WMO Core Metadata Profile 1.3, Key Performance Indicators

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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]

Chapter 1. Overview

1.1. Purpose

This document is intended to define Key Performance Indicators (KPIs) in support of the WMO Core Metadata Profile (WCMP). KPIs provide measurable and valuable quality assessment rules over and above the rulesets put forth by WCMP and ISO 19115:2003/19139:2007.

The core driver of WCMP KPIs is continuous improvement and useability of discovery metadata as part of the WMO Information System (WIS). [5: https://community.wmo.int/activity-areas/wmo-information-system-wis]

1.2. Scope

This document is bound to the WCMP 1.3 specification and codelists. All other metadata specifications or representations are not in scope.

1.3. Audience

The target stakeholder audiences for this document include (but are not limited to):

- Metadata providers (NCs, DCPCs)
- Metadata consumers (GISCs)
- WMO World Data Centres (WDCs)
- GAW World Data Centres (WDCs)
- WMO WIS Operations and Monitoring
- Metadata implementors (generation, ingest)

1.4. How to use

The KPIs in this document are designed to help metadata providers in the curation of discovery metadata, as well as GISCs to measure the quality of metadata from NCs and DCPCs.

In order to improve quality:

- providers should use the KPIs to build into their metadata generation
- consumers should use the KPIs in order to quality assess discovery metadata and provide subsequent feedback to providers

1.5. Scoring

Each KPI assesses a number of criteria asssociated with metadata quality, resulting in a raw score, as well as a percentage. This approach supports weighted rubric scoring.

1.6. Reference implementation

The TT-WISMD maintains pywcmp [6: https://github.com/wmo-im/pywcmp], as the reference WCMP validation utility which includes:

- validation against WMO Core Metadata Profile 1.3, specifically Part 2, Section 2
- validation against the KPIs described in this document

Documentation on installation, configuration and usage can be found on the pywcmp website.

pywcmp is provided as a resource to the community, under continuous improvement. Contributions are welcome and can be facilited by the WMO Task Team on WIS Metadata.

1.7. Codelists rules

WMO and ISO codelists currently exist in numerous locations on the Internet. The authoritative code locations that should be used when validating shall be:

- WMO codelists: https://wis.wmo.int/2012/codelists/WMOCodeLists.xml
- ISO codelists: https://standards.iso.org/iso/19139/resources/gmxCodelists.xml

1.8. Conventions

1.8.1. Symbols and abbreviated terms

Table 1. Symbols and abbreviated terms

Abbreviation	Term
AJAX	Asynchronous JavaScript and XML
CSV	Comma-separated values
DCPC	Data Collection and Production Centres
DOI	Digital Object Identifier
GAW	Global Atmospheric Watch
GISC	Global Information System Centre
GML	Geography Markup Language
GTS	Global Telecommunication System
HTML	Hypertext Markup Language
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
INSPIRE	Infrastructure for Spatial Information in the European Community
ISO	Internatioal Organization for Standardization

Abbreviation	Term
MIME	Multipurpose Internet Mail Extensions
NC	National Centre
OGC	Open Geospatial Consortium
pywcmp	WMO implementation of WCMP validation
URL	Uniform Resource Locator
WCMP	WMO Core Metadata Profile
WDC	World Data Centre
WIS	WMO Information System
WMO	World Meteorological Organization
XHR	XMLHttpRequest
XML	eXtensible Markup Language

Chapter 2. KPI-1: WCMP 1.3, Part 2 Compliance

2.1. Measurement

Requirements specified in the abstract test suite in *Manual on WIS*, Part C2, 2.1 that provide information about the quality of the metadata content.

2.2. Rational for measurement

Compliance with the requirements of the abstract test suite ensure that the metadata record is valid, parseable and has base level information for discovery and access. The metadata record should pass requirement 6.1.1 before further evaluations are performed.

2.3. Rules

Table 2. KPI-1

Rule	Score
Requirement 6.1.1: Each WIS Discovery Metadata record shall validate without error against the XML schemas defined in ISO/TS 19139:2007.	Pass/Fail
Requirement 8.1.1: Each WIS Discovery Metadata record shall include one `gmd:MD_Metadata/gmd:fileIdentifier` attribute.	1
Requirement 8.2.1: Each WIS Discovery Metadata record shall include at least one keyword from the `WMO_CategoryCode` code list.	1
Requirement 8.2.2: Keywords from `WMO_CategoryCode` code list shall be defined as keyword type `theme`.	1
Requirement 8.2.3: All keywords sourced from a particular keyword thesaurus shall be grouped into a single instance of the `gmd:MD_Keywords` class.	1
Requirement 8.2.4: Each WIS Discovery Metadata record describing geographic data shall include the description of at least one geographic bounding box defining the spatial extent of the data.	1

Rule	Score
Requirement 9.1.1: A WIS Discovery Metadata record describing data for global exchange via the WIS shall indicate the scope of distribution using the keyword `GlobalExchange` of type `dataCenter` from thesaurus `WMO_DistributionScopeCode`.	1
Requirement 9.2.1: A WIS Discovery Metadata record describing data for global exchange via the WIS shall have a `gmd:MD_Metadata/gmd:fileIdentifier` attribute formatted as follows (where `{uid}` is a unique identifier derived from the GTS bulletin or file name): `urn:x-wmo:md:int.wmo.wis::{uid}`.	1
Requirement 9.3.1: A WIS Discovery Metadata record describing data for global exchange via the WIS shall indicate the WMO Data License as Legal Constraint (type: `gmd:otherConstraints`) using one and only one term from the `WMO_DataLicenseCode` code list.	1
Requirement 9.3.2: A WIS Discovery Metadata record describing data for global exchange via the WIS shall indicate the GTS Priority as Legal Constraint (type: `gmd:otherConstraints`) using one and only one term from the `WMO_GTSProductCategoryCode` code list.	1

Total possible score: 9 (100%)

2.4. Guidance

Use WCMP templates and/or tools to generate the metadata record (e.g. Excel to WIS).

2.4.1. WMO References

- Manual on WIS: Part C2 - Abstract Test Suite, Data Dictionary and Code Lists

2.4.2. XML Examples

2.4.3. XPaths

Chapter 3. KPI-2: Good quality title

3.1. Measurement

The title of the dataset follows the principles of the WCMP guidance. The length is not too short or too long, contains less than 3 acronyms and is represented in title case. Spelling and grammar are correct.

3.1.1. Rationale for measurement

Title is the first element of metadata information displayed and helps with initial identification. Meaningful and relevant information makes it easier for users to understand the resource.

3.2. Rules

Table 3. Good quality title implementation rules

Rule	Score
2.1: The `title` element is not empty in the `CI_Citation` section of `MD_DataIdentfication` .	1
2.2: The title has 3 words or more.	1
2.3: The title has 150 characters or less.	1
2.4: The title only has printable characters (numbers and letters).	1
2.5: Words in the title are represented in "Title Case".	1
2.6: The title contains less than 3 acronyms (words with all upper case).	1
2.7: The title does not contain bulletin header (regular expression: `[A-Z]{4}\d{2}[\s_]*[A-Z]{4}`).	1
2.8: The title passes a basic spellcheck.	1

Total possible score: 8 (100%)

3.3. Guidance

3.3.1. WMO References

- 5.8.1.1 Product title

3.3.2. XML Examples

3.3.3. XPaths

- `/gmd:MD_Metadata/gmd:identificationInfo//gmd:citation/gmd:CI_Citation/gmd:title` == KPI-3: Good quality abstract

3.4. Measurement

The abstract field length shall not be too short or too long and contain no HTML markup. Spelling and grammar are correct. Bulletin templates should not be used to populate the abstract.

3.5. Rationale for measurement

To faciliate ease of understanding and discovery.

Abstract is a key element of metadata information displayed as part of search results. Fulsome and meaningful abstract information allows for users to both understand and properly evaluate a metadata record and its respective resource in support of data access, visualization and exploitation.

3.6. Rules

Table 4. Good quality abstract implementation rules

Rule	Score
abstract has between 16 and 2048 characters	1
abstract contains no markup (HTML)	1
abstract passes a basic spellcheck	1
abstract contains bulletin template	-1

Total possible score: 3 (100%)

3.7. Guidance

3.7.1. WCMP 1.3 Part 1 Guidance

The abstract should provide a clear and concise statement that enables the reader to understand the content of the dataset. For guidance when completing the abstract, consider the following recommendations:

- State the 'things' that are recorded
- State the key aspects recorded about these things
- State what form the data takes
- State any other limiting information, such as time period of validity of the data

- Add purpose of data resource where relevant (e.g. for survey data)
- Aim to be understood by non-experts
- Do not include general background information
- Avoid jargon and unexplained abbreviations

3.7.2. Relevant recommendations

- Avoid adding a scientific abstract
- Limit information in the abstract to the specific resource that is being described
- Describe the contents of the resource and the key aspects and/or attributes that are represented
- Explain briefly what is unique about this resource and, if appropriate, how it differs from similar resources
- Avoid citing external sources to this resource
- Avoid spelling out commonly used acronym which are already understood by the general public
- Spell out uncommon acronyms only once
- Avoid including HTML/CSV tables, extra spaces or other markup to control display of text. Use simple paragraph(s) only
- Avoid copying text from a journal article verbatim. This can lead to copyright violation concerns. Additionally, abstracts for journal articles are not intended to describe the provided resource and do not meet the metadata requirements. Related papers can be referenced from and/or tied to the metadata
- Avoid using future verb tense when possible. Write using present or past tenses

3.7.3. Spell checking recommendations

- Dictionary by Merriam-Webster: America's most-trusted online dictionary [7: https://www.merriam-webster.com]
- Cambridge Dictionary | English Dictionary, Translations & Thesaurus [8: https://dictionary.cambridge.org]

3.7.4. XML Examples

3.7.5. WMO Guidelines

References of good abstract examples can be found in the Guide to WMO Information System (WMO No. 1061, Section 5.8.1.2) [9: https://library.wmo.int/doc_num.php?explnum_id=10257], product abstract.

3.8. XPaths

- `/gmd:MD_Metadata/gmd:identificationInfo//gmd:abstract` == KPI-4: Temporal information

3.9. Measurement

- Temporal extent: This element describes the period of time that the available product covers
- Data update frequency: The temporal frequency at which the data is updated (i.e. every x hours, days, etc.)
- Status of dataset

3.10. Rationale for measurement

Temporal information is a significant characteristic of weather/climate/water data and as such is critical for users to know which period(s) of time is/are covered by products and how often new products are received.

3.11. Rules

Table 5. Temporal information implementation rules

Rule	Score
The Temporal Extent is present	1
The begin and end components are present in the temporal extent	1
The begin date time is less than or equal to the end date time	1
The Data Update Frequency is present	1
The Data Status is present	1

Total possible score: 5 (100%)

3.12. Guidance

Ensure that the Temporal Extent and the Update Frequency is present in the metadata record.

3.12.1. XML Examples

The TemporalExtent is present in `gmd:temporalElement`:

```
<gmd:temporalElement>
  <gmd:EX_TemporalExtent>
    <gmd:extent>
      <gml:TimePeriod gml:id="boundingTemporalExtentPeriod">
        <gml:beginPosition>2005-10-01</gml:beginPosition>
        <gml:endPosition>2014-10-20</gml:endPosition>
      </gml:TimePeriod>
    </gmd:extent>
  </gmd:EX_TemporalExtent>
</gmd:temporalElement>
```

In the case of an ongoing dataset with a known start date and unknown end date, the end date must be indicated with `now`. For instance, where a dataset is from 2005-10-01 onwards:

```
<gmd:temporalElement>
   <gmd:EX_TemporalExtent>
     <gmd:extent>
       <gml:TimePeriod gml:id="boundingTemporalExtentPeriod">
         <gml:beginPosition>2005-10-01</gml:beginPosition>
         <gml:endPosition indeterminatePosition="now"/>
       </gml:TimePeriod>
     </gmd:extent>
   </gmd:EX_TemporalExtent>
</gmd:temporalElement>
```

It is also recommended to identify a dataset status / progress using the `gmd:MD_ProgressCode` codelist. The following example provides an ongoing dataset progress/status:

```
  <gmd:status>
    <gmd:MD_ProgressCode
codeList="https://standards.iso.org/iso/19139/resources/gmxCodelists.xml#MD_ProgressCo
de" codeSpace="ISOTC211/19115" codeListValue="onGoing">onGoing</gmd:MD_ProgressCode>
  </gmd:status>
```

The Data Update Frequency is present in `gmd:maintenanceAndUpdateFrequency`:

Below is an example of a GTS bulletin which is updated every 6 hours.

```
  <gmd:resourceMaintenance>
    <gmd:MD_MaintenanceInformation>
      <gmd:maintenanceAndUpdateFrequency>
        <gmd:MD_MaintenanceFrequencyCode codeListValue="irregular"
codeList="https://standards.iso.org/iso/19139/resources/gmxCodelists.xml#MD_MaintenancFrequencyCode"/>
      </gmd:maintenanceAndUpdateFrequency>
      <gmd:userDefinedMaintenanceFrequency>
        <gts:TM_PeriodDuration>PT6H</gts:TM_PeriodDuration>
      </gmd:userDefinedMaintenanceFrequency>
      <gmd:maintenanceNote>
        <!-- DRAFT – Guidance on WIS Discovery Metadata (following CBS-16), p38 -->
        <gco:CharacterString>Instances of bulletin SIKB20NGTT are available every 6
hours starting at 03 UTC.</gco:CharacterString>
      </gmd:maintenanceNote>
    </gmd:MD_MaintenanceInformation>
  </gmd:resourceMaintenance>
```

If it is not relevant or necessary to provide information regarding the data update frequency, `gmd:MD_MaintenanceFrequencyCode` can be set to `asNeeded`:

```
  <gmd:resourceMaintenance>
      <gmd:MD_MaintenanceInformation>
        <gmd:maintenanceAndUpdateFrequency>
          <gmd:MD_MaintenanceFrequencyCode
codeList="https://standards.iso.org/iso/19139/resources/gmxCodelists.xml#MD_MaintenancFrequencyCode" codeListValue="asNeeded"/>
        </gmd:maintenanceAndUpdateFrequency>
      </gmd:MD_MaintenanceInformation>
  </gmd:resourceMaintenance>
```

3.12.2. WMO Guidelines

3.13. XPaths

- `/gmd:MD_Metadata/gmd:identificationInfo//gmd:temporalElement/gmd:EX_TemporalExtent/gmd:extent`
- `/gmd:MD_Metadata/gmd:identificationInfo//gmd:resourceMaintenance//gmd:maintenanceAndUpdateFrequency`
- `/gmd:MD_Metadata/gmd:identificationInfo//gmd:status` == KPI-5: WMOEssential data links

3.14. Measurement

Ensure that distribution URLs are included when the DataLicenseCode of `WMOEssential` is indicated in the constraint section.

3.15. Rationale for measurement

All `WMOEssential` data should have 1..n distribution links to the data.

3.16. Rules

Table 6. WMOEssential data links implementation rules

Rule	Score
`DataLicenseCode` is `WMOEssential` and 1..n distribution links are present	1

Total possible score: 1 (100%)

3.17. Guidance

3.17.1. XML Examples

```
<gmd:resourceConstraints>
  <gmd:MD_LegalConstraints>
    <gmd:otherConstraints>
      <gmx:Anchor
xlink:href="https://wis.wmo.int/2012/codelists/WMOCodeLists.xml#WMO_DataLicenseCode_WM
OEssential">WMOEssential</gmx:Anchor>
    </gmd:otherConstraints>
  </gmd:MD_LegalConstraints>
</gmd:resourceConstraints>
```

```
<gmd:MD_DigitalTransferOptions>
  <gmd:onLine>
    <gmd:CI_OnlineResource>
      <gmd:linkage>
        <gmd:URL>https://opendata.dwd.de/weather/wmc/icon-eps/data/grib</gmd:URL>
      </gmd:linkage>
      <gmd:protocol>
        <gco:CharacterString>http</gco:CharacterString>
      </gmd:protocol>
      <gmd:name>
        <gco:CharacterString>GISC Offenbach, Deutscher
Wetterdienst</gco:CharacterString>
      </gmd:name>
      <gmd:description>
        <gco:CharacterString>WMO Information System, download products/data through
GISC Offenbach, Deutscher Wetterdienst</gco:CharacterString>
      </gmd:description>
    </gmd:CI_OnlineResource>
  </gmd:onLine>
</gmd:MD_DigitalTransferOptions>
```

3.17.2. WMO Guidelines

If the data described is categorized as `WMOEssential`, provide a link to the data.

3.18. XPaths

- `/gmd:MD_Metadata/gmd:identificationInfo//gmd:resourceConstraints/gmd:MD_LegalConstraints/gmd:otherConstraints`
- `/gmd:MD_Metadata/gmd:distributionInfo/gmd:MD_Distribution/gmd:transferOptions/gmd:MD_DigitalTransferOptions/gmd:onLine/gmd:CI_OnlineResource/gmd:linkage` == KPI-6: Keywords

3.19. Measurement

- presence of keywords
- grouping of similar keywords
- reference to controlled vocabularies

In addition to measure well-defined references to dictionaries and keyword types, compliance to WCMP 1.3 defines a set of rules that apply to different sets of keywords.

3.20. Rationale for measurement

Encouraging metadata providers to make use of keywords that are published in controlled vocabularies will ultimately help the end user to search for well-known domain related terms.

Keywords are indexed by search engines to narrow down full text searches, adding to the user

experience and making datasets easier to discover. Keywords can be user-defined or specified from controlled vocabularies.

3.21. Rules

Table 7. Keywords implementation rules

Rule	Score
`gmd:keywords` is present	1
`gmd:type` is present	1
`gmd:thesaurusName` is present	1
Keywords terms and thesaurus are present via `gmx:Anchor`	1

Total possible score: 4 per keyword set (100%)

To assess how many keywords are present and provide a total percentage based on the number of keywords and individual scoring.

3.22. Guidance

A high score will be provided for full referenced term, keyword type and thesaurus. Additional recommendations for keywords implementation are found at the Guide to WMO Information System (WMO- No. 1061,Section 5.8.1.8). [10: https://library.wmo.int/index.php?lvl=notice_display&id=6856]

Examples of controlled vocabularies:

- WMO Codes Registry
- WMO Codelists
- General Multilingual Environmental Thesaurus (GEMET) - INSPIRE Spatial Data Themes
- Global Change Master Directory (GCMD)
- Climate and Forecast (CF) Standard Names
- Government of Canada Core Subject Thesaurus (CST)

3.22.1. XML Examples

3.22.2. Well defined keywords examples

Used keyword references URL of a code registry using an Anchor element.

```
  <gmd:MD_Keywords>
    <gmd:keyword>
     <gmx:Anchor
xlink:href="http://wis.wmo.int/2012/codelists/WMOCodeLists.xml#WMO_CategoryCode_meteor
ology">meteorology</gmx:Anchor>
    </gmd:keyword>
  </gmd:MD_Keywords>
```

The type of keyword is given in `MD_KeywordTypeCode` element, the "codelist" indicates URL of the code list, e.g. https://standards.iso.org/iso/19139/resources/gmxCodelists.xml#MD_KeywordTypeCode_theme.

```
<gmd:type>
  <gmd:MD_KeywordTypeCode
codeList="https://standards.iso.org/iso/19139/resources/gmxCodelists.xml#MD_KeywordTyp
eCode_theme" codeListValue="theme">theme</gmd:MD_KeywordTypeCode>
</gmd:type>
```

Keywords reference a thesaurus using an Anchor element with a resolvable HTTP URL.

```
<gmd:thesaurusName>
  <gmd:CI_Citation>
    <gmd:title>
      <gmx:Anchor
xlink:href="http://wis.wmo.int/2012/codelists/WMOCodeLists.xml#WMO_CategoryCode">WMO_C
ategoryCode</gmx:Anchor>
    </gmd:title>
    <gmd:date>
      <gmd:CI_Date>
        <gmd:date>
          <gco:Date>2016-05-26</gco:Date>
        </gmd:date>
        <gmd:dateType>
          <gmd:CI_DateTypeCode
codeList="https://standards.iso.org/iso/19139/resources/gmxCodelists.xml#CI_DateTypeCo
de" codeListValue="revision">revision</gmd:CI_DateTypeCode>
        </gmd:dateType>
      </gmd:CI_Date>
    </gmd:date>
  </gmd:CI_Citation>
</gmd:thesaurusName>
```

Less prefered is to use a `gco:CharacterString` element. Such thesaurus references are still quite common, and formaly valid, but are considered deprecated.

```
<gmd:thesaurusName>
  <gmd:CI_Citation>
    <gmd:title>
      <gco:CharacterString>WMO_CategoryCode</gco:CharacterString>
    </gmd:title>
    <gmd:date>
      <gmd:CI_Date>
        <gmd:date>
          <gco:Date>2016-05-26</gco:Date>
        </gmd:date>
        <gmd:dateType>
          <gmd:CI_DateTypeCode
codeList="https://standards.iso.org/iso/19139/resources/gmxCodelists.xml#CI_DateTypeCo
de" codeListValue="revision">revision</gmd:CI_DateTypeCode>
        </gmd:dateType>
      </gmd:CI_Date>
    </gmd:date>
  </gmd:CI_Citation>
</gmd:thesaurusName>
```

3.22.3. WMO Guidelines

3.23. XPaths

- `//gmd:MD_DataIdentification/gmd:descriptiveKeywords/gmd:MD_Keywords/gmd:keyword`
- `//gmd:MD_DataIdentification/gmd:descriptiveKeywords/gmd:MD_Keywords/gmd:type`
- `//gmd:MD_DataIdentification/gmd:descriptiveKeywords/gmd:MD_Keywords/gmd:thesaurusName` == KPI-7: Graphic overview for non bulletins metadata records

3.24. Measurement

The presence of `gmd:graphicOverview` is checked that it contains a URL to a common web image file type. [11: https://developer.mozilla.org/en-US/docs/Web/Media/Formats/Image_types#Common_image_file_types]

3.25. Rationale for measurement

Product graphic overviews provide the user with a high level preview of the product which can assist in a high level assessment and/or evaluation as part of search results presentation.

3.26. Rules

Table 8. Graphic overview for non bulletins metadata records implementation rules

Rule	Score
graphic overview element is present	1

Rule	Score
graphic overview URL resolves successfully	1
graphic overview URL content is a common web image file type (check MIME type, content header/magic number)	1

Total possible score: 3 (100%)

3.27. Guidance

In addition to the presence of the graphic overview image it would also be valuable to provide consistent image dimensions (e.g. 800x800 pixels) such that all images are normalized and scaling/alignment of overivew images can be applied consistently by web applications rendering search results.

Examples of catalogues using such information are here:

- GISC DWD
- EUMETSAT Product Navigator

3.27.1. XML Examples

```
<gmd:graphicOverview>
  <gmd:MD_BrowseGraphic>
     <gmd:fileName>
        <gmx:Anchor xlink:href="https://navigator.eumetsat.int/preview/meteosat-
msg_naturalenhncd.jpg">Meteosat MSG Natural Enhanced Color</gmx:Anchor>
     </gmd:fileName>
  </gmd:MD_BrowseGraphic>
</gmd:graphicOverview>
```

3.27.2. WMO Guidelines

3.28. XPaths

- `//gmd:identificationInfo/gmd:MD_DataIdentification/gmd:graphicOverview/gmd:MD_BrowseGraphic/gmd:fileName/gmx:Anchor/@xlink:href` == KPI-8: Links health

3.29. Measurement

The number of broken links in each individual metadata record. Broken links include links which, when accessed, result in a 4xx or 5xx HTTP error. [12: https://httpstatuses.com]

Also being measured is the use of HTTPS (with a valid SSL certificate) as the link protocol throughout WIS Metadata.

3.30. Rationale for measurement

Broken links damage the user experience and gives the impression to users that a website is not maintained (88% of the online consumers are less likely to return to a site after a bad experience. [13: https://review42.com/web-design-statistics]) In addition, having numerous broken links affects the reputation and rank of your website when indexed by mass market search engines.

HTTPS is increasingly becoming a requirement for numerous agencies as well as the suggested protocol vs. HTTP. Having non-HTTPS links in a WCMP document often leads to mixed content errors in web applications deployed via HTTPS for example, and using AJAX/XHR design patterns. HTTPS supports secure, authoritative and trustworthy links as part of WIS Metadata.

3.31. Rules

Table 9. Links health implementation rules

Rule	Score
Each valid link present	1
Each valid HTTPS link present	1

Total possible score: (valid links + valid HTTPS links) / (total links * 2) (100%)

3.32. Guidance

3.32.1. XML Examples

```
<gmd:CI_OnlineResource>
 <gmd:linkage>

<gmd:URL>https://eumetview.eumetsat.int/mapviewer/?product=EO:EUM:DAT:MSG:SNOW</gmd:UR
L>
 </gmd:linkage>
</gmd:CI_OnlineResource>
```

```
<gmd:graphicOverview>
  <gmd:MD_BrowseGraphic>
    <gmd:fileName>
      <gco:CharacterString>https://navigator.eumetsat.int/preview/0deg-
snow.jpg</gco:CharacterString>
    </gmd:fileName>
  </gmd:MD_BrowseGraphic>
</gmd:graphicOverview>
```

```
<gmd:code>
  <gmx:Anchor xlink:actuate="onRequest"
xlink:href="https://dx.doi.org/10.14287/10000004"
xlink:title="DOI">doi:10.14287/10000004</gmx:Anchor>
</gmd:code>
```

```
<gmd:dateType>
  <gmd:CI_DateTypeCode
codeList="https://standards.iso.org/iso/19139/resources/gmxCodelists.xml#CI_DateTypeCo
de" codeListValue="revision" codeSpace="ISOTC211/19115">revision</gmd:CI_DateTypeCode>
</gmd:dateType>
```

3.32.2. WMO Guidelines

Ensure that all links resolve and are accessible via HTTPS.

3.33. XPaths

Any element or attribute content with linked information (URLs).

- `//gmd:URL`
- `//gmd:graphicOverview`
- `//gmx:Anchor/@xlink:href`
- `//@codeList`

Chapter 4. KPI-9: Data policy

4.1. Measurement

- Definition of data policy encoded with `WMO_DataLicenceCode` in `gmd:otherConstraints`
- Definition of `gmd:accessConstraints` with `MD_RestrictionCode` = `gmd:otherConstraints`
- Definition of `gmd:useConstraints` with `MD_RestrictionCode` = `gmd:otherConstraints`
- Definition of a scope of distribution added as keyword from controlled vocabulary `WMO_DistributionScopeCode` and `KeywordTypeCode dataCentre`
- Presence of GTS priority if data is marked for `GlobalExchange` or `RegionalExchange`

4.2. Rationale for measurement

Data policy provides information to the users about how the data should be handled. Data providers also have the obligation to define the scope of the distribution of the data within WIS and when applicable the GTS priority.

Data policy Information is expressed via `gmd:resourceConstraints/gmd:MD_LegalConstraints`

4.3. Rules

The following table summarises the relevant elements to define data policy

Element	Description
`gmd:useLimitation`	Free text. limitations regarding usage of the resource (e.g. this data set is not to be used for navigation)
`gmd:accessConstraints`	Controlled vocabulary. `MD_RestrictionCode`, access constraints applied to assure the protection of privacy or intellectual property, and any special restrictions or limitations on obtaining the resource
`gmd:useConstraints`	Controlled vocabularies. `MD_RestrictionCode`, restrictions on the use of a resource
`gmd:otherRestrictions`	Free text

The Manual on the WMO Information System (WMO-No. 1060, WMO-No. 1061) recommendations for data policy implementation are as follows:

Element	Description
gmd:useLimitation	Free text Description
gmd:accessConstraints	gmd:MD_RestrictionCode = otherRestrictions
gmd:useConstraints	gmd:MD_RestrictionCode = otherRestrictions
gmd:otherRestrictions	Vocabulary controlled: WMO_DataLicenceCode (WMOEssential, WMOAdditional, WMOther, NoLimitation)

Additional descriptions to explain the referred WMO_DataLicenceCode could be added in separate otherRestrictions blocks.

Table 10. Data policy implementation rules

Rule	Score
gmd:resourceConstraints are present and there is a WMO_DataLicenceCode term in gmd:otherRestrictions.	1
gmd:accessConstraints, gmd:useConstraints are vocabulary controlled by gmd:MD_RestrictionCode - otherRestrictions	1
gmd:Keywords are present with definition of WMO_DistributionScopeCode keyword term and a gmd:type of vocabulary controlled gmd:MD_KeywordTypeCode = dataCenter	1
gmd:otherConstraints and vocabulary controlled WMO_GTSProductCategoryCode if gmd:keyword is present with terms from WMO_DistributionScopeCode (GlobalExchange, RegionalExchange)	1
gmx:Anchor implemented versus gco:CharacterString when referencing WMO_DataLicenseCode (in gmd:otherConstraints), WMO_GTSProductCategoryCode (in gmd:otherConstraints), WMO_DistributionScopeCode (in Keywords), WMO_DistributionScopeCode (in Thesaurus title)	1

Total possible score: 5 (100%)

Note: Other possible gmd:resourceConstraints elements may exist and not comply to these rules. The score should check that there is one gmd:resourceConstraints element that complies to the rules.

4.4. Guidance

In addition to programmatic checks which will provide a score, the conditions of use for the resource published should be clear to the user. If the codelist implementation is not clear there should be additional free text explanations `gmd:otherConstraints` or `gmd:useLimitation`.

4.4.1. XML Examples

4.4.2. Well defined policies examples

If the record is encoding `WMO_DataLicenseCode` with `gmx:Anchor`, then check for permitted values in the corresponding codelist: http://wis.wmo.int/2012/codelists/WMOCodeLists#WMO_DataLicenseCode

```
<gmd:resourceConstraints>
  <gmd:MD_LegalConstraints>
    <gmd:otherConstraints>
      <gmx:Anchor
xlink:href="https://wis.wmo.int/2012/codelists/WMOCodeLists.xml#WMO_DataLicenseCode_WM
OAdditional">WMOAdditional</gmx:Anchor>
    </gmd:otherConstraints>
  </gmd:MD_LegalConstraints>
</gmd:resourceConstraints>
```

Check if the `WMO_DataLicenseCode` is implemented as `gco:CharacterString` (instead of `gmx:Anchor`)

```
<gmd:resourceConstraints>
  <gmd:MD_LegalConstraints>
    <gmd:otherConstraints>
      <gco:CharacterString>WMOAdditional</gco:CharacterString>
    </gmd:otherConstraints>
  </gmd:MD_LegalConstraints>
</gmd:resourceConstraints>
```

Check for `gmd:accessConstraints` with `gmd:MD_RestrictionCode` = `otherRestrictions`

```
<gmd:resourceConstraints>
  <gmd:MD_LegalConstraints>
    <gmd:accessConstraints>
      <gmd:MD_RestrictionCode
codeList="https://standards.iso.org/iso/19139/resources/gmxCodelists.xml#MD_Restrictio
nCode" codeListValue="otherRestrictions">otherRestrictions</gmd:MD_RestrictionCode>
    </gmd:accessConstraints>
  </gmd:MD_LegalConstraints>
</gmd:resourceConstraints>
```

Check for gmd:useConstraints with gmd:MD_RestrictionCode = otherRestrictions

```
<gmd:resourceConstraints>
  <gmd:MD_LegalConstraints>
    <gmd:useConstraints>
      <gmd:MD_RestrictionCode
codeList="https://standards.iso.org/iso/19139/resources/gmxCodelists.xml#MD_Restrictio
nCode" codeListValue="otherRestrictions">otherRestrictions</gmd:MD_RestrictionCode>
    </gmd:useConstraints>
  </gmd:MD_LegalConstraints>
</gmd:resourceConstraints>
```

Check for scope of distribution keyword from controlled vocabulary WMO_DistributionScopeCode and gmd:KeywordTypeCode = dataCentre with gmx:Anchor

```
<gmd:MD_Keywords>
  <gmd:keyword>
    <gmx:Anchor
xlink:href="https://wis.wmo.int/2012/codelists/WMOCodeLists.xml#WMO_DistributionScopeC
ode_GlobalExchange">GlobalExchange</gmx:Anchor>
  </gmd:keyword>
  <gmd:type>
    <gmd:MD_KeywordTypeCode
codeList="https://wis.wmo.int/2012/codelists/WMOCodeLists.xml#MD_KeywordTypeCode"
codeListValue="dataCenter">dataCenter</gmd:MD_KeywordTypeCode>
  </gmd:type>
  <gmd:thesaurusName>
    <gmd:CI_Citation>
      <gmd:title>
        <gmx:Anchor
xlink:href="https://wis.wmo.int/2012/codelists/WMOCodeLists.xml#WMO_DistributionScopeC
ode">WMO_DistributionScopeCode</gmx:Anchor>
      </gmd:title>
      <gmd:date>
        <gmd:CI_Date>
          <gmd:date>
            <gco:Date>2012-06-27</gco:Date>
          </gmd:date>
          <gmd:dateType>
            <gmd:CI_DateTypeCode
codeList="https://wis.wmo.int/2012/codelists/WMOCodeLists.xml#CI_DateTypeCode"
codeListValue="revision">revision</gmd:CI_DateTypeCode>
          </gmd:dateType>
        </gmd:CI_Date>
      </gmd:date>
    </gmd:CI_Citation>
  </gmd:thesaurusName>
</gmd:MD_Keywords>
```

Check for scope of distribution keyword from controlled vocabulary `WMO_DistributionScopeCode` and `KeywordTypeCode` = `dataCentre` with `gco:CharacterString`

```
<gmd:MD_Keywords>
  <gmd:keyword>
    <gco:CharacterString>GlobalExchange</gco:CharacterString>
  </gmd:keyword>
  <gmd:type>
    <gmd:MD_KeywordTypeCode
codeList="https://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</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="https://wis.wmo.int/2012/codelists/WMOCodeLists.xml#CI_DateTypeCode"
codeListValue="revision">revision</gmd:CI_DateTypeCode>
          </gmd:dateType>
        </gmd:CI_Date>
      </gmd:date>
    </gmd:CI_Citation>
  </gmd:thesaurusName>
</gmd:MD_Keywords>
```

Check for presence of GTS priority if data is marked for `GlobalExchange` or `RegionalExchange`

```
<gmd:MD_Keywords>
    <gmd:keyword>
      <gmx:Anchor
xlink:href="https://wis.wmo.int/2012/codelists/WMOCodeLists.xml#WMO_DistributionScopeC
ode_GlobalExchange">GlobalExchange</gmx:Anchor>
    </gmd:keyword>
    [...]
</gmd:MD_Keywords>

[...]

<gmd:resourceConstraints>
  <gmd:MD_LegalConstraints>
   <gmd:otherConstraints>
      <gmx:Anchor
xlink:href="https://wis.wmo.int/2012/codelists/WMOCodeLists.xml#WMO_GTSProductCategory
Code_GTSPriority3">GTSPriority3</gmx:Anchor>
   </gmd:otherConstraints>
  </gmd:MD_LegalConstraints>
</gmd:resourceConstraints>
```

4.4.3. WMO Guidelines

Further guidance on data policy implementation can be found in the Guide to WMO Information System (WMO No. 1061, Section 5.8.1.10). [14: https://library.wmo.int/doc_num.php?explnum_id=10257]

4.5. XPaths

Data policy

- `//gmd:MD_Metadata/gmd:identificationInfo//gmd:resourceConstraints`

Distribution scope

- `//gmd:MD_DataIdentification/gmd:descriptiveKeywords/gmd:MD_Keywords/gmd:keyword`
- `//gmd:MD_DataIdentification/gmd:descriptiveKeywords/gmd:MD_Keywords/gmd:type`
- `//gmd:MD_DataIdentification/gmd:descriptiveKeywords/gmd:MD_Keywords/gmd:thesaurusName` == KPI-10: Distribution information

Metadata records should contain information regarding how to access the data which it is describing.

4.6. Measurement

The presence of distribution information and supporting elements.

- format (`//gmd:distributionInfo//gmd:distributionFormat/gmd:MD_Format`) That can rely on

existing WMO supported formats

- 1..n `gmd:transferOptions` (`//gmd:distributionInfo//gmd:transferOptions//gmd:onLine`), including a `gmd:linkage` with a URL to access the data
- distributor contact information (organization, email)

4.7. Rationale for measurement

Distribution information provides the necessary information for accessing the data, supported formats, and contact information for the data distributor.

4.8. Rules

By detecting the presence of the distribution format and transferOptions (multiple options are possible). See page 35 of the WMO Core Profile Metadata Guidance.

Table 11. Distribution information implementation rules

Rule	Score
`gmd:MD_Format` is included	1
format specification has an Anchor with a resolvable HTTP URL	1
distributor contact organization is included	1
distributor contact email is included	1
1..n transfer options are present	1

Total possible score: 5 (100%)

4.9. Guidance

- Specify format/medium information and a link to the format specification
- Specify 1..n transfer options as well as a distributor contact. Note that a distributor contact does not have to be the same as the main point of contact, principal investigator
- Specify an email for the distributor

4.9.1. XML Examples

```
<gmd:distributionInfo>
  <gmd:MD_Distribution>
    <gmd:distributionFormat>
      <gmd:MD_Format>
        <gmd:name>
          <gco:CharacterString>FM 94 (BUFR)</gco:CharacterString>
        </gmd:name>
        <gmd:version>
          <gco:CharacterString>XII EXT.</gco:CharacterString>
        </gmd:version>
        <gmd:specification>
          <gmx:Anchor xlink:title="FM 94 (BUFR)"
xlink:href="https://www.wmo.int/pages/prog/www/WMOCodes.html">FM 94
(BUFR)</gmx:Anchor>
        </gmd:specification>
      </gmd:MD_Format>
    </gmd:distributionFormat>
    <gmd:distributor>
      <gmd:MD_Distributor>
        <gmd:distributorContact>
          <gmd:CI_ResponsibleParty>
            <gmd:individualName>
              <gco:CharacterString>Lastname, Firstname</gco:CharacterString>
            </gmd:individualName>
            <gmd:organisationName>
              <gco:CharacterString>NMC FRANCE - Météo-France</gco:CharacterString>
            </gmd:organisationName>
            <gmd:contactInfo>
              <gmd:CI_Contact>
                <gmd:phone/>
                <gmd:address>
                  <gmd:CI_Address>
                    <gmd:deliveryPoint>
                      <gco:CharacterString>Direction des Systèmes d'Information, 42
avenue Gaspard CORIOLIS</gco:CharacterString>
                    </gmd:deliveryPoint>
                    <gmd:city>
                      <gco:CharacterString>TOULOUSE</gco:CharacterString>
                    </gmd:city>
                    <gmd:postalCode>
                      <gco:CharacterString>31057</gco:CharacterString>
                    </gmd:postalCode>
                    <gmd:country>
                      <gco:CharacterString>France</gco:CharacterString>
                    </gmd:country>
                    <gmd:electronicMailAddress>
                      <gco:CharacterString>gisc_support@meteo.fr</gco:CharacterString>
                    </gmd:electronicMailAddress>
```

```
                  </gmd:CI_Address>
                </gmd:address>
                <gmd:onlineResource>
                  <gmd:CI_OnlineResource>
                    <gmd:linkage>
                      <gmd:URL>https://meteofrance.com</gmd:URL>
                    </gmd:linkage>
                  </gmd:CI_OnlineResource>
                </gmd:onlineResource>
              </gmd:CI_Contact>
            </gmd:contactInfo>
            <gmd:role>
              <gmd:CI_RoleCode codeListValue="pointOfContact"
codeList="https://standards.iso.org/iso/19139/resources/gmxCodelists.xml#CI_RoleCode">
pointOfContact</gmd:CI_RoleCode>
            </gmd:role>
          </gmd:CI_ResponsibleParty>
        </gmd:distributorContact>
      </gmd:MD_Distributor>
    </gmd:distributor>
    <gmd:transferOptions>
      <gmd:MD_DigitalTransferOptions>
        <gmd:onLine>
          <gmd:CI_OnlineResource>
            <gmd:linkage>
              <gmd:URL>http://wispi.meteo.fr/openwis-user-
portal/srv/en/main.home?urn=urn:x-wmo:md:int.wmo.wis::ISMN10LFPW</gmd:URL>
            </gmd:linkage>
            <gmd:protocol>
              <gco:CharacterString>WWW:LINK-1.0-http--link</gco:CharacterString>
            </gmd:protocol>
            <gmd:name>
              <gco:CharacterString>Permanent link</gco:CharacterString>
            </gmd:name>
            <gmd:description>
              <gco:CharacterString>GISC Toulouse</gco:CharacterString>
            </gmd:description>
          </gmd:CI_OnlineResource>
        </gmd:onLine>
      </gmd:MD_DigitalTransferOptions>
    </gmd:transferOptions>
  </gmd:MD_Distribution>
</gmd:distributionInfo>
```

4.9.2. WMO Guidelines

4.10. XPaths

- `//gmd:distributionInfo//gmd:distributionFormat/gmd:MD_Format`

- //gmd:distributionInfo//gmd:MD_DigitalTransferOptions//gmd:onLine//gmd:URL
- //gmd:distributionInfo//gmd:MD_Distributor//gmd:organisationName
- //gmd:distributionInfo//gmd:MD_Distributor//gmd:contactInfo//gmd:electronicMailAddress/gco:CharacterString

Chapter 5. KPI-11: Codelists validation

5.1. Measurement

Presence of valid terms from the referred codelist element.

5.2. Rationale for measurement

WCMP records can reference codelists from a number of locations (e.g. online copies of the authoritative sources).

To ensure that the terms themselves are always consistent with the official sources, this KPI will validate that the terms referred to in WCMP records are consistent with the authoritative codelists referred in this KPI.

In many cases terms are included but are not identical to the official definitions on the codelists (e.g. spelling mistakes, case sensitivity errors, etc.).

Software applications may look for exact matches to codelists and handle metadata incorrectly if not properly referenced.

5.3. Rules

Table 12. Codelists validation implementation rules

Rule	Score
codelist referred terms are checked against authoritative sources with an exact match	1

Total possible score: 1 per valid codelist value (100%)

To assess how many valid codelist values are indicated and provide a total percentage based on the total number of codelist values.

5.4. Guidance

Ensure that codelists referenced terms are indicated across the entire record, from authoritative sources.

5.4.1. XML Examples

5.4.2. WMO Guidelines

WMO/ISO Codelists referenced in WCMP

codelist	WCMP Element	Authoritative list
CI_DateTypeCode	//gmd:date/gmd:CI_Date/gmd:dateType/gmd:CI_DateTypeCode	WMOCodeLists (ISO Extended)
CI_RoleCode	//gmd:CI_ResponsibleParty/gmd:role/gmd:CI_RoleCode	gmxCodelists (ISO)
MD_KeywordTypeCode	//gmd:MD_Keywords/gmd:type/gmd:MD_KeywordTypeCode	WMOCodeLists (ISO Extended)
MD_RestrictionCode	//gmd:resourceConstraints//gmd:MD_RestrictionCode	gmxCodelists (ISO)
MD_ScopeCode	//gmd:scope//gmd:MD_ScopeCode	gmxCodelists (ISO)
MD_TopicCategoryCode	//gmd:topicCategory/gmd:MD_TopicCategoryCode	gmxCodelists (ISO)
WMO_DataLicenseCode	//gmd:resourceConstraints//gmd:otherConstraints/[gco:CharacterString|gmx:Anchor]	WMOCodeLists
WMO_GTSProductCategoryCode	//gmd:resourceConstraints//gmd:otherConstraints/[gco:CharacterString|gmx:Anchor]	WMOCodeLists
WMO_CategoryCode	//gmd:descriptiveKeywords/gmd:MD_Keywords/gmd:keyword/[gco:CharacterString|gmx:Anchor]	WMOCodeLists
WMO_DistributionScopeCode	//gmd:descriptiveKeywords/gmd:MD_Keywords/gmd:keyword/[gco:CharacterString|gmx:Anchor]	WMOCodeLists

5.5. XPaths

WCMP elements will vary depending on whether they are:

- ISO Codelists (`gmxCodelists.xml`)
- WMO Codelists / ISO extensions (`WMOCodeLists.xml`)

Authoritative codelists are found at the following locations:

- ISO: https://standards.iso.org/iso/19139/resources/gmxCodelists.xml
- WMO: https://wis.wmo.int/2012/codelists/WMOCodeLists.xml == KPI-12: DOI citation

5.6. Measurement

Whether DOI information is available, can be successfully identified, and provides citation

instructions.

5.7. Rationale for measurement

DOIs are persistent identifiers that allow data to be accessible and citable. They make research data easier to access, reuse and verify, thereby making it easier to build on previous work, conduct new research and avoid duplicating already existing work.

5.8. Rules

Table 13. DOI citation implementation rules

Rule	Score
if DOI anchor is present	1
title is equal to 'DOI'	1
if DOI citation is present as a constraint and includes the same DOI in the anchor	1

Total possible score: 3 (100%)

5.9. Guidance

- Provide the DOI identifier with a `doi:` prefix (e.g. `doi:<doi-identifier>`)
- Provide a 'Cite as' template in `gmd:otherConstraints`

5.9.1. XML Examples

```
  <gmd:identifier>
    <gmd:MD_Identifier>
      <gmd:code>
        <gmx:Anchor xlink:actuate="onRequest"
xlink:href="https://dx.doi.org/10.14287/10000004"
xlink:title="DOI">doi:10.14287/10000004</gmx:Anchor>
      </gmd:code>
    </gmd:MD_Identifier>
  </gmd:identifier>
```

```
  <gmd:otherConstraints>
    <gco:CharacterString>Cite as: WMO/GAW Ozone Monitoring Community, World
Meteorological Organization-Global Atmosphere Watch Program (WMO-GAW)/World Ozone and
Ultraviolet Radiation Data Centre (WOUDC) [Data]. Retrieved [YYYY-MM-DD], from
https://woudc.org. A list of all contributors is available on the website.
doi:10.14287/10000004</gco:CharacterString>
  </gmd:otherConstraints>
```

5.9.2. WMO Guidelines

5.10. XPaths

- `/gmd:MD_Metadata/gmd:identificationInfo//gmd:citation//gmd:identifier//gmd:code/gmx:Anchor/@xlink:href`
- `/gmd:MD_Metadata/gmd:identificationInfo//gmd:citation//gmd:identifier//gmd:code/gmx:Anchor/@xlink:title`
- `/gmd:MD_Metadata/gmd:identificationInfo//gmd:resourceConstraints//gmd:otherConstraints/gco:CharacterString` == KPI-013: File identifier

5.11. Measurement

Accordance of the structure of the metadata record identification with the recommendation defined in chapter 8.1.2 of the Manual on the WMO Information System (WMO-No. 1060).

5.12. Rationale for measurement

The value of the fileIdentifier element, i.e. identifier of the metadata record, shall be unique. Achieving global uniqueness in a distributed environment is not trivial, but the structure recommended in the Manual on WIS significantly simplifies management of the identifiers and reduces chance of conflicts/duplicates.

5.13. Rules

The WMO Core Metadata Profile recommends the use of a URI for `gmd:fileIdentifier` attributes. The URI should be structured as follows:

- Fixed string `urn:x-wmo:md:`
- Citation authority based on the Internet domain name of the data-provider organization, e.g. “int.wmo.wis”, “gov.noaa”, “edu.ucar.ncar”, “cn.gov.cma” or “uk.gov.metoffice”
- Double separator colons: `::`
- Unique identifier (in scope of the citation authority)

Total possible score: 1 (100%)

5.14. Guidance

5.14.1. XML Examples

5.14.2. WMO Guidelines

Use metadata record identification (`gmd:fileIdentifier`) in the form of URI.

5.15. XPaths

- `/gmd:MD_Metadata/gmd:fileIdentifier/gco:CharacterString`