WMO Core Metadata Profile specification

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World Meteorological Organization

Date: 2022-08-03

Version: 2.0.0-alpha2

Document location: TBD

Document status: DRAFT

Task Team on WIS Metadata (TT-WISMD) [1: https://community.wmo.int/governance/commission-membership/commission-observation-infrastructures-and-information-systems-infcom/commission-infrastructure-officers/infcom-management-group/standing-committee-information-management-and-technology-sc-imt/expert-team-metadata-0]

Expert Team on Metadata Standards (ET-Metadata) [2: https://community.wmo.int/governance/commission-membership/commission-observation-infrastructures-and-information-systems-infcom/commission-infrastructure-national-representatives/infcom-management-group/standing-committee-information-management-and-technology-sc-imt/et-metadata]

Standing Committee on Information Management and Technology (SC-IMT) [3: https://community.wmo.int/governance/commission-membership/commission-observation-infrastructures-and-information-systems-infcom/commission-infrastructure-officers/infcom-management-group/standing-committee-information-management-and-technology-sc-imt]

Commission for Observation, Infrastructure and Information Systems (INFCOM) [4: https://community.wmo.int/governance/commission-membership/infcom]

i. Abstract

Discovery and search is a key component to WIS 2.0. Providing quality discovery metadata leveraging industry standards, best practices and architecture helps lower the barrier to and extend the reach of weather, climate, and water data.

This document defines the content, structure and encoding for the WMO Core Metadata Profile (WCMP). This standard is defined as an informal profile/extension of the OGC API - Records Standard [5: https://ogcapi.ogc.org/records].

WCMP documents provide descriptive information for discovery of WMO resources. WMO resources include, but are not limited to, data (NWP models, observations, forecasts and warnings, etc.), services/APIs, and processes.

WCMP documents shall be encoded in GeoJSON (RFC 7946 [6: https://datatracker.ietf.org/doc/html/rfc7946]) as defined in this specification, and shall be made available as HTTP crawlable files, or via API provisioning as defined by OGC API - Records.

Weather/climate/water data is by nature geospatial, and temporal. The W3C Data on the Web Best Practices [7: https://www.w3.org/TR/dwbp] and Spatial Data on the Web Best Practices [8: https://www.w3.org/TR/sdw-bp] provide guidelines on how to best enable spatiotemporal data to lower the barrier for users, search engine optimization and linked data. This also aligns with the FAIR data principles (Findable, Accessible, Interoperable, Reusable) [9: https://en.wikipedia.org/wiki/FAIR_data].

ii. Keywords

The following are keywords to be used by search engines and document catalogues.

wmo, wis 2.0, weather, climate, water, metadata, discovery, search

iii. Security Considerations

No security considerations have been made for this Standard.

Chapter 1. Scope

This document defines the content, structure, and encoding of discovery metadata published as part of a WIS 2.0 catalogue.

The metadata standard defined herein is an informal extension of the International Standard OGC API - Records - Part 1: Core. This metadata standard shall be referred to as the WMO Core Metadata Profile (WCMP).

WCMP discovery metadata records shall be encoded as GeoJSON as defined in OGC API - Records - Part 1: Core, and can represent a number of different resources, including:

- data (NWP model output, observation collections)
- data APIs and data reduction services
- processes (analytics, etc.)

WCMP discovery metadata provides description at the granularity level of a dataset. Station, instrument and observation metadata are supported as part of the WIGOS Metadata Standard [10: https://library.wmo.int/doc_num.php?explnum_id=10109].

This specification defines the conformance requirements for the WMO Core Metadata Profile. Annex A defines the abstract test suite. Annex B provides normative information on codelists.

Chapter 2. Conformance

TODO: WMO techregs for discovery, and how this document meets those techregs

Conformance with this standard shall be checked using the tests specified in Annex A (normative) of this document.

OGC API - Records provides a record metadata model in support of resource discovery. This specification is an as an extension of OGC API - Records - Part 1: Core. Conformance to this specification requires demonstrated conformance to the applicable Conformance Classes of OGC API - Records - Part 1: Core.

Authors of discovery metadata records published within the WIS 2.0 discovery catalogue are required to comply with the WMO Core Metadata Profile (WCMP). WCMP discovery metadata shall therefore be compliant with OGC API - Records - Part 1: Core: Requirements Class: Record Core.

The WMO Secretariat shall publish guidance material to assist authors of WCMP discovery metadata in maintaining consistency betweeen metadata records, as well as quality assessment and reporting.

This specification identifies one (1) Conformance Class. This Conformance Class defines TODO: (x) Requirements, which define the functional requirements of the specification

The mandatory Conformance Classes for WCMP are:

- "WMO Core Metadata Profile Core": This conformance class inherits from OGC API — Records — Part 1: Core: Requirements Class: Record Core which defines the requirements for a catalogue record. The requirements specified in the Requirements Class "Record Core" are mandatory for all implementations of WMCP. The requirements are specified in Chapter 7 and in Annex A.2 in more detail.

Chapter 3. References

- OGC: OGC 20-004, OGC API - Records - Part 1: Core 1.0 (2021) [11: https://docs.ogc.org/DRAFTS/20-004.html]

- OGC: OGC 17-069r, OGC API - Features - Part 1: Core 1.0 (2022) [12: https://docs.opengeospatial.org/is/17-069r4/17-069r4.html]

- IETF: RFC-7946 The GeoJSON Format (2016) [13: https://datatracker.ietf.org/doc/html/rfc7946]

- IETF: RFC-8259 The JavaScript Object Notation (JSON) Data Interchange Formathe GeoJSON Format (2016) [14: https://datatracker.ietf.org/doc/html/rfc8259]

- W3C/OGC: Spatial Data on the Web Best Practices, W3C Working Group Note (2017) [15: https://www.w3.org/TR/sdw-bp]

- W3C: Data on the Web Best Practices, W3C Recommendation (2017) [16: https://www.w3.org/TR/dwbp]

- W3C: Data Catalog Vocabulary, W3C Recommendation (2014) [17: https://www.w3.org/TR/vocab-dcat]

- IANA: Link Relation Types (2020) [18: https://www.iana.org/assignments/link-relations/link-relations.xml]

- Linux Foundation: SPDX License List (2021) [19: https://spdx.org/licenses]

- IETF: JSON Schema (2022) [20: https://json-schema.org]

Chapter 4. Terms and definitions

This document uses the terms defined in OGC Policy Directive 49, which is based on the ISO/IEC Directives, Part 2, Rules for the structure and drafting of International Standards. In particular, the word "shall" (not "must") is the verb form used to indicate a requirement to be strictly followed to conform to this Standard and OGC documents do not use the equivalent phrases in the ISO/IEC Directives, Part 2.

This document also uses terms defined in the OGC Standard for Modular specifications (OGC 08-131r3), also known as the 'ModSpec'. The definitions of terms such as standard, specification, requirement, and conformance test are provided in the ModSpec.

For the purposes of this document, the following additional terms and definitions apply.

term name
> text of the definition

4.1. Abbreviated terms

Table 1. Symbols and abbreviated terms

Abbreviation	Term
API	Application Programming Interface
DCAT	Data Catalog Vocabulary
DCPC	Data Collection and Production Centres
GDC	Global Discovery Catalogue
GIS	Geographic Information System
GISC	Global Information System Centre
HTML	Hypertext Markup Language
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
ISO	Internatioal Organization for Standardization
JSON	JavaScript Object Notation
MQTT	Message Queuing Telemetry Transport
NC	National Centre
NWP	Numerical Weather Prediction
OARec	OGC API - Records
OGC	Open Geospatial Consortium
REST	Representational State Transfer
ROA	Resource-oriented architecture

Abbreviation	Term
S3	Simple Storage Service
SEO	Search engine optimization
SOA	Service-oriented architecture
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
W3C	World Wide Web Consortium
WCMP	WMO Core Metadata Profile
WIS	WMO Information System
WMO	World Meteorological Organization
XML	eXtensible Markup Language

Abbreviation	Term

Chapter 5. Conventions

This section provides details and examples for any conventions used in the document. Examples of conventions are symbols, abbreviations, use of JSON schema, or special notes regarding how to read the document.

5.1. Identifiers

The normative provisions in this Standard are denoted by the URI:

http://wis.wmo.int/spec/wcmp/2.0

All requirements and conformance tests that appear in this document are denoted by partial URIs which are relative to this base.

5.2. Examples

Examples provided in this specification are encoded as GeoJSON.

Complete examples can be found at https://schemas.wmo.int/wcmp/2.0/examples

5.3. Schemas

The WCMP 2.0 schema can be found at https://schemas.wmo.int/wcmp/2.0/wcmpRecordGeoJSON.yaml

5.4. Schema representation

JSON Schema [21: https://json-schema.org] objects are used throughout this specificiation to define the structure of metadata records. These schema / objects are also typically represented using YAML [22: https://en.wikipedia.org/wiki/YAML]. YAML is a superset of JSON, and in this specification are regarded as equivalent.

Metadata record instances are always defined as JSON.

5.5. Use of HTTPS

For simplicity, this document in general only refers to the HTTP protocol. This is not meant to exclude the use of HTTPS and simply is a shorthand notation for "HTTP or HTTPS." In fact, most servers are expected to use HTTPS, not HTTP.

Chapter 6. Introduction

6.1. Overview

The initial WIS Technical Specifications were developed using service-oriented architecture (SOA) principles. It featured complex ISO 19115/19139-based XML for metadata. Since that time, authoritative groups such as W3C and OGC have moved to adopt a more resource-oriented architecture (ROA), leveraging RESTful design patterns as well as mass market encodings such as JSON and HTML.

Aligning with the WIS 2.0 Principles, in order to support the WIS 2.0 Technical Specifications for discovery and search, discovery metadata will be published to a global discovery catalogue, which will provide an OGC API - Records searchable functionality. Users will be able to search from a web browser, whereas machines will interact with an API.

6.1.1. WIS 2.0

WIS 2.0 puts forth the following principles (those focused on discovery metadata are in **bold**):

- **Principle 1: WIS 2.0 adopts Web technologies and leverages industry best practices and open standards**

- **Principle 2: WIS 2.0 uses Uniform Resource Locators (URL) to identify resources**

- **Principle 3: WIS 2.0 prioritizes use of public telecommunications networks (i.e. Internet) when publishing digital resources**

- **Principle 4: WIS2.0 requires provision of Web service(s) to access or interact with digital resources (e.g. data, information, products) published using WIS**

- Principle 5: WIS 2.0 encourages NCs and DCPCs to provide 'data reduction' services via WIS that process 'big data' to create results or products that are small enough to be conveniently downloaded and used by those with minimal technical infrastructure

- **Principle 6: WIS 2.0 will add open standard messaging protocols that use the publish-subscribe message pattern to the list of data exchange mechanisms approved for use within WIS and GTS**

- Principle 7: WIS 2.0 will require all services that provide real-time distribution of messages to cache/store the messages for a minimum of 24 hours, and allow users to request cached messages for download

- Principle 8: WIS 2.0 will adopt direct data exchange between provider and consumer

- Principle 9: WIS 2.0 will phase out the use of routing tables and bulletin headers

- **Principle 10: WIS 2.0 will provide a Catalogue containing metadata that describes both data and the service(s) provided to access that data**

- **Principle 11: WIS 2.0 encourages data providers to publish metadata describing their data and Web services in a way that can be indexed by commercial search engines**

6.1.2. Discovery metadata design considerations

The following describes envisioned workflows of WIS 2.0 in the context of metadata search and harvesting.

We consider the following:

- flexible metadata publishing mechanisms: providers need to be able to publish discovery metadata in the easiest and most efficient way possible

- basic, HTTP crawlable metadata files (filesystem, object storage). For example, publishing discovery metadata as JSON files to an S3 bucket, and then making that bucket available for harvesting and traversal to search engines and metadata harvesters

- the browser as the catalogue: here, browsers utilize mass market search engines as the gateway to low barrier discovery. This pattern may work by way of the Global Discovery Catalogue and the Global Cache, with the idea that search engines can index from the authoritative source

6.1.3. Granularity

In order to provide discovery metadata of value, it is important to clarify the granularity levels of which providers are to provide describing their data/services. Articulating the level of granularity will reduce catalogue "pollution" and bring the user closer to the data via their search criteria.

The following table provides an overview of granularity level and targets for various data types.

Dataset metadata	WCMP
Station metadata	WMDR
Instrument metadata	WMDR
Observation metadata	WMDR

The Discovery metadata workflow below illustrates example metadata publication and discovery workflows against common meteorological data types:
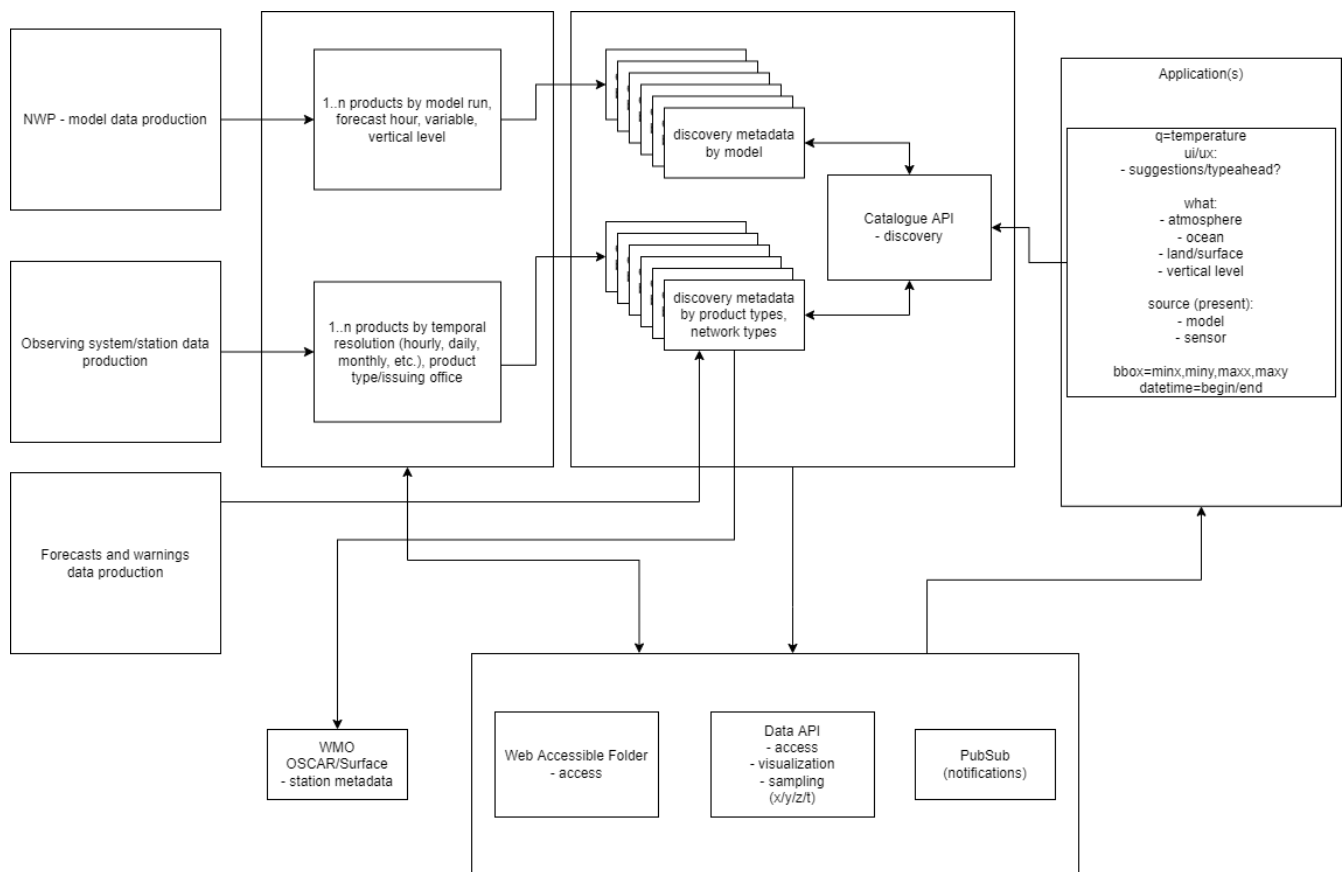
Figure 1. Discovery metadata workflow

Common meteorological data types include:

- collection (model): NWP model (discovery metadata record). Example: Canadian Global Deterministic Prediction System
  - variables are described as themes/concepts (e.g. air temperature)
  - access options:
    - data service or API endpoint to interrogate data/variable/spatiotemporal dimensions
    - x/y/z/t (granule) (STAC Item with link to actual data asset)
- collection (observations): surface weather observations (discovery metadata record)
  - station metadata as WIGOS metadata via WMO OSCAR/Surface
  - access options:
    - data service or API endpoint to interrogate data/variable/spatiotemporal dimensions
    - x/y/z/t (granule) (STAC Item, with link to actual data asset)
- collection (climate archive): climate daily station data (discovery metadata record)
  - access options:
    - API endpoint to interrogate data/variable/spatiotemporal dimensions
    - single observation (granule) (STAC Item with link to actual data asset)

6.2. User stories

As part of requirements gathering [23: https://github.com/wmo-im/wcmp/issues/107], the following user stories provide a description of features that are relevant to WIS 2.0 metadata and search, and are cast from a user perspective:

- As an NWP center operator I want to quickly and easily publish information about the data that my centre provides and update it as needed in a (semi)automated way using the information that I already have in my vast databases so that I can concentrate on my core business

- As the leader of a forecasting team of a national meteorological institution, I would like to be able to find more sources of data that might be relevant/useful for the work of my team, notably NWP and satellite imagery so that we could further improve our predictions. That should work for unprocessed outputs of a prediction model or a satellite as well as for services that offer more sophisticated access to the data, e.g. tailing

- As an entrepreneur (start-up) that provides (wants to provide) tailored weather information I want to be able to find services (free or commercial) that provide meteorological data in a cloud or even better, provide customizable processing of such data - to be able to build my own service on top of it. And I want to be able to find out if a new such service appears or if an existing one changes its abilities so that my company can keep on advancing

- As a software developer (working for a national meteorological centre or a private company), I would like to find a relevant technical description of the service (API) that my boss wants me to integrate with, so that the declared interoperability becomes reality

- As a user I would like to search for real-time observations for a given time and geographical area of interest so that I can have up to date information on weather for my city

- As a web developer I would like to access to a search API that provides easy to read documentation, examples and a simple, intuitive RESTful API with JSON so that I can integrate into my web application quickly

- As a GIS professional, I would like to search for weather/climate/water data from my GIS Desktop support tool so that I can integrate forecast data into my workflow

The following WIS 2.0 marketing video [24: https://gisc.dwd.de/wis2.0/WIS_2.0_final.mp4] adds the following user stories:

- As an everyday user, I would like to find easy to understand and precise weather data so that I can plan to have people over for an outdoor BBQ on a nice day

- As a smart home owner, I would like access to frequently updated data so that I can keep my smart home monitoring up to date

- As a weather specialist, I would like to access weather data in native data formats and subscribe to data updates, so that I can provide tailor made weather services to my users

Given the above, we see a variety of users/actors to which WIS 2.0, driving the need for low barrier, ubiquitous and efficient discovery, visualization, access of weather/climate/water (real-time, near real-time, archive, etc.) data.

6.3. OGC API - Records - Part 1: Core

The OGC Records - API - Part 1: Core specification:

- lowers the discovery barrier to finding the existence of geospatial resources on the Web

- provides the ability for discovery metadata to be published via API machinery or static records

- provides a core record model information communities to extend

- provides a subset of core queryables (e.g. by resource type, by external identifier) which enables federation and cross catalogue discovery functionality

6.4. The WIS 2.0 Global Discovery Catalogue

The GDC will provide a central search endpoint, enabling users to traverse, browse and search data holdings in WIS 2.0. Key search predicate capabilities include:

- geospatial

- temporal (time instant or time period)

- equality predicates (i.e. `property=value`) for any defined property

- full-text (`q=`)

Given the WIS 2.0 principles, use cases, OGC API - Records - Part 1: Core, and the WIS 2.0 Global Discovery Catalogue, WCMP provides a standards-based, clear and well-defined information model to facilitate the management and discovery of data within WIS 2.0.

Chapter 7. The WMO Core Metadata Profile Record

A WCMP record provides descriptive information about a dataset made available through WIS 2.0.

7.1. Conformance Class Core

The WCMP Core Conformance Class provides requirements to articulate the required elements of a WCMP discovery metadata record.

Requirements Class	
http://www.wmo.int/spec/wcmp/2.0/req/core	
Target type	Discovery Metadata
Dependency	IETF RFC 8259: The JavaScript Object Notation (JSON) Data Interchange Format
Dependency	JSON Schema
Dependency	GeoJSON
Dependency	OGC API - Records - Core: Part 1
Pre-conditions	The record conforms to OGC API - Records - Core: Part 1: Requirements Class: Record Core

7.1.1. Validation

The WCMP record schema is based on the schema defined as part of OGC API - Records - Part 1: Core: Requirements Class: Record Core and the associated information model. WCMP records which are valid to WCMP are therefore valid to the OGC API - Records record schema.

Requirement 1	/req/core/validation
A	Each WCMP record SHALL validate without error against the WCMP schema defined in Annex A (TODO: point to correct schema/annex).
A	Each WCMP record SHALL provide `id`, `type`, `geometry` and `properties` properties for GeoJSON compliance.
A	Each WCMP record `type` property SHALL be set to a fixed value of `Feature` for GeoJSON compliance.

7.1.2. Granularity

A WCMP record provides a description at the granularity of a dataset, which facilitates clearer cataloguing and discovery workflow, in combination with data services or APIs, which provide access/query/filter at a lower level of granularity (parameter, variable, spatiotemporal extents).

```
"themes": [
  {
    "concepts": [
      "Temperature",
      "Relative humidity",
      "u-component of Wind",
      "v-component of Wind"
    ],
    "scheme": "http://codes.wmo.int/grib2/codeflag/_4.2"
----
```

```
"themes": [
  {
    "concepts": [
      "Temperature/air temperature",
      "Dewpoint temperature"
    ],
    "scheme": "http://codes.wmo.int/bufr4/b"
----
```

Unresolved directive in sections/clause_7_normative_text.adoc - include::../recommendations/core/REQ_granularity.adoc[]

7.1.3. Identifier

A WCMP record utilizes the OARec `id` property to provide a unique identifier to a dataset. A record identifier is essential for querying and identifying records within the GDC.

```
"id": "urn:x-wmo:md:ca.gc.ec.msc:observations.swob"
```

Requirement 2	/req/core/identifier
A	A WCMP record SHALL have an identifier via the `id`
B	A WCMP record identifier SHALL have a the following notation: `urn:x-wmo:md:{citation_authority}:{local_identifier}`.

C	A WCMP record identifier SHALL contain a citation authority based on the Internet domain name of the data publisher (e.g. `gov.noaa`, `edu.ucar.ncar`, `cn.gov.cma`, `ca.gc.ec.msc`, `uk.gov.metoffice`).
D	A WCMP record identifier SHALL contain a local identifier as defined by the data publisher. The local identifier SHALL NOT have spaces or special/accented characters.

7.1.4. Conformance

A WCMP record leverages the OGC API `conformsTo` property to identify the conformance classes that apply to the record. WCMP conformance identification is valuable for content/version detection and handling.

```
"conformsTo": [
  "http://wis.wmo.int/spec/wcmp/2.0"
]
```

Requirement 3	/req/core/conformance
A	A WCMP record SHALL provide information on conformance via the OARec record `conformsTo` property.
B	A WCMP record `conformsTo` property SHALL advertise conformance to WCMP.

7.1.5. Properties Type

WCMP records provide descriptive information about a number of different resource types, such as dataset or services.

```
"type": "dataset"
```

TODO: create and refer to WCMP2 codelist?

Requirement 4	/req/core/type
A	A WCMP record SHALL provide a `properties.type` property.
B	A WCMP record's `properties.type` property SHALL provide a valid resource type from the WCMP codelists.

7.1.6. Title

A WCMP record's `properties.title` property is a human-readable name for a given dataset.

```
"title": "Surface weather observations"
```

Requirement 5	/req/core/title
A	A WCMP record SHALL provide a `properties.title`

7.1.7. Description

A WCMP record has a `properties.description` property, which is a free-text summary description of the resource the provider wishes to make discoverable.

```
"description": "Surface observations measured at the automatic and manual stations of
the Environment and Climate Change Canada and partners networks, either for a single
station, or for the stations of specific provinces and territories (last 30 days)"
```

Requirement 6	/req/core/description
A	A WCMP record SHALL provide a `properties.description` property.

7.1.8. Keywords

A WCMP record should have a `properties.keywords` property, typically represented using keywords, tags, key phrases, or classification codes.

```
"keywords": [
  "surface",
  "observations",
  "weather",
  "real-time"
]
```

Recommendation 1	/rec/core/keywords
A	A WCMP record SHOULD provide a `properties.keywords` property, as a list of freeform text or tags.

7.1.9. Themes and Topic Hierarchy

A WCMP record has a `properties.themes` property, which is a knowledge organization system used to classify the data that the record is describing. A WCMP can have one or more themes. The WIS 2 Topic Hierarchy is put forth as a specific theme/concept, and is consistent with the topic as defined in distribution links advertising broker services.

```
"themes": [
  {
    "concepts": [
      "weather"
    ],
    "scheme": "https://github.com/wmo-im/wcmp2-codelists/blob/main/codelists/earth-system-domain.csv"
```

```
"themes": [
  {
    "concepts": [
      "wis2/CAN/eccc-msc/data/core/weather/surface-based-observations"
    ],
    "scheme": "https://github.com/wmo-im/wis2-topic-hierarchy"
```

Requirement 7	/req/core/themes_topic_hierarchy
A	A WCMP record SHALL provide a `properties.themes`
B	A WCMP record `properties.theme` SHALL provide ONE theme based on the WIS 2 Topic Hierarchy (additional themes are permitted based on other vocabularies).

7.1.10. Geospatial and Temporal Extents

7.1.10.1. Geospatial Extent

WCMP records provide descriptive information regarding the geospatial properties of a dataset. Geospatial extents provide a useful indicator of the location of the dataset and facilitates searching the Global Discovery Catalogue with geospatial predicates.

```
"geometry": {
    "type": "Polygon",
    "coordinates": [[
            [-142.23, 28.03],
            [-142.23, 82.56],
            [-52.16, 82.56],
            [-52.16, 28.03],
            [-142.23, 28.03]
    ]]
}
```

```
"geometry": {
    "type": "Point",
    "coordinates": [-79.38, 43.65]
}
```

```
"geometry": null
```

Requirement 8	/req/core/extent_geospatial
A	A WCMP record SHALL provide ONE `geometry` property to convey the geospatial properties of a dataset using a geographic coordinate reference system (World Geodetic System 1984 [WGS 84]), and longitude and latitude decimal
B	A WCMP record SHALL provide `geometry` values as integer or float data types.
C	A WCMP record SHALL provide the value of `null` when a conformant geometry cannot be derived.

Recommendation 2	/rec/core/extent_geospatial_point
A	For datasets based on a geometry without a calculated area (i.e. single station point), a WCMP record SHOULD provide the GeoJSON geometry as a `Point` type.

Recommendation 3	/rec/core/extent_geospatial_precision
A	Geometry coordinates SHOULD have a level of precision of 2 decimal places.

7.1.10.2. Additional Geospatial Extents

A WCMP record is able to communicate additional extents (for example, for non-geographic data, or multiple temporal extents) via the `properties.extent` property. The `properties.extent.spatial.bbox` property provides the ability to list 1..n minimum bounding geometries for a given dataset, where:

- minx: westernmost coordinate of the limit of the dataset extent, expressed in longitude decimal degrees as a signed number between -180 and 180, less than or equal to maxx

- miny: southernmost coordinate of the limit of the dataset extent, expressed in latitude decimal degrees as a signed number between -90 and 90, less than or equal to maxy

- maxx: easternmost coordinate of the limit of the dataset extent, expressed in longitude decimal degrees as a signed number between -180 and 180, greater than or equal to minx

- maxy: northernmost coordinate of the limit of the dataset extent, expressed in latitude decimal degrees as a signed number between -90 and 90, greater than or equal to miny

This property also facilitates catalogue searches with geospatial predicate (within extent, etc.).

```
"extent": {
  "spatial": {
    "bbox": [
      [-142, 42, -52, 84]
    ],
    "crs": "http://www.opengis.net/def/crs/OGC/1.3/CRS84"
  }
}
```

Permission 1	/per/core/extent_geospatial
A	A WCMP record MAY provide multiple `properties.extent.spatial.bbox` item properties in order to express additional geospatial extents in other coordinate reference systems.

Temporal Extent

WCMP records provide descriptive information regarding the temporal properties of a dataset. Temporal extents provide a useful indicator of the date/time period of the dataset and facilitates searching the Global Discovery Catalogue with temporal predicates.

```
"time": {
  "date": "2021-10-30"
}
```

```
"time": {
  "timestamp": "2021-10-30T11:11:11Z"
}
```

```
"time": {
  "interval" : ["2020-10-30", "2021-10-30"],
  "resolution": "P1D"
}
```

```
"time": null
```

Requirement 9	/req/core/extent_temporal
A	A WCMP record SHALL provide ONE `time` item property using the Gregorian calendar.
B	A WCMP record SHALL provide the value of `null` when a conformant time cannot be derived.

Recommendation 4	/rec/core/extent_temporal
A	For datasets with known or discrete intervals, a WCMP record SHOULD provide the temporal resolution (`time.resolution`) as a valid ISO 8601 duration (e.g. `P1D`).

7.1.10.3. Additional Temporal Extents

A WCMP record is able to communicate additional time instants or periods via the `properties.extent.temporal` item property. Temporal extents can be fully bound or open in either direction (e.g. until or before. A `properties.extent.temporal.resolution` property is able express the temporal granularity at which a given dataset's data is measured/generated/reported.

```
"extent": {
  "temporal": {
    "interval": [
      [
        "1924-08-18",
        null
      ]
    ],
    "resolution": "P1H",
    "trs": "http://www.opengis.net/def/uom/ISO-8601/0/Gregorian"
  }
}
```

Permission 2	/per/core/extent_temporal
A	A WCMP record MAY provide multiple `properties.extent.temporal` item properties in order to express additional temporal extents in other temporal

7.1.11. Providers

A WCMP record has one or more providers listed as part of the `properties.providers` property. These elements provide contact information based on the role of the provider.

```json
"providers": [
  {
    "name": "Government of Canada; Environment and Climate Change Canada;
Meteorological Service of Canada",
    "individual": "National Inquiry Response Team / \u00c9quipe nationale de
r\u00e9ponse des demandes du public",
    "positionName": "National Inquiry Response Team",
    "contactInfo": {
      "phone": {
        "office": "+01-819-997-2800"
      },
      "email": {
        "office": "+01-506-451-6010"
      },
      "address": {
        "office": {
          "deliveryPoint": "77 Westmorland Street, suite 260",
          "city": "Fredericton",
          "administrativeArea": "NB",
          "postalCode": "E3B 6Z4",
          "country": "Canada"
        },
        "onlineResource": {
          "href": "https://www.canada.ca/en/environment-climate-change.html"
        }
      },
      "hoursOfService": "0700h - 1500h EST",
      "contactInstructions": "email",
      "url": {
        "rel": "canonical",
        "type": "text/html",
        "href": "https://www.canada.ca/en/environment-climate-change.html"
      }
    },
    "roles": [
      {
        "name": "pointOfContact"
      },
      {
        "name": "originator"
      }
    ]
  }
]
```

Requirement 10	/req/core/providers
A	A WCMP record SHALL provide a `properties.providers`

B	A WCMP record `properties.providers` property SHALL provide at least TWO providers (as multiple provider objects or a single provider object with multiple roles) based on the metadata point of contact and the originator of the data (TODO: validation required roles) (TODO: codelist?). Providers are defined as either a URI or inline.

7.1.12. Version

Datasets can typically be versioned by an organization (version of an NWP model, processing chain/workflow, etc.). Data providers may choose to make this information available to the user when providing multiple versions of a dataset over time.

```
"version": "0.1.0"
```

Permission 3	/per/core/version
A	A WCMP record MAY provide a `properties.version` property to describe the version of a given dataset.

7.1.13. Digital Object Identifier

A digital object identifier (DOI) is a persistent identifier or handle used to identify various objects uniquely, and is widely used in scientific publications.

```
"externalIds": [
  {
    "scheme": "doi",
    "value": "https://dx.doi.org/10.14287/10000001"
  }
]
```

Permission 4	/per/core/doi
A	A WCMP record MAY provide a Digital Object Identifier (DOI) as a means to cite research or resource identification using the DOI framework.

Recommendation 5	/rec/core/doi
	property.

A	A WCMP record SHOULD provide DOI references via an item in the `properties.externalIds` array property, where the value of `scheme` fixed to `doi`, and the value of `value` being a permalink of the full DOI with `prefix/suffix` (example https://dx.doi.org/10.14287/10000001).

7.1.14. Record Creation Date

A WCMP record has a `properties.recordCreated` property, which describes the date that the record was created.

```
"recordCreated": "2021-06-12T23:45:24Z"
```

Requirement 11	/req/core/record_creation_date
A	A WCMP record SHALL provide a `properties.recordCreated` property.

7.1.15. Record Update Date

A WCMP record has a `properties.recordUpdated` property, which describes the date that the record was last updated.

```
"recordUpdated": "2022-06-12T18:52:39Z"
```

Requirement 12	/req/core/record_update_date
A	A WCMP record SHALL provide a `properties.recordUpdated` property.

7.1.16. WMO Data Policy

Based on the WMO Unified Data Policy for the International Exchange of Earth System Data (Resolution 1 (Cg-Ext(2021) [25: https://library.wmo.int/doc_num.php?explnum_id=11113#page=9], exchanged data are classified as `core` or `recommended`.

Requirement 13	/req/core/data_policy
A	A WCMP record SHALL provide exactly one `properties.wmo:dataPolicy` property.

B	A WCMP record's `properties.wmo:dataPolicy` property SHALL have exactly one `name` item which SHALL be either `core` or `recommended`.
C	If a WCMP record's `properties.wmo:dataPolicy.name` is equal to `recommended`, a `properties.wmo:dataPolicy.additionalConditions` item SHALL

If the resource is classified as `recommended`, it needs to be indicated if any additional conditions apply. Conditions on use are essential for the WMO Unified Data Policy, but for transparency and clarification any other conditions should also be indicated.

Requirement 14	/req/core/data_policy_conditions
A	A WCMP record's `properties.wmo:dataPolicy.additionalConditions` SHALL enumerate 1..n objects to describe the conditions for the
B	The `properties.wmo:dataPolicy.additionalConditions.name` property SHALL identify the condition applied to the
B	The `properties.wmo:dataPolicy.additionalConditions.scheme` property SHALL be used to identify a codelist or controlled vocabulary to which the condition name applies.
C	If there are **no** additional conditions, the fixed value of `none` SHALL be provided `properties.wmo:dataPolicy.additionalConditions.name` without any scheme identified.

Example: Core Data

```
"wmo:dataPolicy": {
    "name": "core"
}
```

Example: Recommended Data with no additional conditions

```
"wmo:dataPolicy": {
    "name": "recommended",
    "additionalConditions": [
        {
            "name": "none"
        }
    ]
}
```

Example: Recommended Data with additional conditions

```
"wmo:dataPolicy": {
    "name": "recommended",
    "additionalConditions": [
        {
            "name": "copyright",
            "scheme":
"https://standards.iso.org/iso/19139/resources/gmxCodelists.xml#MD_RestrictionCode"
        }
    ]
}
```

For having the most detailed information about data policy and additional conditions it is useful to add provider-specific details.

Recommendation 6	/rec/core/data_policy_conditions
A	A WCMP record's `properties.wmo:dataPolicy.additionalConditions` SHOULD provide additional provider-specific details to the conditions by adding an external URL in a `properties.wmo:dataPolicy.additionalConditions.link` object.
B	The `properties.wmo:dataPolicy.additionalConditions.scheme` property SHOULD be used for conditions which are based on a codelist of controlled vocabulary.
C	A WCMP record's `properties.wmo:dataPolicy.additionalConditions` SHOULD contain a `properties.wmo:dataPolicy.additionalConditions.link.title` property to provide additional human-readable information

Example: Recommended Data with additional conditions and provider-specific details:

```
"wmo:dataPolicy": {
    "name": "recommended",
    "additionalConditions": [
        {
            "name": "license",
            "scheme":
"https://standards.iso.org/iso/19139/resources/gmxCodelists.xml#MD_RestrictionCode",
            "link": {
                "href": "https://www.eumetsat.int/eumetsat-data-licensing",
                "title": "EUMETSAT DATA LICENSING"
            }
        }
    ]
}
```

7.1.17. Distribution Information

7.1.17.1. Overview

A WCMP record provides information regarding how to access and retrieve data and products. This information is specified by defining a `links` array property, with one or more objects to corresponding data access services.

7.1.17.2. Examples

- *Adding the MQTT information*

Below is an example of two link objects, providing both search and MQTT subscription information:

```
"links": [
  {
    "rel": "search",
    "type": "text/html",
    "title": "WOUDC - Data - Station List",
    "href": "https://woudc.org/data/stations"
  },
  {
    "rel"  : "data",
    "type" : "application/json",
    "title": "WIS 2 notification service",
    "href" : "mqtts://broker.example.org",
    "wmo:topic": "cache/a/wis2/CAN/eccc-msc/data/core/weather/surface-based-
observations"
  }
]
```

- *Example with the mandatory distribution information*

Below is provided an example link object of a WMS service providing API access to images:

```
{
  "rel": "item",
  "type": "image/png",
  "title": "Eumetview",
  "href":
"https://view.eumetsat.int/geoserver/ows?service=WMS&request=GetMap&version=1.3.0&laye
rs=msg_fes:ir108&styles=&format={format}&crs={crs}&bbox={bbox}&width={width}&height={h
eight}",
  "templated": true,
  "variables": {
    "crs": {
      "description": "...",
      "type": "string",
      "enum": [
        "EPSG:4326",
        "EPSG:3857"
      ]
    },
    "bbox": {
      "description": "...",
      "type": "array",
      "items": {
        "type": "number",
        "format": "double"
      },
      "minItems": 4,
      "maxItems": 4
    },
    "width": {
      "description": "...",
      "type": "number",
      "format": "integer",
      "minimum": 600,
      "maximum": 5000
    },
    "height": {
      "description": "...",
      "type": "number",
      "format": "integer",
      "minimum": 600,
      "maximum": 5000
    },
    "format": {
      "description": "...",
      "type": "string",
```

```
      "enum": [
        "image/geotiff",
        "image/geotiff8",
        "image/gif",
        "image/jpeg",
        "image/png; mode=8bit"
      ]
    },
    "sampleRequest":
 "https://view.eumetsat.int/geoserver/ows?service=WMS&request=GetMap&version=1.3.0&laye
 rs=msg_fes:ir108&styles=&format=image/jpeg&crs=EPSG:4326&bbox=-77,-
 77,77,77&width=800&height=800"
  }
}
```

- *Example with the complete distribution information*

Additional distribution information is added to allow creating more comprehensive discovery services. Below is an example of such distribution information.

```
{
  "rel": "service",
  "type": "text/html",
  "title": "EUMETSAT Datastore",
  "href": "https://data.eumetsat.int/data/map/EO:EUM:DAT:MSG:MSG15-RSS",
  "distribution": {
    "availableFormats": [
      {
        "name": "native",
        "description": "This is sent in a compressed Submission Information Package
 (SIP) by default.",
        "numberOfFiles": "288 per day",
        "typicalFilesize": "60 MB",
        "typicalFilename": "MSG3-SEVI-MSG15-0100-NA-20130208102743.243000000Z-
 1051616.zip",
        "samples": "https://data.eumetsat.int/data/access/MSG3-SEVI-MSG15-0100-NA-
 20130208102743.243000000Z-1051616.zip",
        "documentation": {
          "rel": "alternate",
          "type": "text/html",
          "title": "SIP documentation and tools",
          "href": "https://www.eumetsat.int/formats#SIP"
        }
      }
    ]
  }
}
```

Requirement 15	/req/core/links
A	A WCMP record SHALL define a `links` property.
B	A WCMP record `links` property SHALL contain at least one link to the data access service allowing users to download the data in one of the supported formats.
C	A WCMP record `links` property SHALL contain the MQTT topic information for real-time data under which the data publication notifications will accessible from the WIS 2 Global Broker. The topic shall follow the WIS 2 topic hierarchy defined in (TODO add the reference to the topic
D	A WCMP record `links` property SHALL contain a Web Accessible Folder (WAF) OR an API link for non real-time data (e.g. climate records, hydrometric data archives).

Recommendation 7	/rec/core/distribution
A	A WCMP record SHOULD describe additional distribution information with the `properties.distribution` property to qualify a given service link. This information SHOULD be used to build the discovery information and allow the user finding and choosing the appropriate service for
B	The `properties.distribution.availableFormat` property SHOULD describe the different formats that can be retrieved using the service link.
C	The `properties.distribution.availableFormat.description` SHOULD describe the associated format.
D	The `properties.distribution.availableFormat.typicalFilename` SHOULD describe the filenames that are going to be retrieved from the service link.
E	The `properties.distribution.availableFormat.typicalFilesize` SHOULD describe the typical filesize that are going to be retrieved from the service link.

F	The `properties.distribution.availableFormat.numberOfFiles` SHOULD describe the typical number of files received during a given period (day, month, …) when using the service link. It SHOULD follow the pattern X per day, X
G	The `properties.distribution.availableFormat.documentation` SHOULD be a `link` for accessing the documentation associated to the format.
H	The `properties.distribution.availableFormat.productSamples` SHOULD be an array of direct links to representative samples of the data.

Recommendation 8	/rec/core/links
A	When a WCMP record's provides a link object to a broker, the `wmo:topic` property SHOULD be consistent to the WIS 2 topic as specified in a `properties.themes` object.

accessing the data.

Annex A: Conformance Class Abstract Test Suite (Normative)

A.1. Conformance Class: Core

label

http://www.wmo.int/spec/wcmp/2.0/conf/core

subject

Requirements Class "core"

classification

Target Type:Discovery Metadata

A.1.1. Validation

label

/conf/core/validation

subject

/req/core/validation

test-purpose

Validate that a WCMP record is valid to the authoritative WCMP schema.

Run JSON Schema validation on the WCMP record against the WCMP authoritative schema

A.1.2. Identifier

label

/conf/core/identifier

subject

/req/core/identifier

test-purpose

Validate that a WCMP record has a valid identifier.

Check for the existence of an `id` property in the WCMP record.

In the WCMP record's `id` property, check that there are four tokens, delimited by `:`.

In the WCMP record's `id` property, delimiting the value on `:`, check that the first three tokens are equal to `['urn', 'x-wmo', 'md']`.

In the WCMP record's `id` property, delimiting the value on `:`, check that the fourth token is is a citation authority based on the data publisher.

In the WCMP record's `id` property, delimiting the value on `:`, check that the fifth token (the local identifier) has no spaces or accented characters.

A.1.3. Conformance

label

/conf/core/conformance

subject

/req/core/conformance

test-purpose

Validate that a WCMP record provides valid conformance information.

Check for the existence of a `conformsTo` property in the WCMP record.

In the WCMP record's `conformsTo` array property, check that ONE of the values is equal to `http://wmo.int/spec/wcmp/2.0/conf/core`.

A.1.4. Type

label

/conf/core/type

subject

/req/core/type

test-purpose

Validate that a WCMP record provides valid resource type information.

Check for the existence of a valid `properties.type` property in the WCMP record.

A.1.5. Geospatial Extent

label

/conf/core/extent_geospatial

subject

/req/core/extent_geospatial

test-purpose

Validate that a WCMP record provides a valid geometry property.

Check for the existence of one `geometry` property in the WCMP record.

Check that all `geometry` value data types are integers or floats.

Check that `geometry` longitudinal values are between -180 and 180.

Check that `geometry` latitudinal values are between -90 and 90.

Check that `geometry` property is a valid GeoJSON geometry.

A.1.6. Temporal Extent

label

   /conf/core/extent_temporal

subject

   /req/core/extent_temporal

test-purpose

   Validate that a WCMP record provides a valid temporal extent property.

> Check for the existence of one `time` item property in the WCMP record.
>
> Check that `time` object is one of `date` string, `timestamp` string, `interval` array, or `null.
>
> Check that all non-null `time` values are valid RFC3339 representations, or `..` for an open ended extent.

A.1.7. Title

label

   /conf/core/title

subject

   /req/core/title

test-purpose

   Validate that a WCMP record provides a title property.

> Check for the existence of a `properties.title` property in the WCMP record.

A.1.8. Description

label

/conf/core/description

subject

/req/core/description

test-purpose

Validate that a WCMP record provides a description property.

Check for the existence of a `properties.description` property in the WCMP record.

A.1.9. Themes and Topic Hierarchy

label

/conf/core/themes_topic_hierarchy

subject

/req/core/themes_topic_hierarchy

test-purpose

Validate that a WCMP record provides a themes property based on the WIS 2 Topic Hierarchy.

Check for the existence of a `properties.themes` property in the WCMP record.

Within `properties.themes`, check for one theme with a scheme value of `http://www.wmo.int/spec/wis-topics/1.0`.

Within the theme based on the WIS 2 Topic Hierarchy scheme, check that all values are valid topic hierarchies.

A.1.10. Providers

label

/conf/core/providers

subject

/req/core/providers

test-purpose

Validate that a WCMP record provides contact information for the metadata point
of contact and originator of the data.

Check for the existence of a `properties.providers` property in the WCMP record.

Within `properties.providers`, check for the existence of `originator` and
`pointOfContact` within the `roles` array property across all provider objects.

A.1.11. Record Creation Date

label

/conf/core/record_creation_date

subject

/req/core/record_creation_date

test-purpose

Validate that a WCMP record provides a record creation date.

Check for the existence of a `properties.recordCreated` property in the WCMP
record.

A.1.12. Record Update Date

label

/conf/core/record_update_date

subject

/req/core/record_update_date

test-purpose

Validate that a WCMP record provides a record update date.

Check for the existence of a `properties.recordUpdated` property in the WCMP record.

A.1.13. WMO Data Policy

label

/conf/core/data_policy

subject

/req/core/data_policy

test-purpose

Validate that a WCMP record provides information about data policy and if applicable additional information about licensing and/or rights.

Check for the existence of a `properties.wmo:dataPolicy` property in the WCMP record.

Check that `properties.wmo:dataPolicy` has an element `name` that is equal to `core` or `recommended`.

If `properties.wmo:dataPolicy.name` is equal to `recommended`, check for the existance of a `properties.wmo:dataPolicy.additionalConditions` element containing at least one object with a `name` property.

Check that `properties.wmo:dataPolicy.additionaConditions.conditions` is `none`. If the value is not `none`, then check for the existence of a `properties.wmo:dataPolicy.additionalConditions.scheme` property.

A.2. Links

label

   /conf/core/links

subject

   /req/core/links

test-purpose

   Validate that a WCMP record provides a link property.

Check for the existence of a single `links` array property in the WCMP record.

Check that the `links` property provides a minimum of one link object.

For a link object describing real-time data, check that the `href` property starts with the `mqtt` or `mqtts` protocol, AND that `wmo:topic` is additionally defined.

For a link object describing archived (NOT real-time) data made available via API, check that the `rel` property is a recognized API service type as defined by IANA or OGC.

For a link object describing archived (NOT real-time) data made available via Web Accessible Folder, check that the `rel` property is a recognized API service type as defined by IANA or OGC.

Annex B: Codelists

Annex C: Bibliography

- W3C/OGC: Spatial Data on the Web Best Practices, W3C Working Group Note 28 September 2017, https://www.w3.org/TR/sdw-bp

- W3C: Data on the Web Best Practices, W3C Recommendation 31 January 2017, https://www.w3.org/TR/dwbp

- W3C: Data Catalog Vocabulary, W3C Recommendation 16 January 2014, https://www.w3.org/TR/vocab-dcat

- IANA: Link Relation Types, https://www.iana.org/assignments/link-relations/link-relations.xml

- Linux Foundation: SPDX License List, https://spdx.org/licenses

Annex D: Revision History

Date	Release	Editor	Primary clauses modified	Description
2021-11-06	Template	Tom Kralidis	all	initial template