CGMS

CGMS-WMO Task Force on Metadata Implementation

Guidance Documentation on WMO Core Profile Metadata Creation For Satellite Products

Introduction

The CGMS Task Force on Metadata Implementation (CGMS-WMO TFMI) has been created in 2015 and tasked to define guidance documentation for creating WMO Core Profile 1.3 metadata records regarding Satellite Data Products and helping Meteorological Satellite Data Organisation defining and maintaining WIS discovery metadata records.

This documentation is intended for metadata authors or product/infrastructure specialist that would like to create WMO Core Profile 1.3 metadata records for making datasets available via the WMO Information System infrastructure.

The following guide is not intended to create metadata records for datasets that are being distributed on the WMO Global Telecommunication System (GTS) as bulletins. For creating such metadata records, please consult [tbd].

The guidance documentation is composed of the present document and associated WMO Core Profile Templates (see 2 References) that can be used to create individual metadata records or automate the creation of several records. The documentation regroup and define a set of recommendations to be followed in order to provide the right level of satellite product information in the defined WMO Core Profile metadata records. The information included in the metadata record and their respective XML mapping is based on a study involving Satellite data specialists of CGMS member organizations and the WMO IPET-SUP.

References

WMO Core Profile 1.3 Template:

To view the template use that link:

https://github.com/CGMS-TFMI/CGMSTFMI-Teleconferences/blob/master/CGMS-TF-MI-Publications/CGMSTFMI-WMOCoreProfile-Guidance-Documentation/WMO-Core-Profile-Templates/WMOCoreProfile1.3-Template.xml

to download the template use that link:

https://raw.githubusercontent.com/CGMS-TFMI/CGMSTFMI-Teleconferences/master/CGMS-TF-MI-Publications/CGMSTFMI-WMOCoreProfile-Guidance-Documentation/WMO-Core-Profile-Templates/WMOCoreProfile1.3-Template.xml

WMOCore Profile 1.3 Raw Template:

To view the template use that link:

https://github.com/CGMS-TFMI/CGMSTFMI-Teleconferences/blob/master/CGMS-TF-MI-Publications/CGMSTFMI-WMOCoreProfile-Guidance-Documentation/WMO-Core-Profile-Templates/WMOCoreProfile1.3-RawTemplate.xml

to download the template use that link:

https://raw.githubusercontent.com/CGMS-TFMI/CGMSTFMI-Teleconferences/master/CGMS-TF-MI-Publications/CGMSTFMI-WMOCoreProfile-Guidance-Documentation/WMO-Core-Profile-Templates/WMOCoreProfile1.3-RawTemplate.xml

CGMS TFMI Information Model:

http://www.cgms-info.org/documents/CGMS-TF-MI-SatelliteDataEssentialInformationForDiscoveryMetadata.pdf

WIS Guidance for creating GTS bulletin metadata:

http://www.wmo.int/pages/prog/www/WIS/wiswiki/tiki-index.php?page=WmoCoreMetadata

WMO Core Profile documentation:

Part 1 : http://wis.wmo.int/2012/metadata/WMO_Core_Metadata_Profile_v1.3_Part_1.pdf

Part 2 : http://wis.wmo.int/2012/metadata/WMO_Core_Metadata_Profile_v1.3_Part_2.pdf

OSCAR Space-based capabilities: https://www.wmo-sat.info/oscar/spacecapabilities

WIS DIscovery Metadata

The WMO Core Profile (WMCP) v1.3, while sometimes referred to as "discovery" metadata, is also aimed at providing catalogue users with sufficient information for them to decide on the suitability of the data, and to provide access to, or details on how to access the data. Some of the information contained in a WMCP metadata record is vital for optimising the searching functionality offered by the WIS Product catalogues. In the WIS, users typically need to search one of the WIS catalogues, for discovering and accessing products.

A "discovery" metadata record has to contain the following components of information, to help users understand that product: What, When, Where, Who, How. A summary overview is provided below, and details are provided in Section 9.1

1. Product Information:

- **What**: This is the product content, and it is mainly defined by the Product Title and the Product Abstract fields, though additional fields can also be used. The information in the title and abstract is very important because the Product Title and Abstract are indexed by any Product catalogue, and thus searchable. In addition, the title and part of the abstract are presented to users, in the search results of each WIS Catalogue, and so good content here can assist users' efficiency in their "search, view search results, and decide" activity.
- **When**: This is the temporal coverage of the dataset or product, and is captured in the "temporal extent" section of the metadata record. It is possible to describe on-going, finite, or 'rolling window' datasets.
- **Where**: This is the geospatial extent of the dataset, describing which geographical area(s) the product covers, over the earth or atmosphere. It can be the full earth, a region or a specific place. In the WMCP, if the data is geographical, the metadata record must define as at least one bounding box with latitude-longitude coordinates, but that information can also be enhanced by using geographical identifiers for geographical regions, features (such as coastlines) and the like.
- **Who**: This is the contact details of the organization that is responsible for the product; the contact details of the organization responsible for the metadata, and (optionally) the name of the party that should be "cited", when referencing the data. It's possible, but not necessary for the same party to be responsible for both the metadata and data.
- **How - Data access and use**: This information is composed of the distribution information, but also includes the data policy, or terms and conditions for accessing the product. Most of the time, the distribution section offers a URL linking to a data access service. The data access service might require registration, and /or might offer sub-select/sub-sampling of the product.

Currently, users wishing to access information that has the Data Policy (shown in "ResourceConstraints") of “WMOAdditional” must be registered with their regional GISC. Data with a Data Policy of "WMOEssential" can be accessed wihout restriction. Users wishing to set up a “subscription” service, however, must register, regardless of the type of information they require.

2. **WIS necessary technical information**: Section 9.2 of this document defines the set of information required, to have a functioning, distributed WIS infrastructure. This includes, for instance, the WIS unique identifier for each metadata records.

WMO Core Profile and ISO standard

The WMO Core Profile 1.3 is a customization, also called a profile, of the more generic ISO 19115 discovery metadata standard. It allows the meteorological community to better define meteorological products (terrestrial, earth observations, numerical weather predictions model outputs). The ISO 19115 structure is detailed and complex, because it was designed to accommodate a wide range of information resource types. The WMO Core Profile, as well as providing more targeted searching, aimed to remove the need to understand some of those intricacies of ISO19115. This Guide aims to simplify the knowledge needed by users who are starting to create WMO Core Profile v.1.3 metadata records.

WMO Core Profile Metadata Granularity and Scope

One difficulty, when creating a metadata record, is to understand what level of detail of a dataset should be described, in the record for a particular product / dataset. Some products of the same type are continuously produced, during the life time of a satellite, or as model forecast outputs. Creating a new metadata record for each individual satellite instrument measurement granule (produced every three minutes), or for each forecast run (produced three times a day) would make the WIS catalogues' content grow at a huge rate, and the thousands of new metadata records would contain the same information, apart from the measurement time. This would dramatically damage the catalogue search experience, and would make it difficult to find products.

To solve that problem, the creation of one metadata record for an entire “collection” of "like" products is generally recommended, provided that effective searching, and other WIS infrastructure needs are not compromised. An example of "like" products is where each observation product only varies within one or two dimensions (time, geographical position, etc), while still coming from the same measurement instrument or station.
An example of this approach is the EUMETSAT Meteosat Second Generation (MSG) Seviri Level 1.5 dataset which includes all the level 1.5 radiances over the entire MSG mission with a global coverage, and is described by one unique metadata record. The user discovering this product collection, via the WIS portals, is re-directed to a EUMETSAT service offering sub-sampling capacities for selecting the interesting time period and geographic region.

That said, it is up to the data provider to decide what is a valid collection. To assist, IPET-MDRD has defined, in the Annex Section 12 (Collection Definition Criteria), a set of “granularity” criteria to consider when defining a collection metadata record.

WIS product Categories

Two forms of information (and corresponding transport protocols) are used in WIS catalogues:

a) **GTS-delivered data**. This is mainly, but not exclusively, traditional WMO 'bulletins';
b) **non-GTS-delivered data**. This can include both data stored as files, and data as

services.

a) The first category is governed by the set of regulations described in the Manual on GTS (WMO No. 386), including the bulletin header (abbreviated header line) which identifies a bulletin like ISMS01 AMMC.
Metadata records for GTS bulletin datasets need to follow a set of additional rules, and require an understanding of the GTS regulations. Non bulletin files can also be distributed via the GTS.
The most notable feature is the store-and-forward delivery mechanism for bulletins and other data on the GTS. This is the reason that there used to be no URL for a bulletin - once a bulletin is delivered, it is not retained for later reference.
Today, GISCs serve bulletins issued in the past 24 hours, but the common practice is still that a metadata record for bulletins does not include the access URL(s).

b) The second category includes datasets described and searchable from the WIS catalogues, but which are served from the different responsible organizations, via their own infrastructure and data access services. WMO Core Profile (WMCP) 1.3 metadata records for this second category have to follow a minimum* set of rules, to stay compliant with the standard. (*This is a subset of the rules which apply to GTS-served data)
Typically, these metadata record include a URL to access the data.

This guide provides extensive support for creating the different information parts of a metadata record, for non-GTS delivered data are this categroy encompasses most of the satellite data products.

COMPLIANCE to additional metadata standards

This guide provides information to help create metadata records that comply with WMO Core Metadata Profile (**WMCP**) v.1.3. The WMCP Profile is based on ISO-19115 (Geographic information — Metadata standard). ISO 19115 provides two profiling mechanisms:

(i) recommending a more constrained use of ISO19115 (either by recommending use of less fields, making an optional element mandatory, or constraining the expected content of a field) - to suit the needs of a particular community; and

(ii) in addition to (i), defining additional non-ISO19115 fields (and field content) to be added to any record.

Examples of type (i) ISO19115 profiles, in addition to the WMCP, include the INSPIRE Metadata Profile (Infrastructure for Spatial Information in the European Community), the North American Profile, the Australian and New Zealand Metadata Profile (ANZLIC) and UK GEMINI. An example of (ii) is the Marine Community Profile. For more information, see also http://www.dcc.ac.uk/resources/metadata-standards/iso-19115.

Each ISO19115 profile defines specific rules that should be met. For example, to comply with the INSPIRE metadata profile, the additional requirements to be met include the provision of one keyword from the general environmental multilingual thesaurus (GEMET), a lineage statement and a conformance statement to Regulation (EC) No 1205/2008.

The content of a WMO Core Profile 1.3 metadata record, defined following this current guide, can be extended, so that the record also supports additional profiles (such as, for instance, INSPIRE or ANZLIC). In such a case, the metadata author is required to implement any additional requirements specified in the corresponding profile's documentation. The extended WMO Core Profile 1.3 metadata record can still be published on the WIS.

WMO Core Profile - Validation Tools

Metadata publishers are required to ensure that created metadata records conform to relevant technical specifications. For example, XML documents need to be well-formed, schema-valid, and conformant with other requirements imposed by the specifications.

A set of ISO and WMCP validation tools can be used, to ensure that a created WMO Core Profile record is correctly formatted (syntactically and semantically), and can be ingested by a GISC.

In most cases, to validate metadata, the metadata author will need a local copy of the metadata record, or the URL of the metadata file, and offer the local location or url in an online service, or with a locally installed validation software.
Online validation services can automatically evaluate the content of the metadata in terms of the completeness, accuracy and conformance. Some validation tools, such as the one developed by NOAA (http://www.ngdc.noaa.gov/docucomp/recordServices) may give a score based on different aspects including content and quality of metadata.

It is recommended to test the metadata with one of the available tools. It is also always possible to seek assistance from your Principal GISC.

Below is a list of web services and tools used to validate WMO Core Profile 1.3 and ISO 19115/19139 metadata records.

WMO Core Profile 1.3 validation services/tools:

- **NOAA's WMO validation service**:
  http://www.ngdc.noaa.gov/docucomp/validationServicesWmo?
- **GeoNetwork-ANZMEST, with WMO Core Profile Validation**
  https://sourceforge.net/projects/anzmest/files/bom-releases/
  This directory has the Bureau of Meteorology releases of ANZMEST 2.10.x (based on GeoNetwork), which includes WMO Core Profile 1.3 editing and validation tool.
  For instructions on running the software and validation, see the WIS Wiki page on validation tools [below]
- **WIS Wiki page on validation tools** : https://wiswiki.wmo.int/tiki-index.php?page=MDG_Test

ISO 19115/19139 validation services/tools:

- NOAA ISO validation page: http://www.ngdc.noaa.gov/docucomp/recordServices
- GeoNetwork-ANZMEST – BOM branch
  https://sourceforge.net/projects/anzmest/files/bom-releases/ (includes 19115:2006, 19115:INSPIRE)

Principles of metadata management on the WIS

The Global Information System Centres (GISCs) are responsible for the management of metadata. According to the WMO technical regulations, each GISC shall :

- Provide a comprehensive metadata catalogue with discovery services for all National Centres (NC) and Data Collection and Production Centres (DCPC) data content across the WIS,
- Support the Search and Retrieve via URL protocol (SRU),
- Ensure the synchronisation of metadata among GISCs, using the OAI-PMH protocol,

- Support user's identification and authorization, including in terms of metadata maintenance,
- Provide metadata publishing facilities : Using Uploading/Harvesting metadata publishing or on-line Metadata editing to allow Metadata author creating metadata records.

How to publish metadata ?

- Metadata could be published at DCPC or GISC level.
- Find which GISC you belong to (i.e. which is your principal GISC). The official reference of WIS centres (GISCs and affiliated DCPCs and NCs, areas of responsibility) is the Annex VII to the WMO Technical Regulations (WMO N°1060), ***Annex B Approved WIS Centres***. The list of GISCs, and related links, is also available online on WMO portal: https://www.wmo.int/pages/prog/www/WIS/centres/index_en.php. The procedure to be used for metadata management (account creation, editing facilities, ...) may vary between centres, but will usually be via the GISC portal (at least, as a first point of contact).
- Proceed to registering on your principal GISC (this could be done online, depending on GISC's capabilities or policies), after which you will be assigned a username and a role;
- Publish your metadata via your principal GISC : In order to publish your metadata records, use the appropriate method among those allowed by the GISC (import/insert metadata, or harvest metadata using OAI-PMH).
  Note: For a limited number of records, it is typically also possible to use a GISC's online editing services.

For more comprehensive information regarding the WIS and publishing metadata on the WIS, please consult the WIS Manual (http://wis.wmo.int/WIS-Manual).

Generating WMO Core Profile METADATA

This guide is intended to help product specialists creating WIS metadata records describing satellite products. It describes how and where to insert the necessary product information but also WIS specific information in the XML metadata record while abstracting as much as possible the WMO Core Profile standard, ISO 19115 standard and its XML mapping (ISO 19139). The current guide is defining from [7. WMO Core Profile CGMS TFMI recommendations] a set of recommendations when adding each individual pieces of information regarding a product (title, abstract, data responsible party, data access, etc).

A template based approach has been also chosen to abstract the ISO 19115 standards and a metadata author consulting this guide should make a copy of WMOCoreProfile1.3-Template.xml or WMOCoreProfile1.3-RawTemplate.xml and open that template and fill the information regarding the product he intends to make available via the WIS following the recommendations from [7. WMO Core Profile CGMS TFMI recommendations]. The template-based approach allows a non-knowledgeable person in ISO 19115 to create an XML metadata record with the most important set of information to make them easily searchable and accessible from a WIS portal.

This approach can also be used as the foundation for building a web-based editing tool where the user will fill a web form that will be used to populate the template to create the final metadata record.

Template-based principle

A Template is a file containing placeholders or variables that should be replaced with dedicated product information to create a WIS discovery metadata record. The placeholders in the template are in all in capital letters in the form of for instance WMCP-CREATION-DATE or PRODUCT-TITLE.

WMOCoreProfile1.3-Template.xml (see 2 References) is a template for human beings containing in addition to the placeholders, examples in parentheses, ie. ORGANISATION-NAME (e.g NOAA). With a minimum set of effort, a metadata author can by following the examples in WMOCoreProfile1.3-Template.xml and the guidance recommendations from [7. WMO Core Profile CGMS TFMI recommendations] replace the different placeholders and create a WMO Core Profile 1.3 compliant record.

WMOCoreProfile1.3-RawTemplate.xml is a template with only the placeholders, which can be used as a starting template record for automating the generation of metadata records.

WMO Core Profile CGMS TFMI recommendations

The following paragraph describes the list of information to provide to build a meaningful metadata record and for each individual information, the template placeholder(s) to replace, what information is expected from the metadata creator, its location within the ISO metadata records and some examples. The metadata creator should while reading the documentation, open the metadata template WMOCoreProfile1.3-Template.xml and find the corresponding placeholder(s) to add the product information.

Information sets below are described in the given order: Product Information, WIS Technical Information, Addiitonal Satellite information. For each element it will be indicated if it is a mandatory attribute to be compliant with the WMO Core Profile 1.3.

Product Information

Metadata Responsible Party	
TEMPLATE Value:	ADD-ORGANISATION-NAME, ADD-ADDRESS-STREET, etc
Information:	Responsible party for the created metadata record
Necessity:	Mandatory for WMO Core Profile 1.3
Category:	Administrative information
XPath:	*/gmd:MD_Metadata/gmd:contact/gmd:CI_ResponsibleParty*

This element describes the metadata responsible party contact details (address, telephone, email). For example:

```
<gmd:contact>
        <gmd:CI_ResponsibleParty>
            <gmd:organisationName>
                <gco:CharacterString>EUMETSAT</gco:CharacterString>
            </gmd:organisationName>
            <gmd:contactInfo>
                <gmd:CI_Contact>
                    <gmd:address>
                        <gmd:CI_Address>
                            <gmd:deliveryPoint>
                                <gco:CharacterString>EUMETSAT Allee 1</gco:CharacterString>
                            </gmd:deliveryPoint>
                            <gmd:city>
                                <gco:CharacterString>Darmstadt</gco:CharacterString>
                            </gmd:city>
                            <gmd:administrativeArea>
```

```
                            <gco:CharacterString>Hessen</gco:CharacterString>
                        </gmd:administrativeArea>
                        <gmd:postalCode>
                            <gco:CharacterString>64295</gco:CharacterString>
                        </gmd:postalCode>
                        <gmd:country>
                            <gco:CharacterString>Germany</gco:CharacterString>
                        </gmd:country>
                        <gmd:electronicMailAddress>
                            <gco:CharacterString>ops@eumetsat.int</gco:CharacterString>
                        </gmd:electronicMailAddress>
                    </gmd:CI_Address>
                </gmd:address>
                <gmd:onlineResource>
                    <gmd:CI_OnlineResource>
                        <gmd:linkage>
                            <gmd:URL>http://www.eumetsat.int</gmd:URL>
                        </gmd:linkage>
                    </gmd:CI_OnlineResource>
                </gmd:onlineResource>
            </gmd:CI_Contact>
        </gmd:contactInfo>
        <gmd:role>
            <gmd:CI_RoleCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/ML_
gmxCodelists.xml#MD_ScopeCode" codeListValue="pointOfContact">pointOfContact</gmd:CI_RoleCode>
        </gmd:role>
    </gmd:CI_ResponsibleParty>
</gmd:contact>
```

Product Level	
TEMPLATE Value:	ADD-PRODUCT-LEVEL
Information:	Product Processing Level
Necessity:	Optional. Recommend by the CGMS TFMI
Category:	Product Information
XPath:	*/gmd:MD_Metadata/gmd:contentInfo/gmd:MD_ImageDescription/gmd:processingLevelCode/ /gmd:code/gco:CharacterString*

This element describes the product level. Within the earth observation community the level indicates the type of processing that has been applied to original product.

- Level 0 is the original products at full resolution, with all communications artifacts (synchronization frames, ...) removed.
- Level 1 contains the instrument data at full resolution time-referenced with or without radiometric and geometric calibration coefficients and georeferencing parameters applied, depending on the level 1 type. The CGMS TFMI recommends to use the level definition from 8.1 for the different level 1 types.
- Level 2 regroups all derived geophysical variables at the same resolution and location as the Level 1 products.

Product Responsilbe Party	
TEMPLATE Value:	ADD-PRODUCT-RESPONSIBLE-PARTY
Information:	Organisation responsible for the product described in the metadata record
Necessity:	Mandatory for WMO Core Profile 1.3
Category:	Product Information
XPath:	*/gmd:MD_Metadata/gmd:identificationInfo//gmd:pointOfContact*

This element contains the contact details regarding the data provider responsible for the product. For an example please refer to the example of "**Metadata Responsible Party"** as it is using the XML element to provide the contact details.

Product Title	
TEMPLATE Value:	ADD-PRODUCT-TITLE
Information:	Product Name
Necessity:	Mandatory for WMO Core Profile 1.3
Category:	Product information
XPath:	*/gmd:MD_Metadata/gmd:identificationInfo//gmd:citation/ /gmd:alternateTitle/gco:CharacterString*

The Product Title and the Product Abstract are the two most relevant elements in the WCMP metadata record in the context of the WIS Product catalogues as those two elements are presented to the users in the search results and product description page to highlight the product characteristics. They therefore need to focus on presenting the product to the users.

For level 1 products that are calibrated and georeferenced measurements, the CGMS TFMI recommends to define the origin instrument name and type (Imager, Sounder, Altimeter), the product level, the measurement type, the satellite name if well know by the user community. In case of a geostationary satellite, the satellite position (0 degrees) is recommended in the title when it can be shortly described using a geographic identifier.

For instance for products created from geostationary satellites: "AMSR-2 Level 1 Brightness Temperature - GCOM-W1", "High Rate SEVIRI L1.5 Image Data – MSG – 0 degree". For products created from LEO satellites: "SLSTR L1B radiances and brightness temperatures in NTC", "HIRS GDS Level 1B – NOAA",

For level 2 products that are measurements derived products, the CGMS TFMI recommends to qualify the product type and indicate from which instrument the product originates when relevant. A list of typical product types is provided in annex 1 of this document.

For instance typical titles could be: "AMSR-2 Sea Surface Temperature - GCOM-W1", "Operational Geophysical Data Record - Sea Surface Height Anomaly - Jason-2", "Effective Snow Cover by VIS/IR Radiometry". Below is an example:

```
<gmd:identificationInfo>
	<gmd:MD_DataIdentification>
		<gmd:citation>
			<gmd:CI_Citation>
				<gmd:title>
					<gco:CharacterString/>
				</gmd:title>
				<gmd:alternateTitle>
					<gco:CharacterString>
						AMSR-2 Level 1 Brightness Temperature - GCOM-W1
					</gco:CharacterString>
				</gmd:alternateTitle>
			<gmd:CI_Citation>
		<gmd:citation>
	<gmd:MD_DataIdentification>
<gmd:identificationInfo>
```

Product Abstract	
TEMPLATE Value:	ADD-PRODUCT-ABSTRACT
Information:	Abstract describing the product
Necessity:	Mandatory for WMO Core Profile 1.3
Category:	Product information

XPath: */gmd:MD_Metadata/gmd:identificationInfo//gmd:abstract*

The product abstract is important in the context of the WIS catalogues, as it is the product information that is presented in the search results page. It should describe what is judged important by the data producer for informing and attracting users to use his product. The CGMS TFMI is recommending to structure the product description in the way described below in order to create a more coherent and homogenous set of satellite data products on the WIS. Having product abstracts structured similarly will help users comparing and related different satellite data products.

The product abstract should focus on describing the satellite product and in particular the origin instrument name and type, the product level, geometry and production frequency (hourly, every 3 minutes, etc). Information related to the product processing can also be provided when relevant. Additionally information related to the format in which the product is made available and the way of getting access to the product is relevant (name the type of service from which the product is available).

1. **Abstract for Level 1 Products:**

The CGMS TFMI recommends using the list of instrument types from Annex [8.4 Instrument types, and associated characteristics of L1 products], the level 1 types from Annex [8.1 Level 1 type] and the geometry types [8.2 Level 1 product geometry] to create the product abstract.

For instance below is a typical Level 1 product abstract:

This is the rectified High Rate Meteosat SEVIRI image data product. It is a High Rate, every 15 mins transmission products in 12 spectral channels from SEVIRI, a moderate-resolution optical imager with a fixed disc like field of view centered at 0 degree latitude and 0 degree longitude. Level 1.5 (commonly denominated as Level 1c) image data corresponds to the geolocated and radiometrically pre-processed image data, ready for further processing, e.g. the extraction of meteorological products. Any spacecraft specific effects have been removed, and in particular, linearisation and equalisation of the image radiometry has been performed for all SEVIRI channels. The on-board blackbody data has been processed. Both radiometric and geometric quality control information is included. The product is available in HRIT on EUMETCAST the EUMETSAT NRT dissemination system and in a variety of format (native, netcdf, JPG, PNG, Tiff, etc, see distribution part for more information). There are 96 products generated over a complete day (every 15 mins).

2. **Abstract Level 2 Products:**

Level 2 Products are products derived from the orginal measurements and as the scope is wider it is more difficult to establish a comprehensive list of the different product type. Therefore the CGMS TFMI recommends using the Level 2 products type defined in Annex 8.3 Level 2 Product types.

Here is a typical Level 2 product abstract:

Title*: IASI Atmospheric Temperature Water Vapour and Surface Skin Temperature - Metop*

The Atmospheric Temperature, Water Vapour and Surface Skin Temperature (TWT) product contains the vertical profiles of atmospheric temperature and humidity, with a vertical sampling at 101 pressure levels, and surface skin temperature. The vertical profiles are retrieved from the IASI sounder measurements (of IASI L1C product) together with collocated microwave measurements (AMSU & MHS 1B) when available. The main objective of the Infrared Atmospheric Sounding Interferometer (IASI) is to provide high resolution atmospheric emission spectra to derive temperature and humidity profiles with high spectral and vertical resolution and accuracy. Additionally

it is used for the determination of trace gases, as well as land and sea surface temperature, emissivity and cloud properties. The products are provided at the single IASI footprint resolution (which is about 12 km with a spatial sampling of about 25 km at Nadir). The quality and yield of the vertical profiles retrieved in cloudy IFOVs is strongly related to the cloud properties available in the IASI CLP product and the availability of collocated microwave measurements.

Temporal Extent	
TEMPLATE Value:	ADD-TEMPORAL-INFORMATION
Information:	Time period for which the product is available
Necessity:	Mandatory for WMO Core Profile 1.3
Category:	Product information
XPath:	*/gmd:MD_Metadata/gmd:identificationInfo///gmd:extent[3]//gmd:temporalElement/gmd:EX_TemporalExtent/gmd:extent*

This element describes the starting and ending date or date and time information for the data product. The date information is constructed as YYYY-MM-DD, The date and time information is constructed as YYYY-MM-DDTHH:MM:SSZ. For example: `2016-04-17T13:42:54Z`.

The following example shows a dataset with a starting date and an ending date

```
<gmd:temporalElement>
<gmd:EX_TemporalExtent id="boundingTemporalExtent">
<gmd:extent>
<gml:TimePeriod gml:id="boundingTemporalExtentPeriod">
<gml:beginPosition>1878-06-27</gml:beginPosition>
<gml:endPosition>2012-12-31</gml:endPosition>
</gml:TimePeriod>
</gmd:extent>
</gmd:EX_TemporalExtent>
</gmd:temporalElement>
```

Reference metadata: http://data.nodc.noaa.gov/geoportal/rest/document?id=%7BBFF658F0-66A1-45E5-B107-446DAF02695F%7D

It is also possible to describe on-going datasets with a starting date but no ending dates. In that case the attribute indeterminatePosition=”now” should be used.

```
<gmd:temporalElement>
  <gmd:EX_TemporalExtent id="temporalExtent">
    <gmd:extent>
      <gml:TimePeriod gml:id="boundingTemporalExtentPeriod">
        <gml:beginPosition>2006-10-01</gml:beginPosition>
        <gml:endPosition indeterminatePosition="now"/>
      </gml:TimePeriod>
    </gmd:extent>
  </gmd:EX_TemporalExtent>
</gmd:temporalElement>
```

Reference metadata: http://data.nodc.noaa.gov/geoportal/rest/document?id=%7B129EE48B-D70E-4129-BBC0-338BF1622D62%7D

Geographical Information	
TEMPLATE Value:	ADD-GEOSPATIAL-INFORMATION
Information:	Geographic coverage of the product as a bounding box in Latitude/Longitude
Necessity:	Mandatory for WMO Core Profile 1.3
Category:	Product Information
XPath:	*/gmd:MD_Metadata/gmd:identificationInfo//gmd:extent//gmd:geographicElement/ gmd:EX_GeographicBoundingBox*

Geographical area covered by the data product. The geographical area is described as a bounding box with latitude and longitude in decimal degrees.

The following example shows the XML element for a dataset with a bounding box information.

```
<gmd:geographicElement>
<gmd:EX_GeographicBoundingBox id="boundingGeographicBoundingBox">
  <gmd:westBoundLongitude>
    <gco:Decimal>-180</gco:Decimal>
  </gmd:westBoundLongitude>
  <gmd:eastBoundLongitude>
    <gco:Decimal>180</gco:Decimal>
  </gmd:eastBoundLongitude>
  <gmd:southBoundLatitude>
    <gco:Decimal>-90</gco:Decimal>
  </gmd:southBoundLatitude>
  <gmd:northBoundLatitude>
    <gco:Decimal>90</gco:Decimal>
  </gmd:northBoundLatitude>
</gmd:EX_GeographicBoundingBox>
</gmd:geographicElement>
```

Geographic Identifier	
TEMPLATE Value:	ADD-GEOGRAPHIC-IDENTIFIER
Information:	Geographic Identifier indicating the zone covered on earth by the product
Necessity:	Optional
Category:	Product Information
XPath:	/gmd:MD_Metadata/gmd:identificationInfo//gmd:extent//gmd:geographicIdentifier//gmd:code/gco:CharacterString

Optional geographic identifier indicating the zone covered on earth by the product when it is a well know acronym in the targeted user community.

```
<gmd:extent>
   <gmd:EX_Extent>
      <gmd:geographicElement>
         <gmd:EX_GeographicDescription>
            <gmd:geographicIdentifier>
               <gmd:MD_Identifier>
                  <gmd:code>
                    <gco:CharacterString>ADD-GEOGRAPHIC-IDENTIFIER (eg. Full Disk 0
degrees)</gco:CharacterString>
                   </gmd:code>
               </gmd:MD_Identifier>
            </gmd:geographicIdentifier>
         </gmd:EX_GeographicDescription>
       </gmd:geographicElement>
   </gmd:EX_Extent>
</gmd:extent>
```

1.1.1 Descriptive keywords

Descriptive keywords are used to add additional information for classifying the products

WMO Keyword Category	
TEMPLATE Value:	WCMP-WMO-CATEGORY-CODE
Information:	One of the WMO Category keywrods for classifiying the product.
Necessity:	Mandatory for WMO Core Profile 1.3
Category:	Product Information

XPath:	/gmd:MD_Metadata/gmd:identificationInfo/gmd:MD_Identification/gmd:descriptiveKeywords

Any WIS referenced product shall have a least one WMO Category keyword. The chosen keyword shall be one of the following available values:

Table 16. WMO_CategoryCode «CodeList»

	Name	Domain code	Definition
1.	WMO_CategoryCode	WMOCatCd	additional topic categories for WMO community
2.	weatherObservations	001	weather observations
3.	weatherForecasts	002	weather forecasts
4.	meteorology	003	Meteorology
5.	hydrology	004	Hydrology
6.	climatology	005	Climatology
7.	landMeteorologyClimate	006	land meteorology and climate
8.	synopticMeteorology	007	synoptic meteorology
9.	marineMeteorology	008	marine meteorology
10.	agriculturalMeteorology	009	agricultural meteorology
11.	aerology	010	Aerology
12.	marineAerology	011	marine aerology
13.	oceanography	012	Oceanography
14.	landHydrology	013	land hydrology
15.	rocketSounding	014	rocket sounding
16.	pollution	015	Pollution
17.	waterPollution	016	water pollution
18.	landWaterPollution	017	land water pollution
19.	seaPollution	018	sea pollution
20.	landPollution	019	land pollution
21.	airPollution	020	air pollution
22.	glaciology	021	Glaciology
23.	actinometry	022	Actinometry
24.	satelliteObservation	023	satellite observation
25.	airplaneObservation	024	airplane observation
26.	observationPlatform	025	observation platform

The CGMS TFMI recommends to use for satellite products the keyword “satelliteObservation” (024). An additional keyword can also be added if necessary to define the scientific field. For instance below is an example to qualify the product as satelliteObservation and meteorology.

```
<gmd:descriptiveKeywords>
  <gmd:MD_Keywords>
    <gmd:keyword>
      <gco:CharacterString>satelliteObservation</gco:CharacterString>
    </gmd:keyword>
    <gmd:type>
       <MD_KeywordTypeCode          xmlns="http://www.isotc211.org/2005/gmd"          codeListValue="theme"
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/gmxCodelists.xml#MD_KeywordTypeCode">
          Theme
       </MD_KeywordTypeCode>
    </gmd:type>
```

```
    <gmd:thesaurusName>
       <gmd:CI_Citation>
          <gmd:title>
             <gco:CharacterString>WMO_CategoryCode</gco:CharacterString>
          </gmd:title>
          <gmd:date>
             <gmd:CI_Date>
                <gmd:date>
                   <gco:Date>2008-06-01</gco:Date>
                </gmd:date>
                <gmd:dateType>
                   <gmd:CI_DateTypeCode                                    codeListValue="publication"
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode"/>
                </gmd:dateType>
             </gmd:CI_Date>
          </gmd:date>
       </gmd:CI_Citation>
    </gmd:thesaurusName>
  </gmd:MD_Keywords>
</gmd:descriptiveKeywords><gmd:descriptiveKeywords>
  <gmd:MD_Keywords>
    <gmd:keyword>
      <gco:CharacterString>meteorology</gco:CharacterString>
    </gmd:keyword>
    <gmd:type>
       <MD_KeywordTypeCode          xmlns="http://www.isotc211.org/2005/gmd"          codeListValue="theme"
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/gmxCodelists.xml#MD_KeywordTypeCode">
          Theme
       </MD_KeywordTypeCode>
    </gmd:type>
    <gmd:thesaurusName>
       <gmd:CI_Citation>
          <gmd:title>
             <gco:CharacterString>WMO_CategoryCode</gco:CharacterString>
          </gmd:title>
          <gmd:date>
             <gmd:CI_Date>
                <gmd:date>
                   <gco:Date>2008-06-01</gco:Date>
                </gmd:date>
                <gmd:dateType>
                   <gmd:CI_DateTypeCode                                    codeListValue="publication"
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode"/>
                </gmd:dateType>
             </gmd:CI_Date>
          </gmd:date>
       </gmd:CI_Citation>
    </gmd:thesaurusName>
  </gmd:MD_Keywords>
</gmd:descriptiveKeywords>
```

Product Sample Visualization URL	
TEMPLATE Value:	ADD-PRODUCT-IMAGERY-URL
Information:	URL to a sample data visualization
Necessity:	Optional for WMO Core Profile 1.3 but used by WIS Portal to display products
XPath:	*/gmd:MD_Metadata/gmd:identificationInfo//gmd:graphicOverview/gmd:MD_BrowseGraphic/gmd:fileName/gco:CharacterString*

The CGMS TFMI recommends to add a link to the product visualization when possible as GISC portals can display the provided linked image to make the products more attractive for end users.

Below is an example based on EUMETSAT Seviri Level 1.5.

```
<gmd:graphicOverview>
   <gmd:MD_BrowseGraphic>
      <gmd:fileName>
         <gco:CharacterString>http://navigator.eumetsat.int:80/smartEditor/preview/msg-level-1-
5.jpg</gco:CharacterString>
      </gmd:fileName>
      <gmd:fileDescription>
         <gco:CharacterString>preview</gco:CharacterString>
      </gmd:fileDescription>
      <gmd:fileType>
         <gco:CharacterString>jpg</gco:CharacterString>
      </gmd:fileType>
   </gmd:MD_BrowseGraphic>
</gmd:graphicOverview>
```

1.1.2 Data Policy Information

Data Policy Information	
TEMPLATE Value:	ADD-DATA-POLICY
Information:	Data usage and limitations to access the resource
Necessity:	Mandatory for WMO Core Profile 1.3, for data intended for Global Exchange on the GTS. Otherwise, highly recommended, since the absence of a policy can result in users assuming that there are no limitations on Data use. To avoid uncertainty, where there ARE no limitations, use the Data Policy of "NoLimitation".
Category:	Product Information
XPath:	/gmd:MD_Metadata/gmd:identificationInfo/*/gmd:resourceConstraints/gmd:MD_LegalConstraints/↘ {complex content}, including ↘ /gmd:otherConstraints/*/text()=WMO_DataLicenseCode and ↘ /gmd:otherConstraints/*/text()=WMO_GTSProductCategoryCode

The Data Policy category is used to specify the conditions under which the data products can be accessed and used. Completing the data policy section of a WMO Core Profile metadata record is very dependant on the type of data, data policy and the different ways that the data is being distributed. For those reasons, and to minimize the complexity of this section, three representative examples, covering some typical data policies - are presented below.

- **Example 1: Non GTS Product, with a policy of no constraints on use or distribution.**
- **Example 2: Non GTS Product, with a policy applicable in the WMO context**

For a more comprehensive documentation, please refer to the WIS manual, and the WMO Core Profile documentation.

When adding the data policy information, two different parts of the metadata record have be filled:

- the **resourceConstraints** part, which contains the data policy information; and
- the **scope of distribution** part: using one of the terms: 'GlobalExchange', 'RegionalExchange' or 'OriginatingCentre' (to be inserted as a keyword, as explained in Section 9.1.2.1).

Each of the 3 examples below present the first part of the above information (**resourceConstraints**), that is to be added.

Within the the **resourceConstraints** section, the DataLicenseCode term is added into an 'otherConstraints' field; and an explanation of the Data Policy is typically added to an additional 'otherConstraints' field.

/gmd:MD_Metadata/gmd:identificationInfo//gmd:resourceConstraints/gmd:MD_LegalConstraints/gmd:otherConstraints/*/text()*

Allowable terms from the DataLicenseCode include: 'WMOAdditional', 'WMOEssential',

"WMOOther" or "NoLimitation". All of these terms are defined at
http://wis.wmo.int/2012/codelists/WMOCodeLists.xml#WMO_DataLicenseCode

---

- Example 1 detail : **Non GTS Product, with a policy of no constraints on use or distribution**

Publicly available datasets are datasets where no conditions and restrictions apply, on data access and data usage.

The 'useLimitation' field in the 'resourceConstraints' block should contain “No conditions apply”, and an 'otherConstraints' field should contain the phrase “NoLimitation”.

```
<!-- Example of publicly available, unrestricted data -->
<gmd:resourceConstraints>
  <gmd:MD_LegalConstraints>
    <!--  add useLimitation with ..No conditions apply..  -->
    <gmd:useLimitation>
      <gco:CharacterString>No conditions apply</gco:CharacterString>
    </gmd:useLimitation>
    <gmd:useConstraints>
      <!--  Restriction code have to point to WMOCodeLists.xml -->
<gmd:MD_RestrictionCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/gmx
Codelists.xml#MD_RestrictionCode"
         codeListValue="otherRestrictions">otherRestrictions</gmd:MD_RestrictionCode>
    </gmd:useConstraints>
    <!--  otherConstraints with ..NoLimitation..  -->
    <gmd:otherConstraints>
      <gco:CharacterString>NoLimitation</gco:CharacterString>
    </gmd:otherConstraints>
  </gmd:MD_LegalConstraints>
</gmd:resourceConstraints>
```

In addition, the **scope of distribution** would also ideally be stated (as a keyword), and for non GTS products it should be 'OriginatingCentre'

```
<!-- Scope of distribution for non GTS products: OriginatingCentre -->
<gmd:descriptiveKeywords>
  <gmd:MD_Keywords>
    <gmd:keyword>
      <!--  keyword OriginatingCentre applies for DCPC Data -->
      <gco:CharacterString>OriginatingCentre</gco:CharacterString>
    </gmd:keyword>
    <gmd:type>
      <gmd:MD_KeywordTypeCode
           codeList="http://wis.wmo.int/2012/codelists/WMOCodeLists.xml#MD_DistributionScopeCode"
           codeListValue="dataCentre">dataCentre</gmd:MD_KeywordTypeCode>
    </gmd:type>
    <gmd:thesaurusName>
      <gmd:CI_Citation>
        <gmd:title>
          <gco:CharacterString>WMO_DistributionScopeCode, WMOCodelists dictionary Version 1.3
[http://wis.wmo.int/2012/codelists/WMOCodeLists.xml#WMO_DistributionScopeCode]</gco:CharacterString>
        </gmd:title>
    .. .. .. etc    (see Section 9.1.8 (ii) for full details
```

- Example 2 details : **Non GTS Product, with a policy applicable in the WMO context**

This example describes a data product that is not distributed on the GTS, and which has a single data policy applicable in the WMO context. Note that policies that are applicable in the WMO context (and therefore flagged, in an 'otherConstraints' field, with the term "WMOOther") will be presented by the GISCs to the users when they discover the data. GISCs have no obligations to show the other data policies.

A term from the WMO_DataLicenseCode codelist (http://wis.wmo.int/2012/metadata/version_1-3/WMOCodelists.xml#WMO_DataLicenseCode) should be added to an 'otherConstraints' field.

NB: The Data Policy term of "WMOOther" can also be used for data that is delivered via the GTS.

```
<gmd:resourceConstraints>
  <gmd:MD_LegalConstraints>
    <!--   Add useLimitation to indicate the limitations of usage for the data  -->
      <gmd:useLimitation>
        <gco:CharacterString>Disclaimer - While every effort has been made to ensure that these data are accurate and reliable within the limits of the current state of the art, OrganisationX cannot assume liability for any damages caused by any errors or omissions in the data, nor as a result of the failure of the data to function on a particular system. OrganisationX makes no warranty, expressed or implied, nor does the fact of distribution constitute such a warranty.
        </gco:CharacterString>
      </gmd:useLimitation>
      <gmd:accessConstraints>
<gmd:MD_RestrictionCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/gmx
Codelists.xml#MD_RestrictionCode"   codeListValue="copyright">copyright</gmd:MD_RestrictionCode>
      </gmd:accessConstraints>
      <gmd:accessConstraints>
         <gmd:MD_RestrictionCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/gmx
Codelists.xml#MD_RestrictionCode"
codeListValue="otherRestrictions">otherRestrictions</gmd:MD_RestrictionCode>
      </gmd:accessConstraints>
      <gmd:useConstraints>
        <gmd:MD_RestrictionCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/gmx
Codelists.xml#MD_RestrictionCode"   codeListValue="copyright">copyright</gmd:MD_RestrictionCode>
      </gmd:useConstraints>
      <gmd:useConstraints>
         <gmd:MD_RestrictionCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/gmx
Codelists.xml#MD_RestrictionCode"
codeListValue="otherRestrictions">otherRestrictions</gmd:MD_RestrictionCode>
      </gmd:useConstraints>
      <!--  Add WMOOther, to signal that the policy is applicable in the WMO Context -->
      <gmd:otherConstraints>
         <gco:CharacterString>WMOOther
Ordnance Survey Open Data License [https://www.ordnancesurvey.co.uk/docs/licences/os-opendata-licence.pdf]
         </gco:CharacterString>
      </gmd:otherConstraints>
   </gmd:MD_LegalConstraints>
</gmd:resourceConstraints>
```

The scope of distribution, using the term 'OriginatingCentre' would also, ideally, be added (as a keyword).

Please refer to the example encoding of 'scope of distribution', provided (above) under Example 1 above, or in Section 9.1.2.1.

1.1.2.1 WMO Distribution Scope Keyword

9.1.2.1 WMO Distribution Scope Code Keyword

TEMPLATE Value:	ADD-DISTRIBUTION-SCOPE
Information:	Scope of distribution of data within the WMO Information System.
Necessity:	Conditional. Mandatory for WMO Core Profile 1.3, for GTS data.
Category:	Product Information
XPath:	/gmd:MD_Metadata/gmd:identificationInfo/*/gmd:descriptiveKeywords/*/gmd:keyword/*/text() /gmd:MD_Metadata/gmd:identificationInfo/*/gmd:descriptiveKeywords/*/gmd:type/*/@codeListValue=”dataCentre” /gmd:MD_Metadata/gmd:identificationInfo/*/gmd:descriptiveKeywords/*/gmd:thesaurusName/*/ gmd:title/*/text() =“WMO_DistributionScopeCode”

Any WMCP record for GTS data must contain a DistributionScopeCode keyword. The scope of distribution, for data within WIS, shall be expressed as a keyword, using a term from the "WMO_DistributionScopeCode", and that keyword shall have a **KeywordTypeCode** of "datacentre". The keyword will be one of the following terms (from the controlled vocabulary called "WMO_DistributionScopeCode"):

- GlobalExchange
- RegionalExchange
- OriginatingCentre

A WIS Discovery Metadata record describing data for global exchange via the WIS shall have a keyword “GlobalExchange”, of KeywordTypeCode “dataCentre”, from the thesaurus of "WMO_DistributionScopeCode"; and it must also, within the resourceConstraints section of the record, include a term from both the WMO_DataLicenseCode and WMO_GTSProductCategoryCode (see Section 9.1.10, for details)

The **GTS** (Global Telecommunication System) is a data delivery infrastructure, with data mirrored across some or all of the GISCS, as part of the WIS.
The keyword term from the codelist called WMO_DistributionScopeCode is used to indicate whether the product described by a metadata record is or isn't delivered via the GTS and GISCS, and, within the GTS, whether it is globally or regionally exchanged.

- The metadata marked **GlobalExchange** or **RegionalExchange** is for data delivered via the GTS. Data is transmitted from an originating NC/DCPC to the principal GISC, distributed to all (or some) GISCs, then placed on the GISC caches.
- The metadata marked **RegionalExchange, is for data that, while transmitted on the GTS,** might be simply exchanged between two WMO Members (by bilateral agreement). Some example data are regional warnings, or voluminous NWP products.
- The metadata marked **OriginatingCentre** indicates 'non-GTS data'; and includes, for instance, data delivered to users from a DCPC.

Below is an example for ‘non-GTS data’ which is relevant for all satellite data products not distributed on the GTS:

```
<gmd:descriptiveKeywords>
    <gmd:MD_Keywords>
        <gmd:keyword>
            <gco:CharacterString>OriginatingCentre</gco:CharacterString>
        </gmd:keyword>
        <gmd:type>
            <gmd:MD_KeywordTypeCode
codeList="http://wis.wmo.int/2012/codelists/WMOCodeLists.xml#MD_KeywordTypeCode"
codeListValue="dataCentre">dataCentre</gmd:MD_KeywordTypeCode>
        </gmd:type>
        <gmd:thesaurusName>
            <gmd:CI_Citation>
                <gmd:title>
```

```
                    <gco:CharacterString>WMO_DistributionScopeCode
[http://wis.wmo.int/2012/codelists/WMOCodeLists.xml]</gco:CharacterString>
                </gmd:title>
                <gmd:date>
                    <gmd:CI_Date>
                        <gmd:date>
                            <gco:Date>2012-06-27</gco:Date>
                        </gmd:date>
                        <gmd:dateType>
                            <gmd:CI_DateTypeCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/codelist/gmx
Codelists.xml#CI_DateTypeCode" codeListValue="revision">revision</gmd:CI_DateTypeCode>
                        </gmd:dateType>
                    </gmd:CI_Date>
                </gmd:date>
            </gmd:CI_Citation>
        </gmd:thesaurusName>
    </gmd:MD_Keywords>
</gmd:descriptiveKeywords>
```

1.1.3 Data Access Information

1.1.4 Distribution Information

9.1.4 Distribution Information	
TEMPLATE Value:	ADD-URL-TO-DATA-ACCESS-SERVICE, ADD-DISTRIBUTOR-SHORTNAME (eg:EUM), ADD-DISTRIBUTOR-EMAIL-ADDRESS, ADD-FORMAT-NAME, ADD-FORMAT-VERSION
Information:	Resource format, distributor information, and resource transfer options (urls)
Necessity:	Highly Recommended for WMO Core Profile 1.3
Category:	Product Information
XPath:	/gmd:MD_Metadata/gmd:distributionInfo/*/gmd:distributionFormat/*/gmd:formatDistributor/*/ {complex content}, including ↘distributorContact/gmd:CI_ResponsibleParty/ and ↘distributorTransferOptions/*/gmd:online/

Below is an example for a GRIB product made available via FTP server (distributor details are not included in this snippet, for readability, but are included in the TEMPLATE record)

```
<gmd:distributionInfo>
    <gmd:MD_Distribution>
        <gmd:distributionFormat>
            <gmd:MD_Format>
                <gmd:name>
                    <gco:CharacterString>GRIB</gco:CharacterString>
                </gmd:name>
                <gmd:version>
                    <gco:CharacterString>FM 92 GRIB Edition 2</gco:CharacterString>
                </gmd:version>
                <gmd:specification>
                 <gco:CharacterString>http://www.wmo.int/pages/prog/www/WMOCodes.html</gco:CharacterString>
                </gmd:specification>
            </gmd:MD_Format>
        </gmd:distributionFormat>
        <gmd:transferOptions>
            <gmd:MD_DigitalTransferOptions>
                <gmd:onLine>
                    <gmd:CI_OnlineResource>
                        <gmd:linkage>
                            <gmd:URL>ftp://data-portal.ecmwf.int/</gmd:URL>
                        </gmd:linkage>
                        <gmd:protocol>
                            <gco:CharacterString>WWW:DOWNLOAD-1.0-ftp--download</gco:CharacterString>
```

```
                        </gmd:protocol>
                        <gmd:name>
                            <gco:CharacterString>ECMWF DCPC FTP Server</gco:CharacterString>
                        </gmd:name>
                        <gmd:description>
                            <gco:CharacterString>WMO Information System download service through ECMWF
DCPC</gco:CharacterString>
                        </gmd:description>
                        <gmd:function>
                            <gmd:CI_OnLineFunctionCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/gmx
Codelists.xml#CI_OnLineFunctionCode" codeListValue="download">download</gmd:CI_OnLineFunctionCode>
                        </gmd:function>
                    </gmd:CI_OnlineResource>
                </gmd:onLine>
            </gmd:MD_DigitalTransferOptions>
        </gmd:transferOptions>
    </gmd:MD_Distribution>
</gmd:distributionInfo>
```

1.1.5 Party to be cited

9.1.5 Cited Party Information	
TEMPLATE Value:	ADD-CITED-RESPONSIBLE-PARTY-ORGANISATION*O-MW
Information:	Party that should be cited as the 'originator' [that is, data-author], for the resource
Necessity:	Optional for WMO Core Profile 1.3
Category:	Product Information
XPath:	/gmd:MD_Metadata/gmd:distributionInfo/*/gmd:citation/*/gmd:citedResponsibleParty/gmd:CI_ResponsibleParty/{complex content}

Where the data owner wishes to be cited, in references made to their data, they can stipulate this in the citedResponsibleParty block, using a role of 'originator'

Below is an example:

```
<gmd:identificationInfo>
<gmd:MD_DataIdentification>
   <gmd:citation>
      <gmd:CI_Citation>
         …. .. .. ..
         <gmd:citedResponsibleParty>
            <gmd:CI_ResponsibleParty>
                <gmd:organisationName>
                    <gco:CharacterString>EUMETSAT</gco:CharacterString>
                </gmd:organisationName>
                <gmd:role>
                    <gmd:CI_RoleCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/gmx
Codelists.xml#MD_ScopeCode" codeListValue="pointOfContact">originator</gmd:CI_RoleCode>
                </gmd:role>
            </gmd:CI_ResponsibleParty>
         </gmd:citedResponsibleParty>
         <gmd:otherCitationDetails>
             <gco:CharacterString>Add other citing instructions here</gco:CharacterString>
         </gmd:otherCitationDetails>
           .. .. .. ..
       </gmd:CI_Citation>
    </gmd:citation>
     .. .. .. ..
  </gmd:MD_DataIdentification>
</gmd:identificationInfo>
```

Additional details on how the item should be cited can be added to the 'otherCitationDetails' block.

Mandatory WIS Technical Information

1.1.6 Metadata Record Unique Identifier

Metadata Record Unique Identifier	
TEMPLATE Value:	ADD-WMCP-IDENTIFIER
Information:	Unique Identifier for individual WIS Discovery Metadata Records
Necessity:	Mandatory for WMO Core Profile 1.3
Category	WIS Technical Information
XPath:	*/gmd:MD_Metadata/gmd:fileIdentifier*

The WCMP UID should be structured as follow:

urn:x-wmo:md:DataProviderInternetDomainName:ProductUID

with

":" a separator
urn:x-wmo:md: being mandatory,
DataProviderInternetDomainName: being the Citation authority based on the Internet domain name of the data-provider organization (eg. int.eumetsat, gov.noaa)
ProductUID being a unique identifier with a structure defined by the responsible satellite data organisation

Examples:

UID for Roshydromet MTVZA-GY Level 1C data Meteor-M N2:

```
urn:x-wmo:md:planet.iitp.ru:EO:ROSH:DAT:METEOR-M:MTVZA-GY
```

EUMETSAT Meteosat Seviri Level 1.5:

```
urn:x-wmo:md:int.eumetsat:EO:EUM:DAT:MSG:HRSEVIRI
```

Additional rules apply for metadata records describing a GTS products. Please refer to the WMO Core Profile Version 1.3 Specification for additional information regarding GTS products.

1.1.7 Metadata Modification DateStamp

Metadata Modification DateStamp	
TEMPLATE Value:	ADD-LAST-MODIFICATION-DATE
Information:	Last modification date of the metadata record
Necessity:	Mandatory for WMO Core Profile 1.3
Category:	WIS Technical Information
XPath:	*/gmd:MD_Metadata/gmd:dateStamp*

This is the metadata record last modification date with the following date pattern: YYYY-MM-DD

Creation Date	
TEMPLATE Value:	ADD-CREATION-DATE

Information:	Creation date of the product
Necessity:	Mandatory for WMO Core Profile 1.3
Category:	WIS Technical Information
XPath:	/gmd:MD_Metadata/gmd:identificationInfo//gmd:citation//gmd:date// gmd:dateType=”creation”

This is the product Creation date with the following date pattern: YYYY-MM-DD.

For instance:

```
<gmd:date>
   <gmd:CI_Date>
      <gmd:date>
         <gco:Date>2015-03-23</gco:Date>
      </gmd:date>
   <gmd:dateType>
      <gmd:CI_DateTypeCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode"
codeListValue="creation"/>
   </gmd:dateType>
   </gmd:CI_Date>
<gmd:date>
```

Additional Satellite Product information

Below the CGMS TFMI recommends adding a links to a set of typical information: calibration and product information such as processing information. In addition, it is recommended to add links from the OSCAR space database in order to describe the instrument and platform information from that curated official WMO source of information.

1.1.8 Calibration URL Information

Calibration URL Information	
TEMPLATE Value:	URL-TO-CALIBRATION-INFO
Information:	URL links to additional calibration information regarding the product
Necessity:	Optional, recommended when available by the TFMI CGMS Information model
Category	Product Information
XPath:	*/gmd:MD_Metadata/gmd:identificationInfo//gmd:citation//gmd:citedResponsibleParty*

The CGMS TFMI recommends for qualifying the product to provide additional information pointers regarding technical and scientific aspects of the product. It is recommended to provide when available information regarding the product calibration and quality. That information can be provided within the identificationInfo element by replacing the placeholder URL-TO-CALIBRATION-INFO.

For instance for the EUMETSAT Seviri Level 1.5 product the calibration information is inserted as follow in the below element:

```
<gmd:citedResponsibleParty>
  <gmd:CI_ResponsibleParty>
    <gmd:contactInfo>
      <gmd:CI_Contact>
        <gmd:onlineResource>
          <gmd:CI_OnlineResource>
            <gmd:linkage>
               <gmd:URL>
http://www.eumetsat.int/website/home/Data/Products/Calibration/MSGCalibration/index.html</gmd:URL>
             </gmd:linkage>
```

```
            <gmd:name>
              <gco:CharacterString>Seviri Instrument Calibration information</gco:CharacterString>
            </gmd:name>
            <gmd:function>
               <gmd:CI_OnLineFunctionCode
codeList="http://www.ngdc.noaa.gov/metadata/published/xsd/schema/resources/Codelist/gmxCodelists.xml#CI_OnL
ineFunctionCode"                                                codeListValue="calibrationInformation"/>
            </gmd:function>
          </gmd:CI_OnlineResource>
        </gmd:onlineResource>
      </gmd:CI_Contact>
    </gmd:contactInfo>
    <gmd:role/>
  </gmd:CI_ResponsibleParty>
</gmd:citedResponsibleParty>
```

If there is no need to add additional calibration information, the element gmd:citedResponsibleParty containing the placeholder URL-TO-CALIBRATION-INFO has to be removed.

1.1.9 Product Url Technical and Scientific Information

Product Url Technical and Scientific Information	
TEMPLATE Value:	URL-TO-PRODUCT-INFO
Information:	URL to additional product information
Necessity:	Optional, recommended when available by the TFMI CGMS Information model
Category	Product Information
XPath:	*/gmd:MD_Metadata/gmd:identificationInfo//gmd:citation//gmd:citedResponsibleParty*

The CGMS TFMI additionally recommends to add additional technical/scientific URL link information regarding the product if necessary. That information can be provided by replacing the placeholder URL-TO-PRODUCT-INFO with the given URL as described in the following example:

```
<gmd:citedResponsibleParty>
    <gmd:CI_ResponsibleParty>
      <gmd:contactInfo>
        <gmd:CI_Contact>
       <gmd:onlineResource>
       <gmd:CI_OnlineResource>
        <gmd:linkage>
  <gmd:URL>http://www.eumetsat.int/website/home/Data/Products/Level1Data/index.html</gmd:URL>
        </gmd:linkage>
        <gmd:name>
<gco:CharacterString>Meteosat Second Generation product documentation</gco:CharacterString>
        </gmd:name>
        <gmd:function>
          <gmd:CI_OnLineFunctionCode
codeList="http://www.ngdc.noaa.gov/metadata/published/xsd/schema/resources/Codelist/gmxCodelists.xml#CI_OnLineFunctionCode"
codeListValue="productInformation"/>
        </gmd:function>
       </gmd:CI_OnlineResource>
       </gmd:onlineResource>
         </gmd:CI_Contact>
      </gmd:contactInfo>
      <gmd:role/>
     </gmd:CI_ResponsibleParty>
</gmd:citedResponsibleParty>
```

1.1.10 Referencing OSCAR Space Information

OSCAR Space is a database of information regarding space-based capabilities maintained by WMO and referencing all earth-observation missions. The CGMS TFMI recommends to add links to the instrument and satellite mission information contained in OSCAR in order to create a coherent set of information for earth observation metadata records, creating a consistent description of all satellite based products and allowing users to easily understand the product (its type, origin instrument, …).

1.1.10.1 OSCAR Instrument information

OSCAR Instrument information	
TEMPLATE Value:	ADD-OSCAR-INSTRUMENT-PAGE, ADD-INSTRUMENT-NAME
Information:	URL to the corresponding OSCAR instrument page
Necessity:	Optional for WMO Core Profile 1.3 but recommended by CGMS TFMI
Category:	Product Information
XPath:	*gmd:MD_Metadata/gmd:identificationInfo/gmd:MD_Identification/gmd:descriptiveKeywords*

The metadata author should replace the ADD-OSCAR-INSTRUMENT-PAGE placeholder with OSCAR instrument page URL and ADD-INSTRUMENT-NAME with the intrument name. The OSCAR database is freely accessible from https://www.wmo-sat.info/oscar/spacecapabilities.

For instance the page URL for the GOES IMAGER is http://www.wmo-sat.info/oscar/instruments/view/879 and the page URL for the SEVIRI IMAGER is http://www.wmo-sat.info/oscar/instruments/view/503

```
<gmd:descriptiveKeywords>
  <gmd:MD_Keywords>
  <gmd:keyword>
      <gmx:Anchor xlink:href="http://www.wmo-sat.info/oscar/instruments/view/503" xlink:actuate="onRequest"
xlink:role="http://www.wmo-sat.info/oscar/instrumenttypes/view/1">SEVIRI</gmx:Anchor>
  </gmd:keyword>
  <gmd:type>
     <gmd:MD_KeywordTypeCode codeListValue="instrument"
codeList="http://www.ngdc.noaa.gov/metadata/published/xsd/schema/resources/Codelist/gmxCodelists.xml#MD_Key
wordTypeCode">instrument</gmd:MD_KeywordTypeCode>
  </gmd:type>
  <gmd:thesaurusName>
    <gmd:CI_Citation>
      <gmd:title>
        <gco:CharacterString>OSCAR (Observing Systems Capability Analysis and Review Tool) List of all
Instruments (http://www.wmo-sat.info/oscar/instruments)</gco:CharacterString>
      </gmd:title>
      <gmd:date>
        <gmd:CI_Date>
        <gmd:date>
          <gco:Date>2016-02-10</gco:Date>
        </gmd:date>
        <gmd:dateType>
          <gmd:CI_DateTypeCode codeListValue="revision"
codeList="http://www.ngdc.noaa.gov/metadata/published/xsd/schema/resources/Codelist/gmxCodelists.xml#CI_Dat
eTypeCode">revision</gmd:CI_DateTypeCode>
        </gmd:dateType>
        </gmd:CI_Date>
      </gmd:date>
      <gmd:citedResponsibleParty>
        <gmd:CI_ResponsibleParty>
        <gmd:organisationName>
          <gco:CharacterString>WMO Secretariat</gco:CharacterString>
        </gmd:organisationName>
```

```
        <gmd:contactInfo>
          <gmd:CI_Contact>
          <gmd:onlineResource>
          <gmd:CI_OnlineResource>
          <gmd:linkage>
            <gmd:URL>http://www.wmo.int/pages/about/sec/sg_en.html</gmd:URL>
          </gmd:linkage>
          <gmd:protocol>
            <gco:CharacterString>WWW:LINK-1.0-http-link</gco:CharacterString>
          </gmd:protocol>
          </gmd:CI_OnlineResource>
          </gmd:onlineResource>
          </gmd:CI_Contact>
        </gmd:contactInfo>
        <gmd:role>
          <gmd:CI_RoleCode codeListValue="publisher"
codeList="http://www.ngdc.noaa.gov/metadata/published/xsd/schema/resources/Codelist/gmxCodelists.xml#CI_Rol
eCode">publisher</gmd:CI_RoleCode>
        </gmd:role>
        </gmd:CI_ResponsibleParty>
      </gmd:citedResponsibleParty>
    </gmd:CI_Citation>
  </gmd:thesaurusName>
  </gmd:MD_Keywords>
</gmd:descriptiveKeywords>
```

1.1.10.2 OSCAR Platform information

OSCAR Platform information	
TEMPLATE Value:	ADD-OSCAR-PLATFORM-PAGE, ADD-OSCAR-PLATFORM-NAME
Information:	URL to the corresponding OSCAR platform page
Necessity:	Optional for WMO Core Profile 1.3 but recommended by CGMS TFMI
XPath:	gmd:MD_Metadata/gmd:identificationInfo/gmd:MD_Identification/gmd:descriptiveKeywords

The metadata author should replace the ADD-OSCAR-PLATFORM-PAGE placeholder with OSCAR instrument page URL and ADD-PLATEFORM-NAME with the platform name. The OSCAR database is freely accessible from https://www.wmo-sat.info/oscar/spacecapabilities.

For instance the page URL for the NOAA GOES-14 Satellite is https://www.wmo-sat.info/oscar/satellites/view/150.

```
<gmd:descriptiveKeywords>
  <gmd:MD_Keywords>
  <gmd:keyword>
      <gmx:Anchor xlink:href="http://www.wmo-sat.info/oscar/satelliteprogrammes/view/102"
xlink:actuate="onRequest">Meteosat Second Generation</gmx:Anchor>
  </gmd:keyword>
  <gmd:type>
     <gmd:MD_KeywordTypeCode codeListValue="instrument"
codeList="http://www.ngdc.noaa.gov/metadata/published/xsd/schema/resources/Codelist/gmxCodelists.xml#MD_Key
wordTypeCode">instrument</gmd:MD_KeywordTypeCode>
  </gmd:type>
  <gmd:thesaurusName>
    <gmd:CI_Citation>
      <gmd:title>
        <gco:CharacterString>OSCAR (Observing Systems Capability Analysis and Review Tool) List of all
Instruments (http://www.wmo-sat.info/oscar/instruments)</gco:CharacterString>
      </gmd:title>
      <gmd:date>
        <gmd:CI_Date>
        <gmd:date>
          <gco:Date>2016-02-10</gco:Date>
        </gmd:date>
```

```
        <gmd:dateType>
          <gmd:CI_DateTypeCode codeListValue="revision"
codeList="http://www.ngdc.noaa.gov/metadata/published/xsd/schema/resources/Codelist/gmxCodelists.xml#CI_Dat
eTypeCode">revision</gmd:CI_DateTypeCode>
        </gmd:dateType>
        </gmd:CI_Date>
      </gmd:date>
      <gmd:citedResponsibleParty>
        <gmd:CI_ResponsibleParty>
        <gmd:organisationName>
          <gco:CharacterString>WMO Secretariat</gco:CharacterString>
        </gmd:organisationName>
        <gmd:contactInfo>
          <gmd:CI_Contact>
          <gmd:onlineResource>
          <gmd:CI_OnlineResource>
          <gmd:linkage>
            <gmd:URL>http://www.wmo.int/pages/about/sec/sg_en.html</gmd:URL>
          </gmd:linkage>
          <gmd:protocol>
            <gco:CharacterString>WWW:LINK-1.0-http-link</gco:CharacterString>
          </gmd:protocol>
          </gmd:CI_OnlineResource>
          </gmd:onlineResource>
          </gmd:CI_Contact>
        </gmd:contactInfo>
        <gmd:role>
          <gmd:CI_RoleCode codeListValue="publisher"
codeList="http://www.ngdc.noaa.gov/metadata/published/xsd/schema/resources/Codelist/gmxCodelists.xml#CI_Rol
eCode">publisher</gmd:CI_RoleCode>
        </gmd:role>
        </gmd:CI_ResponsibleParty>
      </gmd:citedResponsibleParty>
    </gmd:CI_Citation>
  </gmd:thesaurusName>
  </gmd:MD_Keywords>
</gmd:descriptiveKeywords>
```

Annex

Glossary

- CGMS: Coordination Group for Meteorological Satellites
- CGMS-WMO TFMI: CGMS-WMO Task Force on Metadata Implementation
- GTS: Global Telecommunication Network
- WMO IPET-SUP: WMO Inter-Programme Expert Team on Satellite Utilization and Products
- WIS: WMO Information System
- GISC: Global Intercommunication System Centre
- DCPC: Data Collection and Production Centre
- NC: National Centre
- WMCP: WMO Core Profile
- ISO 19115: http://www.iso.org/iso/catalogue_detail?csnumber=26020
-

Level 1 types

- ***level 1a***: separated sensor counts for each instrument.
- ***level 1b***: geo-referenced sensor counts with appended calibration coefficients (reversible: calibration coefficients are separated from sensor counts). For radar: back-scatter crosssections.
- ***level 1c***: geo-referenced brightness temperatures (or radiances) and albedo (non-reversible: calibration coefficients have been applied to sensor counts and radiances have been converted to brightness temperatures). In the case of IASI, the spectra are apodized.
- ***level 1d***: re-mapped and filtered brightness temperatures (or radiances) and albedo (e.g. cloud mask applied.

Level 1 product geometry

- Swath
- Nadir only
- Set of limb observations
- Spectrum

Level 2 Product types.

Atmosphere Types
Aerosol
Cloud
Forecasts
Humidity
Lightning
Precipitation
Pressure
Radiation
Temperature
Trace Gases
Wind
Land Types

Fire
Land Surface Temperature
Snow and Ice
Soil Moisture
Vegetation
Ocean
Ocean Colour
Ocean Salinity
Ocean Surface Wind
Sea Ice
Sea Surface Height
Sea Surface Temperature
Wave
Climate Types
Fundamental Climate Record
Thematic Climate Data Record
Operational Climate Monitoring

CGMS

Instrument types, and associated characteristics of L1 products

Instrument	General Instrument Characteristics	L1 Product Type	L1 Product Geometry
		• level 1a: separated sensor counts for each instrument. • level 1b: geo-referenced sensor counts with appended calibration coefficients (reversible: calibration coefficients are separated from sensor counts). For radar: back-scatter crosssections. • level 1c: geo-referenced brightness temperatures (or radiances) and albedo (non-reversible: calibration coefficients have been applied to sensor counts and radiances have been converted to brightness temperatures). In the case of IASI, the spectra are apodized. • level 1d: re-mapped and filtered brightness temperatures (or radiances) and albedo (e.g. cloud mask applied)	• Swath • Nadir only • Set of limb observations • Spectrum
01. Moderate-resolution optical imager	Wide range of instruments with the following general characteristics: Operating in the VIS, NIR, SWIR, MWIR and TIR spectral bands, i.e. from ~ 0.4 to ~15 µm. Discrete channels, number from a few to a few tens, separated by dichroics, filters or spectrometers, with bandwidths from ~10 nm to ~1 µm. Imaging capability, i.e. continuous and contiguous sampling, with spatial resolution in the order of 1 km, covering a swath of several 100 km to a few 1000 km. Scanning law generally cross-track, sometimes multi-angle, sometimes under more polarisations. Applicable in both LEO and GEO. Depending on spectral bands, number and bandwidth of channels, and radiometric accuracy, the application fields may include: cloud observation, surface variables, ocean	1b, 1c, 1d	Swath

	colour, aerosol, and cloud-motion winds.		
02. High resolution optical imager	Spatial resolution in the range of less than 1 m to a few 10 m. Covered wavelengths in the VIS, NIR and SWIR bands, i.e. 0.4 to 3 µm, with possible extension to supporting MWIR and TIR. Variable number or channels and bandwidths: single channel (panchromatic) with around 0.4 µm bandwidth (e.g., 500-900 nm) 3 to 10 (multispectral) channels with around 0.1 µm bandwidth continuous spectral range (hyperspectral) with typically100 channels of around 10 nm bandwidth; Imaging capability, i.e. continuous and contiguous sampling, covering a swath ranging from a few 10 km to some 100 km, often addressable within a field-of-regard of several 100 km. Applicable in LEO (GEO not excluded but not yet exploited). Depending on the spectral bands, number and bandwidth of channels, and steerable pointing capability, the application fields may include: panchromatic: recognition, stereoscopy; multispectral: land use/cover, vegetation classification, disaster monitoring; hyperspectral: vegetation process study, carbon cycle.	1b, 1c, 1d	Swath
03. Cross-nadir scanning SW sounder	Covered wavelengths in the UV, VIS, NIR and SWIR bands, i.e. 0.2 to 3 µm. Spectral resolution ranging from a fraction of nm to a few nm. Spatial resolution in the order of 10 km. Horizontal sampling not necessarily continuous and contiguous. Scanning capability varying from none (nadir-only) to a swath of a few 1000 km. Applicable both in LEO and in GEO. Covered application fields depending on spectral bands and resolution: UV basic for ozone; extension to VNIR includes some Cl compounds and several NOx; extension to SWIR includes some green-house species, more accurately measured if supporting MWIR and/or TIR bands are associated.	1b, 1c, 1d	Swath

04. Cross-nadir scanning IR sounder	Covered wavelengths in the MWIR and TIR bands, i.e. 3 to 15 μm, with possible extension to FIR up to 50 μm, and auxiliary channels in VIS/NIR. Spectral resolution in the order of 0.1 cm-1 (very high) or 0.5 cm-1 (hyperspectral) or 10 cm-1 (radiometer). Spatial resolution in the order of 10 km. Horizontal sampling not necessarily continuous and contiguous. Scanning capability varying from none (nadir-only) to a swath of a few 1000 km. Applicable both in LEO and in GEO. Covered application fields mostly depending on the spectral resolution, as follows: radiometers: coarse vertical resolution temperature and humidity profiles; hyperspectral: high vertical resolution temperature and humidity profile, coarse ozone profile and total column or gross profile of few other species, mostly green-house; very-high resolution spectrometers: profiles of several species of atmospheric chemistry interest, including CFC's and other aggressive species.	1b, 1c, 1d	Swath
05. SW and IR sounder	Covered wavelengths in both short-wave (VIS/NIR/SWIR and long-wave (MWIR/TIR). Spectral resolution in the order of 0.2 cm-1 in both SW and LW bands. Spatial resolution in the range of less than 1 km to a few 10 km. Horizontal sampling not necessarily continuous and contiguous. Scanning capability varying from none (nadir-only) to a swath of a several 100 km. Applicable in LEO. The purpose of this type of instrument is to observe greenhouse gases with signatures in both SW and LW to improve the profiling vertical resolution in the PBL.	1b, 1c, 1d	Swath
06. MW imaging radiometer, conical scanning	Covered frequencies from 1 to 200 GHz (wavelengths 1.5 mm to 30 cm), operating in atmospheric window channels of bandwidths from some 100 MHz to some GHz. Spatial resolution from a few kilometres to some 100 km, determined by antenna size and frequency. Horizontal sampling continuous and contiguous, over a swath of some 1500 km. Conical scanning, providing two or more polarisations.	1b, 1c, 1d	Swath

	Applicable only in LEO. Covered application fields mostly depending on the frequency and the spatial resolution (i.e., the antenna size): sea-surface salinity and volumetric soil moisture from lowest frequencies; sea-surface temperature, surface soil moisture, wind speed from low-medium frequencies (wind vector by full polarisation); precipitation, snow, ice from higher frequencies.		
07. MW sounding radiometer, cross-track scanning	Covered frequencies from 20 to 200 GHz (wavelengths 1.5 to 15 mm), operating in absorption bands split in several channels of bandwidths from a few MHz to some GHz. Spatial resolution from some 10 to some 100 km, determined by antenna size and frequency. Horizontal sampling not necessarily continuous and contiguous. Cross-track scanning, providing single or dual polarisations over a swath of some 2000 km. Applicable only in LEO (possibilities in GEO being studied). Covered application fields depending on the exploited frequency bands: nearly-all-weather temperature profile from oxygen bands (e.g., 54 GHz, 118 GHz); nearly-all-weather humidity profile from water vapour bands (e.g., 183 GHz); precipitation also observed.	1b, 1c, 1d	Swath
08. MW imaging/sounding radiometer, conical scanning	Covered frequencies from 10 to 1000 GHz (wavelengths 0.3 mm to 3 cm), operating in absorption bands split in several channels of bandwidths from a few MHz to several GHz; and a number of window channels of bandwidths from some 100 MHz to some GHz. Spatial resolution from a few kilometres to some 100 km, determined by antenna size and frequency. Horizontal sampling continuous and contiguous, over swath of some 1500 km. Conical scanning, providing dual polarisation for window channels and single or dual polarisation for absorption-band channels. Applicable only in LEO. Covered application fields depending on the exploited frequency bands and channels: nearly-all-weather temperature profile from oxygen bands (e.g., 54 GHz, 118 GHz);	1b, 1c, 1d	Swath

	nearly-all weather humidity profile from water vapour bands (e.g., 183 GHz); sea-surface temperature, surface soil moisture, wind speed from low-medium frequencies (wind vector by full polarisation); precipitation, snow, ice from higher frequencies.		
09. Special scanning or non-scanning MW radiometer	Imaging, by synthetic aperture or real-aperture multi-beam antenna: operating in L-band (typically 1.4 GHz); spatial resolution in the order of 50 km with swath of a few 100 km (multi-beam) or some 1000 km (synthetic aperture); applicable only in LEO; for sea-surface salinity and volumetric soil moisture. Imaging, by cross-track electronic scanning: operating in K-band (typically 19 GHz); spatial resolution in the order of 20 km with swath of some 3000 km; applicable only in LEO; for sea ice and heavy precipitation over the sea. Nadir-pointing radiometers: operating on frequencies from 15 to 40 GHz (wavelengths 7.5 mm to 2 cm), across the water vapour absorption band around 23 GHz by two or three channels with a bandwidth of several 100 MHz; spatial resolution of some 20 km and near-continuous sampling along the track; applicable only in LEO; to provide information on total-column water vapour to correct for the atmospheric path delay induced on the signal of the radar altimeter. Imaging from GEO by real or synthetic aperture antenna: operating in absorption bands of oxygen (e.g., 54, 118, 425 GHz) and water vapour (e.g., 183, 380 GHz); spatial resolution changing with frequency, e.g. 50 at 54 GHz; to provide sub-hourly sampling of nearly-all-weather temperature and humidity sounding, and liquid and solid precipitation.	1b, 1c, 1d	Swath or nadir-only
10. Limb-scanning sounder	Covered wavelengths in the ranges of short-wave (UV to SWIR), or infrared (MWIR and TIR) or millimetre-submillimetre (0.1 to 3 mm or 100 to 3000 GHz). Spectral resolution in the range of 0.2 nm (SW) or 0.05 cm-1 (IR) or 100 MHz (Mm-submm). Limb scanning, mechanically determining the vertical resolution (in the range of 1-3 km) and the observed	1b	Limb scan

	atmospheric layer (in the range of 10 to 80 km); and the spatial resolution (about 300 km along-view). In the SW range, scanning may be provided by solar occultation, as well as moon or stars occultation. Applicable only in LEO. Application: high-vertical resolution atmospheric chemistry in the stratosphere and mesosphere, to track species depending on the exploited spectral band.		
11. Broad-band radiometer	Covered wavelengths in the bands of total radiation emerging from Earth and atmosphere (0.2-300 μm) and the fraction represented by reflected solar radiation (0.2-4.0 μm). One broad-band channel integrating over each of the two bands, and optional narrow-bandwidth channels in VIS and/or TIR to collect information on clouds within the IFOV. Cross-track scanning with continuous and contiguous sampling, to cover a swath of a few 1000 km with spatial resolution in the order of 10 km; or biaxial scanning or combination of a cross-track scanning and a wide-angle non-scanning unit to enable conversion of radiance into irradiance; or non-scanning, either with 2π view or along-track only. Applicable both in LEO and in GEO. Observation from the L1 Lagrange libration point also is possible. Application: observation of upward long-wave and short-wave irradiance at TOA, associated to solar irradiance for the purpose of monitoring Earth radiation budget.	1b, 1c	Swath
12. Solar irradiance monitor	Covered wavelengths in the range of solar radiation (0.15-50 μm). Integration over the full range (Total Solar Irradiance) and/or spectroscopy in the 0.15-3 μm range. Total Solar Irradiance measured by absolute techniques, e.g. active cavity radiometers. Applicable in LEO, in GEO, and in special high-orbits. Application: observation of the solar irradiance: at TOA in association with upward long-wave and short-wave irradiance, for the purpose of monitoring Earth radiation budget; at the Sun surface, particularly for variability, significant of Sun interior processes.	1b	Spectrum
13. GNSS radio-occultation sounder	GNSS receiver exploiting at least two L-band frequencies around 1.18, 1.25 and 1.58 GHz.(or 19, 24 and 25.4 cm). Earth's limb observation from surface to the satellite altitude during the occultation phase of satellites of the	1b	Set of limb observations

	GNSS constellations (GPS, GLONASS, Galileo, Beidou). Directional antennas looking aft- (for setting GNSS) and/or fore- (for rising GNSS), and toroidal antenna for navigation. Spatial resolution around 300 km in the direction LEO-satellite to occulting GNSS-satellite, a few 10 km transverse. Horizontal sampling limited by the daily number of occultation events, from 250 to 1500 depending on the number of tracked GNSS constellations and the aft- and/or fore- tracking capability. Supported by a complex system of ground stations for clock error correction by double differentiation. Applicable only in LEO. Applications: very-high vertical resolution profiling of temperature, water vapour and air density; and electron total content and density in the ionosphere.		
14. Lightning imager	Detector matrix (CCD) all-time watching the earth in a very-narrow oxygen band at 777.4 nm. Measurement: flash rate and intensity in the IFOV. Spatial resolution 5-10 km; horizontal sampling continuous and contiguous, over a swath of several 100 km from LEO, full disk from GEO. Applicable both in LEO and in GEO. Applications: detection of convective cloud systems, thus proxy of precipitation; also proxy of earth's electric field and of NOx generation.		
15. Cloud and precipitation radar	Operating frequencies in Ku (~14 GHz), or Ka (~35 GHz), or W (~94 GHz) bands. Ku and Ka bands often flown together. Pulse repetition rate such as to result in a vertical resolution of a few 100 m. Spatial resolution 2 to 5 km; horizontal sampling continuous and contiguous, swath from only nadir (W-band) to several 100 km (Ku and Ka bands). Applicable only in LEO. Applications depending of the exploited frequency: Ku-band suitable for heavy rain (liquid, with droplets that may exceed 1 cm); Ka-band: suitable for light rain (from stratiform clouds) and snowfall; W-band: suitable for non-precipitating clouds (droplets < 0.1 mm).	1b	Swath or nadir-only
16. Radar scatterometer	Operating frequencies in C (~5 GHz), and/or Ku (~14 GHz)	1b	Swath

	bands. Very accurate calibration, to measure backscatter coefficients (σ0) from sea capillary waves. Observation performed from at least 3 distinct directions; spatial resolution 10 to 50 km; horizontal sampling continuous and contiguous, swath some 1000 km. Two scanning concepts: pushbroom, side-looking with azimuths 45°, 90° and 135*, on one side or both; and conical, with two beams to provide four distinct σ0 from each IFOV. Applicable only in LEO. Applications: sea-surface wind; also surface soil moisture.		
17. Radar altimeter	Operating frequencies in Ku-band (~14 GHz) or Ka-band (~36 GHz), with supporting C (~5 GHz) or S (~3 GHz) to correct for signal rotation in the ionosphere. Very accurate ranging measurement, supported by co-flying MW radiometer in the 23 GHz water vapour band for path delay correction. Observation essentially nadir (large-swath possibly to be performed by interferometry of signals from two parallel antennas); spatial resolution in the order of 20 km, possible to be improved to hundred metres along-track by SAR-like processing. Applicable only in LEO. Applications: sea-surface height (ocean topography), significant wave height, sea-surface wind speed, sea-ice thickness; geoid (by analysis of measurement series and the support of precise orbitography).	1b	Nadir
18. Space lidar	Operating wavelengths in the UV (e.g., 355 nm), or VIS (e.g., 532 nm), or NIR (e.g., 1064 nm), or SWIR (e.g., 1600 nm); possible dual-wavelength, two receivers (for Mie and Rayleigh scattering), polarimetry. Spatial resolution in the range of 100 m, often degraded up to 50 km in order to collect enough de-correlated samples; vertical resolution in the range of 100 m (a few 10 cm for lidar altimeters). Non-scanning; either nadir-viewing or oblique. Several designs for different purposes: Doppler lidar generally operating in UV, for both Mie and Rayleigh scattering, to track aerosol and air molecules; oblique view for radial wind in clear-air and aerosol; Backscatter lidar operating at one (in UV) or two (VIS and NIR) wavelengths, often with more polarisations; nadir view for aerosol profile, cloud top height and atmospheric	1b	

	discontinuities; Lidar altimeter operating at two wavelengths, VIS and NIR; nadir view, very high vertical resolution (for sea-ice elevation) and horizontal resolution (for ice boundaries); Differential absorption lidar (DIAL), operating at one wavelength centred on the absorption peak of one trace gas (e.g., O3, H2O and CO2), and nearby windows; nadir-view.		
19. Imaging radar (SAR)	Operating frequencies in P (~0.4 GHz), L (~1.3 GHz), S (~2.7 GHz), C (~5.3 GHz), X (~9.6 GHz), or Ku (~17.2 GHz) band - the mostly used bands being L, C and X. Several combinations of polarizations in transmission and reception possible to be implemented: HH, VV, VV/HH, HH/HV and VV/VH. Spatial resolution can be traded-off with swath: from 1-30 m associated to swath of 30-100 km; and 100-1000 m associated to swath of 300-500 km. Pushbroom, side-looking generally on one side, keeping high resolution within a field-of-regard of several 100 km. Wide range of applications for every frequency band, with variable effectiveness: P-band most suited for biomass monitoring and hydrological mapping; S-band best suited for volumetric soil moisture; C-band covering the widest range (sea-ice, wave parameters by spectral analysis of image segments, surface soil moisture, snow parameters, glaciers, ground water, etc.); X-band providing the best spatial resolution, thus best suited for surveillance; Ka-band specifically suited for snow, that is semi-transparent at lower frequencies; interferometry of the signals from one SAR at different times or two SARs flying in tandem enables measuring the Digital Elevation Model (DEM) and detecting changes of contours and elevation. Applicable only in LEO.	1b	
20. Positioning system	Laser retroreflector: mirrors (generally cube corners) to reflect laser beams sent to the satellite by ground laser-equipped sites during positioning sessions. GNSS receiver: exploiting the differential phase of signals from a few satellites of the Global Navigation Satellite System. Radio positioning system: transponders involving satellite and ground transmitting-receiving stations. Star tracker: CCD imager that tracks bright stars, recognise		

	the pattern and sends information to the satellite attitude control system. Applications: satellite navigation and attitude control; basic to provide the underlying geoid for the altimetry mission, in turn basic for geoid determination; space geodesy: crustal plates positioning and motion; concurring to the observation of the Earth's gravity field.		
21. Gravity sensing system	Accelerometer: to measure the variation of the gravity field along the satellite trajectory. Gradiometer: network of accelerometers to measure the gravity-gradient tensor. Satellite-to-satellite ranging: transmit-receiver systems in K-band (24 GHz) and Ka-band (32 GHz) to accurately measure the distance and its variations between satellites in coordinated orbits. Also implemented by simultaneous reception of signals from tens of GNSS satellites for extremely accurate determination of positioning changes. Applications closely connected with precise orbitography by positioning sys		
22. Solar processes monitor	Family of instruments for remote observation of solar phenomena, either as spectrally-analysed fluxes from the full sun disk, or by detailed imagery of the layers of the solar atmosphere and the heliosphere. Observations: Electromagnetic radiation at discrete wavelengths and total spectral irradiance: Gamma-ray, X-ray, EUV, UV, radio, etc.; Coronal mass ejections and their propagation through interplanetary space; Additional features of the sun and solar atmosphere, such as: magnetic field and the velocity of surface and sub-surface flows.. Observing positions include LEO, GEO, the L1 Lagrange libration point, but also any orbit around the Sun or Earth with constant viewing of the Sun.		
23. Solar wind and cosmic radiation monitor	System of detectors for in-situ measurements of the plasma, energetic particles, and magnetic field in the heliosphere. Specific observations: solar wind (electrons, protons, and heavy ions); energetic electrons, protons, and heavy ions, including galactic cosmic rays; solar wind magnetic field.		

24. Magnetosphere/ionosphere sounder	Systems providing 3-D sounding of the Magnetosphere and Ionosphere through the use of satellite fleets on particular orbits: formation fliying across the magnetospheric volume and tail in highly elliptical orbits; optimized low orbits for ionospheric coverage. The measurements include plasma and energetic particles, magnetic fields, electric fields, scintillations, and electromagnetic waves and radiation		
25. Aurora imager and other special imagers	Family of instruments to image auroral features: FUV and UV imagers; VIS and/or NIR imagers. This also includes imagers of the plasmasphere.		
26. Magnetosphere/ Ionosphere sensor (platform environment)	System of sensors of the plasma, energetic particles, and magnetic and electric fields in the magnetosphere and ionosphere. These instruments are designed both to detect Space Weather disturbances in the magnetosphere and ionosphere, and for the diagnoses of satellite anomalies. Observations include: low-energy and high-energy electrons, protons, and heavy ions; magnetic field; electric field.		
27. Data collection system	Transponder that relays to ground the data collected in situ by Data Collection Platforms (DCP). Applicable in LEO and GEO. Operating modes: random access to collect messages transmitted at fixed times (self-timed DCP) or in emergency (alert DCP); message acquisition only after interrogation of the DCP; location of the DCP if mobile (only from LEO).		
28. Search & rescue system	Transponder that relays distress signals from ground users in difficulty to local user terminals that, in turn, relay the message to a mission control centre enabled to activate the most appropriate unit of the international search & rescue organisation. Applicable in LEO and GEO. LEO enables location of the transmitting user. For GEO, the information on location must be embedded in the message.		