001/XMLSchema | XML Schema namespace |
| ows | http://www.opengis.net/ows/2.0 | OWS Common 2.0 |
| gml | http://www.opengis.net/gml/3.2 | GML 3.2.1 |
| gmlcov | http://www.opengis.net/gmlcov/1.1 | Coverages Implementation Schema 1.1 |
| wcs | http://www.opengis.net/wcs/2.1 | WCS 2.1 |
| eop | http://www.opengis.net/eop/2.0 | Earth Observation Metadata Profile of Observations and Measurements |
| opt | http://www.opengis.net/opt/2.0 | Optical Earth Observation Metadata Profile of Observations and Measurements (extension of eop) |
| sar | http://www.opengis.net/sar/2.0 | SAR Earth Observation Metadata Profile of Observations and Measurements (extension of eop) |
| wcseo | http://www.opengis.net/wcs/wcseo/1.1 | WCS Application Profile - Earth Observation 1.1 |

| Prefix | Namespace URI | Description |
|---|---|---|
| scal | http://www.opengis.net/wcs/scaling/1.0 (schema uses http://www.opengis.net/WCS_service-extension_scaling/1.0) | WCS Scaling Extension |
| int | http://www.opengis.net/wcs/interpolation/1.0 (schema uses http://www.opengis.net/WCS_service-extension_interpolation/1.0 | WCS Interpolation Extension |
| crs | http://www.opengis.net/wcs/crs/1.0 | WCS CRS Extension |
| gmd | http://www.isotc211.org/2005/gmd | ISO 19139 Metadata |
| gmi | http://standards.iso.org/iso/19115/-2/gmi/1.0 | ISO 19139-2 Metadata |
| mdb | http://standards.iso.org/iso/19115/-3/mdb/1.0 | ISO 19115-3 Metadata |

## 4.4. Multiple representations

When multiple representations of the same information are given in a specification document these are consistent. Should this not be the case then this is considered an error, and the XML Schema shall take precedence.

# Chapter 5. Cross Service Interaction

## 5.1. Overview

TODO

TODO

# Chapter 6. Grouping of Associated Data

## 6.1. Overview

TODO

TODO

# Chapter 7. Collection and Product Registration

## 7.1. Overview

TODO

TODO

# Chapter 8. Condense Coverage Description Information

## 8.1. Overview

TODO

TODO

# Chapter 9. Uniform Coverage Grouping

## 9.1. Overview

TODO

TODO

# Chapter 10. WCS Masking Extension

## 10.1. Overview

TODO

TODO

# Chapter 11. rangeType Description Enhancements

## 11.1. Overview

EO-WCS 1.1 extends the range type description of WCS 2.0 which is inherited from the Coverage Implementation Schema (CIS) 1.0 (formerly known as GML Application Schema - Coverages (GMLCOV).

The extension includes elements to specify the measured physical properties (`wcseo:dataSemantics`), the data types of stored numbers (`wcseo:dataType`), the conversion from stored numbers to physical properties (`wcseo:dataType2dataSemantics`), as well as a hint for how to generate a RGB version (`wcseo:RGBgenerationHint`).

The additional range type information is provided via the `wcseo:rangeTypeExtension` element which is either included once for the whole range type under the `swe:DataRecord` element or separately for each channel, often referred to as band, under each `swe:DataRecord/swe:field/swe:Quantity` element. It may also be included in both locations for example when there is one common RGB generation hint but the data conversion is specific for each band.

The new elements are introduced one by one in the following sections and extensive examples are given below.

## 11.2. Physical Properties

The `wcseo:rangeTypeExtension` element first includes the `wcseo:dataSemantics` element of type `anyURI`. This element holds an URI preferably resolving to a description of the observed physical property like `http://sweet.jpl.nasa.gov/2.3/stateSpectralBand.owl#Visible`.

This element needs to be synchronized with the `definition` attribute of each `swe:Quantity` element as well as the unit of measure defined via the `code` attribute of the `swe:uom` element again of each `swe:Quantity` element.

XML instance examples included with the OGC schemas make use of `http://www.opengis.net/def/property/OGC/0/Radiance` for the `definition` attribute which doesn't resolve to something useful as expected. Another URI used in OGC examples is `http://sweet.jpl.nasa.gov/2.0/physRadiation.owl#Radiance`. The latest version of this at the time of writing is `http://sweet.jpl.nasa.gov/2.3/propEnergyFlux.owl#Radiance`.

It is suspected that the ESA funded projects RARE, SMAAD, OBEOS, and/or PRODTREES define URIs to describe physical properties as well. However, a web research didn't bring up anything useful in this direction. Thus, for the time being, the examples given use the SWEET ontologies defined by the NASA Jet Propulsion Laboratory

(http://sweet.jpl.nasa.gov).

An example for a unit of measure code is `W.m-2.sr-1` as defined by `http://sweet.jpl.nasa.gov/2.3/reprSciUnits.owl#wattPerMeterSquaredPerSteradian` for radiance as used above.

SWE Common mandates the usage of units as defined by http://aurora.regenstrief.org/UCUM. However, this server is not accessible anymore and seems to be moved to http://unitsofmeasure.org/ucum.html.

Another physical property example is spectral radiance with URI `http://sweet.jpl.nasa.gov/2.3/propEnergyFlux.owl#SpectralRadiance` and unit of measure code `W.m-2.sr-1.nm-1` as defined by `http://sweet.jpl.nasa.gov/2.3/reprSciUnits.owl#wattPerMeterSquaredPerSteradianPerWavelength`.

## 11.3. Data Types

The `wcseo:rangeTypeExtension` element further includes the `wcseo:dataType` element, again of type `anyURI`. This element again holds an URI preferably resolving to a description of the data type. Examples of such URIs are `http://www.opengis.net/def/dataType/OGC/1.1/nonNegativeInteger`, `http://www.opengis.net/def/dataType/OGC/0/unsignedInt`, or `http://www.opengis.net/def/property/netcdf/1.0/unsignedShort`.

The data type is also implicitly provided via the actual coverage encoding. However, to describe it explicitly in the `wcseo:rangeTypeExtension` element allows clients to retrieve it also in coverage descriptions and without need to understand and parse the actual coverage encoding format.

## 11.4. Conversion from Data Types to Physical Properties

In order to be able to convert the stored numbers to the value of the actual measured physical property the `wcseo:dataType2dataSemantics` element is added to the `wcseo:rangeTypeExtension`. It describes the conversion via two real number intervals and a type.

`wcseo:intervalFrom` gives the interval of values stored in the coverage, `wcseo:intervalTo` specifies the interval the stored values are converted to, and `wcseo:type` defines which conversion method to use. Both intervals are given via two real numbers and the type via anyURI.

The example below describes a linear transformation, as typically used for optical data, from [1,4095] to [390.0000,780.0000] i.e. for a value x between 1 and 4095 the actual measured value y is calculated as: y = 390 + (x-1) * (780-390) / (4095-1)

```
<wcseo:dataType2dataSemantics>
  <wcseo:intervalFrom>1 4095</wcseo:intervalFrom>
  <wcseo:intervalTo>390.0000 780.0000</wcseo:intervalTo>
  <wcseo:type>linear</wcseo:type>
</wcseo:dataType2dataSemantics>
```

Another example, given below, describes the inverse to a logarithmic transformation as for example sometimes used for radar data. The transformation of stored values x in the interval [1,65535] to observed values y in the interval [2,1000000000] is given by y = 2 * e^(((x-1)*(ln(1000000000)-ln(2)))/(65535-1)).

```
<wcseo:dataType2dataSemantics>
  <wcseo:intervalFrom>1 65535</wcseo:intervalFrom>
  <wcseo:intervalTo>2 1000000000</wcseo:intervalTo>
  <wcseo:type>exponential</wcseo:type>
</wcseo:dataType2dataSemantics>
```

## 11.5. Hint for RGB Generation

The last element in the `wcseo:rangeTypeExtension` element is the `wcseo:RGBgenerationHint` element. It is meant to provide a hint for clients wanting to visualize the data. It includes the elements `wcseo:bandSequence`, `wcseo:intervalFrom`, `wcseo:intervalTo`, and `wcseo:type`. The first is a list of three band names or band arithmetic instructions delimited by spaces used for the three bands to generate the RGB version. The names used shall be equal to `name` attributes of the respective `swe:field` element. The other three elements are comparable to the ones used in the data conversion above.

The example below describes the RGB generation from a single band product by reusing the single band three times and logarithmically stretching the interval [100,10000000] to [1,255] i.e. value x is converted to y using y = ((ln(x)-ln(100))*(255-1))/(ln(10000000)-ln(100))+1.

```
<wcseo:RGBgenerationHint>
  <wcseo:bandSequence>gray gray gray</wcseo:bandSequence>
  <wcseo:intervalFrom>100 10000000</wcseo:intervalFrom>
  <wcseo:intervalTo>1 255</wcseo:intervalTo>
  <wcseo:type>logarithmic</wcseo:type>
</wcseo:RGBgenerationHint>
```

## 11.6. Recommended definitions

This section details our recommendations for the most commonly used data as well as for data not covered here. Of course data providers are free to choose any definitions, it's just highly recommended to use resolvable URIs providing meaningful descriptions ideally machine as well as human readable.

### 11.6.1. `wcseo:dataSemantics`, `swe:Quantity/@definition`, and `swe:uom/@code`

The list below provides recommendations for the values of the three items `wcseo:dataSemantics`, `definition` attribute of `swe:Quantity`, and `code` attribute of `swe:Quantity/swe:uom` for the most common use cases.

- Panchromatic
  - `wcseo:dataSemantics`
    - `http://sweet.jpl.nasa.gov/2.3/stateSpectralBand.owl#Visible`
  - `definition`
    - `http://sweet.jpl.nasa.gov/2.3/propEnergyFlux.owl#SpectralRadiance`
  - `code`
    - `W.m-2.sr-1.nm-1`
- RGB
  - `wcseo:dataSemantics`
    - `http://sweet.jpl.nasa.gov/2.3/stateSpectralBand.owl#Red`
    - `http://sweet.jpl.nasa.gov/2.3/stateSpectralBand.owl#Green`
    - `http://sweet.jpl.nasa.gov/2.3/stateSpectralBand.owl#Blue`
  - `definition`
    - `http://sweet.jpl.nasa.gov/2.3/propEnergyFlux.owl#SpectralRadiance`
  - `code`
    - `W.m-2.sr-1.nm-1`
- SAR
  - `wcseo:dataSemantics`
    - `http://sweet.jpl.nasa.gov/2.3/stateSpectralBand.owl#CBand`
  - `definition`
    - TODO `http://sweet.jpl.nasa.gov/2.3/propEnergyFlux.owl#Intensity`
  - `code`
    - TODO none, digital number (dn), `http://sweet.jpl.nasa.gov/2.3/propEnergyFlux.owl#Intensity` (`W.m-2`), Relative Amplitude (dB),

http://sweet.jpl.nasa.gov/2.3/propSpaceDistance.owl#ScatteringCoefficient

- TODO something using radiance
  - wcseo:dataSemantics
    - TODO
  - definition
    - http://sweet.jpl.nasa.gov/2.3/propEnergyFlux.owl#Radiance
  - code
    - W.m-2.sr-1

```
http://www.opengis.net/def/property/OGC-EO/0/opt/MaxCloudCover
http://www.opengis.net/def/property/OGC-EO/0/opt/MaxSnowCover
```

### 11.6.2. wcseo:dataType

```
http://www.opengis.net/def/dataType/OGC/1.1/nonNegativeInteger
http://www.opengis.net/def/dataType/OGC/0/unsignedInt
http://www.opengis.net/def/property/netcdf/1.0/unsignedShort
http://sweet.jpl.nasa.gov/2.0/info.owl
```

### 11.6.3. wcseo:type in wcseo:dataType2dataSemantics and wcseo:RGBgenerationHint

```
linear
logarithmic
exponential
```

### 11.6.4. definition attribute of swe:DataRecord

TBD http://www.opengis.net/def/property/OGC-EO/0/opt/SpectralMode/PANCHROMATIC http://www.opengis.net/def/ogc-eo/opt/SpectralMode/PANCHROMATIC

```
http://www.opengis.net/def/property/OGC-EO/0/opt/SpectralMode/COLOR
http://www.opengis.net/def/ogc-eo/opt/SpectralMode/COLOR
http://www.opengis.net/def/order/OGC-EO/0/SpectralBandColorComposition
```

### 11.6.5. swe:identifier vs. name attribute of swe:field

```
name is NCName
identifier is anyURI could be used for more complex IDs...
```

### 11.6.6. reason attribute of swe:nilValue

```
http://www.opengis.net/def/nil/OGC/0/unknown
http://www.opengis.net/def/nil/OGC/0/BelowDetectionRange
http://www.opengis.net/def/nil/OGC/0/AboveDetectionRange
```

## 11.7. Examples

The following provides an example gmlcov:rangeType element including additional range type information for RGB generation on swe:DataRecord level as well as data conversion information on swe:Quantity level.

```
<gmlcov:rangeType>
  <swe:DataRecord definition="TODO">
    <swe:extension>
      <wcseo:rangeTypeExtension>
        <wcseo:RGBgenerationHint>
          <wcseo:bandSequence>gray gray gray</wcseo:bandSequence>
          <wcseo:intervalFrom>100 10000000</wcseo:intervalFrom>
          <wcseo:intervalTo>1 255</wcseo:intervalTo>
          <wcseo:type>logarithmic</wcseo:type>
        </wcseo:RGBgenerationHint>
      </wcseo:rangeTypeExtension>
    </swe:extension>
    <swe:label>Gray Channel/Band</swe:label>
    <swe:field name="gray">
      <swe:Quantity definition=
"http://sweet.jpl.nasa.gov/2.3/propEnergyFlux.owl#SpectralRadiance">
        <swe:extension>
          <wcseo:rangeTypeExtension>

<wcseo:dataSemantics>http://sweet.jpl.nasa.gov/2.3/stateSpectralBand.owl#Visibl
e</wcseo:dataSemantics>

<wcseo:dataType>http://www.opengis.net/def/dataType/OGC/1.1/nonNegativeInteger<
/wcseo:dataType>
            <wcseo:dataType2dataSemantics>
              <wcseo:intervalFrom>100 10000000</wcseo:intervalFrom>
```

```
              <wcseo:intervalTo>390.0000 780.0000</wcseo:intervalTo>
              <wcseo:type>linear</wcseo:type>
            </wcseo:dataType2dataSemantics>
          </wcseo:rangeTypeExtension>
        </swe:extension>
        <swe:identifier>gray</swe:identifier>
        <swe:label>Gray Channel/Band</swe:label>
        <swe:description>Gray Channel/Band</swe:description>
        <swe:nilValues>
          <swe:NilValues>
            <swe:nilValue reason="http://www.opengis.net/def/nil/OGC/0/unknown
">0</swe:nilValue>
          </swe:NilValues>
        </swe:nilValues>
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        <swe:constraint>
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            <swe:interval>0 10000000</swe:interval>
            <swe:significantFigures>8</swe:significantFigures>
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        </swe:constraint>
      </swe:Quantity>
    </swe:field>
  </swe:DataRecord>
</gmlcov:rangeType>
```

# Bibliography


- [1] OGC 09-153, WCS 2.0 Overview: Core and Extensions, version 1.0.0
- [2] ISO 8601:2004(E) Data elements and interchange formats - Information interchange - Representation of dates and time
- [3] IETF RFC 2616, Hypertext Transfer Protocol — HTTP/1.1. IETF, 1999
- [4] www.epsg.org
- [5] W3C Note 11, SOAP Messages with Attachments. W3C Note 11, 2000
- [6] XML Schema Part 2: Datatypes Second Edition, W3C Recommendation, 2004
- [7] OpenSearch Specification, 1.1, Draft 5
- [8] OGC 09-025r2, OpenGIS Web Feature Service 2.0 Interface Standard - With Corrigendum, version 2.0.2
- [9] OGC 16-118 EO Data Access Best Practice, version 0.0.1

# Annex A: Revision History

| Date | Release | Author | Paragraph modified | Description |
|---|---|---|---|---|
| 2016-07-22 | 0.0.1 | Stephan Meißl | All | Draft proposal from ESA project EVO-ODAS |