Service Metadata and Discovery Best Practices

CEOS

Discovery and Access Interest Group

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Document Status Sheet

Issue	Date	Comments	Editors
1.0D4	28/10/2021	First internal draft 4 shared with ESA.	Y. Coene, D. Guerrucci.
1.0D5	12/11/2021	Additional content added. Version provided for internal ESA review.	
1.0D6	30/11/2021	GeoDCAT-AP examples updated to use “@id” where otherwise ambiguous. Additional content added. Complete example files added in Annex C. First draft for distribution to CEOS SLT Team.	
1.0D7	11/03/2022	Updated after feedback from CEOS SLT Team. • Resolved comments MM-1, MM-2, MM-3, MM-4, MM-5, MM-7, MM-9. • BP-0021 and corresponding encoding “requirements” downgraded to “recommendation” (MM-11). • BP-0022 and corresponding encoding “requirements” downgraded to “recommendation” (MM-12). • BP-0032 and BP-X420 upgraded to “requirement” (DJN-13). • BP-8240 updated to include allowed enumeration values and “ProjectionAuthority” added to example (MM-16). • BP-8415 and other corresponding encoding “recommendations” for BP-0031 upgraded to “requirement” (MM-17). • “should” used instead of “shall” for all “recommendations” (MM-17). • “Resource locator“ and “Coupled resource” recommendations and associated examples removed including BP-0051, BP-0052, BP-2610, BP-2620, BP-3610, BP-3620, BP-4610, BP-5610, BP-7620, BP-8620 (DJN-14, DJN-19).	Y. Coene, M. Morahan, D.J. Newman.

Issue	Date	Comments	Editors
		• Requirement BP-0515 for discovery interface added to allow for coupled resource discovery (DJN-14, DJN-19). • Requirements BP-0534, BP-0542 and BP-0544 about search parameters added. • Reference document [RD-38] added.	
1.0D8	15/04/2022	Updated after feedback related to remaining TBD/TBC from M. Morahan as discussed at SLT meeting (29/03/2022): • SRV-BP-2220 (ISO19139) mapping proposed for "Version Description" (gmd:otherCitationDetails) derived from mapping provided for ISO19115-2 (Email M. Morahan 5/4/2022 point 1). • SRV-BP-7220 (ISO19115-3): mapping proposed for "Version Description" (cit:otherCitationDetails) derived from mapping provided for ISO19115-2 (Email M. Morahan 5/4/2022 point 1). • TBD removed for "Version Description" mapping in SRV-BP-3220 and SRV-BP-6220 as no mapping currently available (Email M. Morahan 5/4/2022 point 1). • SRV-BP-8710 (UMM-JSON): Role=TBD replaced by Role=PUBLISHER and footnote added with allowed role values for organization (Email M. Morahan 5/4/2022 point 2). • SRV-BP-0411: Updated to take into account that type values are not in KMS (Email M. Morahan 5/4/2022 point 3). • SRV-BP-0451: Updated and reference to ROR removed (Email M. Morahan 5/4/2022 point 4). Use of ROR limited to schema.org encoding in separate requirement SRV-BP-0452. • §4.1 NASA CMR: Updated as per email from M. Morahan 5/4/2022 point 5. • SRV-BP-0524: optional search parameters removed from requirement.	Y. Coene, M. Morahan.

Issue	Date	Comments	Editors
1.0D9	05/05/2022	"Resource locator" and "Coupled resource" recommendations and associated examples included that were removed in 1.0D7 to allow obtaining broader feedback during document review. The affected recommendations are currently labelled as "[Under-Review]" and include BP-0051, BP-0052, BP-2610, BP-2620, BP-3610, BP-3620, BP-4610, BP-5610, BP-7620, BP-8620. They will be converted into [Recommendation] or be removed depending on the document review feedback collected.	Y. Coene, D. Guerrucci.
1.0	10/11/2022	Recommendations labelled as [Under-Review] upgraded to [Recommendation]. Note added to SRV-BP-0033 addressing comment from J. Del Rio Vera (WGCapD), 29/09/2022. Verb (shall/should) aligned with obligation in BP-8710, BP-0411, BP-0542. URL corrected in BP-0452.	Y. Coene

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1 Introduction

1.1 Background

CEOS agencies have made significant progress in recent years in making available EO collection and granule metadata in an interoperable way by applying Best Practices [AD-1]. This has allowed for discovery or metadata through a common two-step mechanism based on OpenSearch. In addition, the number of EO collections discoverable through the CEOS International Directory Network (IDN) continues to grow as partners make available their collection metadata in one of the supported encodings of the Unified Metadata Model for collections, such as the metadata format (DIF10) annotated with platform, instrument and science keywords from a common thesaurus (GCMD).

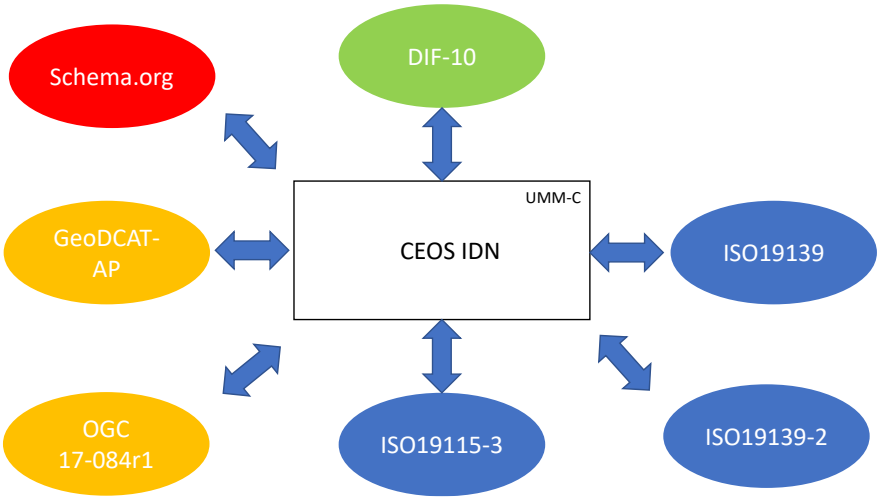

Figure 1: Different encodings of UMM-C metadata

A logical next step is for CEOS agencies to support interoperable discovery of services, applications or tools related to their EO collections and make available information about these services, applications or tools in an agreed metadata format for future publication through IDN. The “service” resources which are the subject of the current document, are intended to view, process, access, transform or analyze data from EO collections and include, but are not limited to:

- Downloadable tools and applications,
- Tools and applications accessible online via a Web-based user interface,
- Services offering machine to machine interfaces (API).

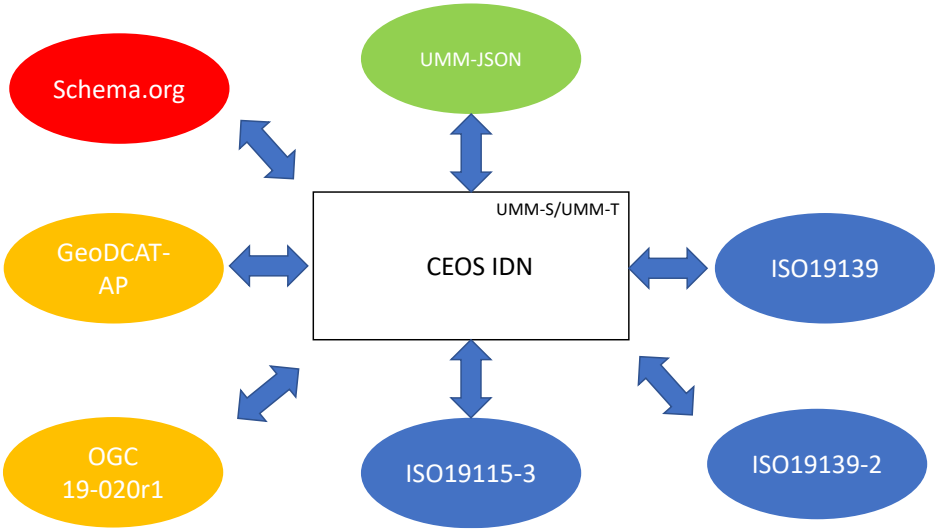

Figure 2: Different encodings of UMM-S/T metadata

At the moment, other formats than UMM-JSON are not supported within IDN.

1.2 Purpose of the document

This document aims to provide minimal recommendations and best practices on the use of service, tool and application metadata and discovery.

The purpose of this document is to achieve the following

- Promote the use of a common approach for service/tool/application metadata and discovery, associated with Earth Observation collections.
- Define the expectations and requirements of candidate implementations.
- Remove ambiguity in implementation where possible.
- Facilitate the aggregation of results between disparate Earth Data providers and Earth Data services/tools/applications via common standards.
- Allow for clients to access and invoke services with no prior knowledge of the service interface.
- Facilitate smooth integration between related implementations for collection and granule discovery and subsequent use of compatible services or tools possibly from other providers.

1.3 Document overview

The document is organized as follows:

- Chapter 1 is the introduction of the document.
- Chapter 2 gives an overview of objectives and needs.
- Chapter 3 lists the Best Practices and recommendations. The Best Practices and recommendations include general recommendations not tied to a specific

implementation technology and recommendations which only apply when a specific technology or encoding is used.

- Chapter 4 describes some current practices.

Finally, Annex A provides a overview of (mandatory) metadata elements present in UMM-S, UMM-T and INSPIRE Technical Guidance and provides a traceability to the corresponding CEOS Best Practice (if any) described in the current document.

1.4 Terms, Definitions and Abbreviated Terms

1.4.1 Terms and Definitions

See [RD-1]. The following terms and definitions are also used in this document.

Term	Definition
access point	An internet address containing a detailed description of a spatial data service, including a list of end points to allow its execution.
application	A self-contained set of operations to be performed, typically to achieve a desired data manipulation, written in a specific language (e.g. Python, R, Java, C++, C#, IDL) [RD-17].
application package	A platform independent and self-contained representation of an Application, providing executables, metadata and dependencies such that it can be deployed to and executed within an Exploitation Platform [RD-17].
Collection	A collection is an aggregation of granules sharing the same product specification. A collection typically corresponds to the series of products derived from data acquired by a sensor on board a satellite and having the same mode of operation [AD-1].
container	A container is a standard unit of software that packages up code and all its dependencies so that includes everything needed to run an application: code, runtme, system tools, system libraries and settngs [RD-17].
Exploitation platform	An on-line system made of products, services and tools for exploitation of data [RD-17].
FedEO	FedEO provides interoperable access, following ISO/OGC interface guidelines, to Earth Observation metadata (https://fedeo-client.ceos.org/about).

Granule	A granule is the finest granularity of data that can be independently managed. A granule usually matches the individual file of EO satellite data. [AD-1].
IDN	An international effort developed to assist researchers in locating information on available collections and services. The directory is sponsored as a service to the Earth science community (https://idn.ceos.org).
Interface	named set of operations that characterize the 16ehavior of an entity [ISO19119].
Invocable Spatial Data Service	a spatial data service that (a) has metadata which fulfils the requirements of the INSPIRE Implementing Rules for Metadata, (b) has at least one resource locator that is an access point, (c) is conformant with a documented and publicly available set of technical specifications providing the information necessary for its execution [RD-6].
metadata	Information about a resource [RD-2].
metadata element	Discrete unit of metadata [RD-2].
service	distinct part of the functionality that is provided by an entity through interfaces [RD-2]. Services provide functions for the creation, access, processing and analysis of data.Services can be web services, provided across the web and following a well-defined machine protocol. In these guidelines software can be a service or web service. Services can be delivered through an implemented software instance that enables users to ‘do’ something with data. The user does not necessarily directly interact with the code [RD-14].
service interface	shared boundary between an automated system or human being and another automated system or human being [ISO 19101].
software	A computer program, in source code or compiled form, that supports scholarly research. Software may be downloaded, compiled, executed and instantiated [RD-14].
Spatial Data Service	The operations which may be performed, by invoking a computer application, on the spatial data contained in spatial data sets or on the related metadata [RD-6].

tool	Includes downloadable tools and tools accessible via a web user interface.

1.4.2 Acronyms

See [RD-1]. The following acronyms are also used in this document.

Acronym	Definition
API	Application Programming Interface
CMR	Common Metadata Repository
DIF-10	Directory Interchange Format Version 10
FedEO	Federated Earth Observation Missions
GCMD	Global Change Master Directory
IDN	International Directory Network
INSPIRE	INfrastructure for SPatial InfoRmation in Europe
KMS	Keyword Management System (https://gcmd.earthdata.nasa.gov/kms/, https://gcmd.earthdata.nasa.gov/KeywordViewer/)
STAC	SpatioTemporal Asset Catalog
UMM	Unified Metadata Model

1.5 References

1.5.1 Applicable Documents

ID	Reference	Title	Issue
[AD-1]	CEOS-OPENSEARCH-BP-V1.3	CEOS OpenSearch Best Practice Document	1.3

Table 1 – Applicable documents

1.5.2 Reference Documents

ID	Reference	Title	Issue
[RD-1]	CEOS/WGISS/DSIG/GLOS	Long-Term Preservation of Earth Observation Space Data: Glossary of Acronyms and Terms	1.3
[RD-2]	ISO 19115-1:2014	Geographic Information – Metadata – Part 1: Fundamentals, https://www.iso.org/standard/53798.html	First Edition 2014-04-01
[RD-3]	DIF-10	https://earthdata.nasa.gov/esdis/eso/standards-and-references/directory-interchange-format-dif-standard	10
[RD-4]	EED2-TP-040_Rev04_UMM-S	UMM-Services, https://wiki.earthdata.nasa.gov/display/CMR/UMM+Documents	1.4
[RD-5]	UMM-T, 423-FORM-002, A	Appendix F. Metadata requirements ase reference for Unified Metadata Model – Tool (UMM-T), 5/14/2020, https://wiki.earthdata.nasa.gov/display/CMR/UMM+Documents	1.0
[RD-6]		Technical Guidance for the implementation of INSPIRE dataset and service metadata based on ISO/TS 19139:2007, 2017-03-02, https://inspire.ec.europa.eu/id/document/tg/metadata-iso19139	2.0.1
[RD-7]	ISO 19119:2005	Geographic Information – Services, http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=39890	
[RD-8]	ISO 19115-3:2016	Geographic Information – Metadata – Part 3: XML schema implementation for fundamental concepts, http://www.iso.org/iso/home/store/catalogue_ics/catalogue_detail_ics.htm?csnumber=32579	
[RD-9]	ISO 19139:2007	ISO 19139, Geographic Information – Metadata XML (ISO 19139:2007),	

		http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=32557	
[RD-10]	https://semiceu.github.io/GeoDCAT-AP/releases/2.0.0]	GeoDCAT-AP Version 2.0.0, SEMIC Recommendation 23 December 2020	2.0.0
[RD-11]	OGC 11-035r1	EO Product Collection, Service and Sensor Discovery using the CS-W ebRIM Catalogue, 2013-03-26	1.0
[RD-12]	OGC 19-020r1	OGC Testbed-15: Catalogue and Discovery Engineering Report, https://docs.ogc.org/per/19-020r1.html	
[RD-13]	UMM-JSON	https://git.earthdata.nasa.gov/projects/EMFD/repos/unified-metadata-model/browse	
[RD-14]		ESIP Software and Services Citation Cluster. (2019). Software and Services Citation Guidelinesand Examples. Ver. 1. ESIP. https://doi.org/10.6084/m9.figshare.7640426.	
[RD-15]	CEOS/WGISS/DSIG/PIDBP	Persistent Identifiers Best Practices, July 2021	1.4
[RD-16]		https://commonmark.org/	
[RD-17]	OGC 20-089	OGC Best Practice for Earth Observation Application Package, 2021-08-21, Candidate TC Vote Draft.	1.0
[RD-18]	OGC 12-084r2	OGC OWS Context Atom Encoding Standard, http://docs.opengeospatial.org/is/12-084r2/12-084r2.html, 14/01/2014.	1.0
[RD-19]	OGC 14-055r2	OGC OWS Context GeoJSON Encoding Standard, https://docs.opengeospatial.org/is/14-055r2/14-055r2.html, 2017-04-13	1.0
[RD-20]		DataCite Metadata Working Group. (2021). DataCite Metadata Schema Documentation for the Publication and Citation of Research Data and Other Research Outputs. Version 4.4. DataCite e.V.	4.4

		https://doi.org/10.14454/3w3z-sa82	
[RD-21]		Arfon M. Smith et al., “Software citation principle”, 2016, https://doi.org/10.7717/peerj-cs.86	
[RD-22]	OGC 10-032r8	OGC OpenSearch Geo and Time Extensions, Version 1.0, 14-04-2014.	
[RD-23]	OGC 13-026r9	OGC Opensearch Extension for Earth Observation, Version 1.1, 25-11-2019, https://docs.ogc.org/is/13-026r9/13-026r9.html	
[RD-24]		https://github.com/dewitt/opensearch/blob/master/mediawiki/Community/Proposal/Specifications/OpenSearch/Extensions/Semantic/1.0/Draft%201.wiki	
[RD-25]	OGC 17-047r1	OGC OpenSearch-EO GeoJSON(-LD) Response Encoding Standard, Version 1.0, 2020-04-27, https://docs.opengeospatial.org/is/17-047r1/17-047r1.html	
[RD-26]		Technical Guidance for the implementation of INSPIRE Discovery Services, 2011-11-07, Version 3.1.	
[RD-27]	OGC 07-045r1	OGC Catalogue Services Specification 2.0.2 – ISO Metadata Application Profile for CSW 2.0, version 1.0.1 (2007), https://www.ogc.org/standards/cat.	
[RD-28]	RFC-4287	The Atom Syndication Format, https://tools.ietf.org/html/rfc4287	
[RD-29]	RFC-7946	The GeoJSON Format, https://tools.ietf.org/html/rfc7946	
[RD-30]	OGC 17-084r1	EO Collection GeoJSON(-LD) Encoding, OGC Best Practice, https://docs.ogc.org/bp/17-084r1/17-084r1.html	

[RD-31]	ICSM	ICSM ISO19115-1 Metadata for Services Best Practices, https://icsm-au.github.io/metadata-working-group/defs/MetadataForServicesGuide.html	
[RD-32]	ESIP science-on-schema.org	Matthew B. Jones, Stephen Richard, Dave Vieglais, Adam Shepherd, Ruth Duerr, Doug Fils, Lewis McGibbney. (2021). Science-on-Schema.org v1.2.0 (Version 1.2.0). Zenodo. https://doi.org/10.5281/zenodo.4477164, https://github.com/ESIPFed/science-on-schema.org	
[RD-33]		STAC API, https://github.com/radiantearth/stac-api-spec#stac-api	
[RD-34]	OGC 17-069r3	OGC 17-069r3, OGC API – Features – Part 1: Core, http://docs.opengeospatial.org/is/17-069r3/17-069r3.html	
[RD-35]	OGC 20-004	OGC API - Records - Part 1: Core, https://github.com/opengeospatial/ogcapi-records, http://docs.ogc.org/DRAFTS/20-004.html	
[RD-36]	OGC 18-062	https://github.com/opengeospatial/ogcapi-processes, https://docs.ogc.org/DRAFTS/18-062.html	
[RD-37]	DCAT	Data Catalog Vocabulary (DCAT) – Version 2, W3C Recommendation, http://www.w3.org/TR/vocab-dcat/	2.0
[RD-38]	OGC 19-079r1	OGC API - Features - Part 3: Filtering http://docs.ogc.org/DRAFTS/19-079r1.html	

Table 2 – Reference documents

2 Objectives and Needs

2.1 Resources

The resources which are the subject of the current document include:

- Downloadable tools and applications,
- Tools and applications accessible online via a Web-based user interface,
- Services offering machine to machine interfaces.

They are intended to view, process, access, subset, transform or analyze data from EO collections. They may correspond to software available as source code, as an executable, a container, or a virtual machine image, while other software may be available as a service [RD-21].

For the sake of brevity, we use the term “Service” to denote any of these resources (See *Figure 3*). Also, depending on the context, a “Service Consumer” may be a user accessing a Web-based user interface or downloading a tool, or a software program invoking a machine to machine interface (API).

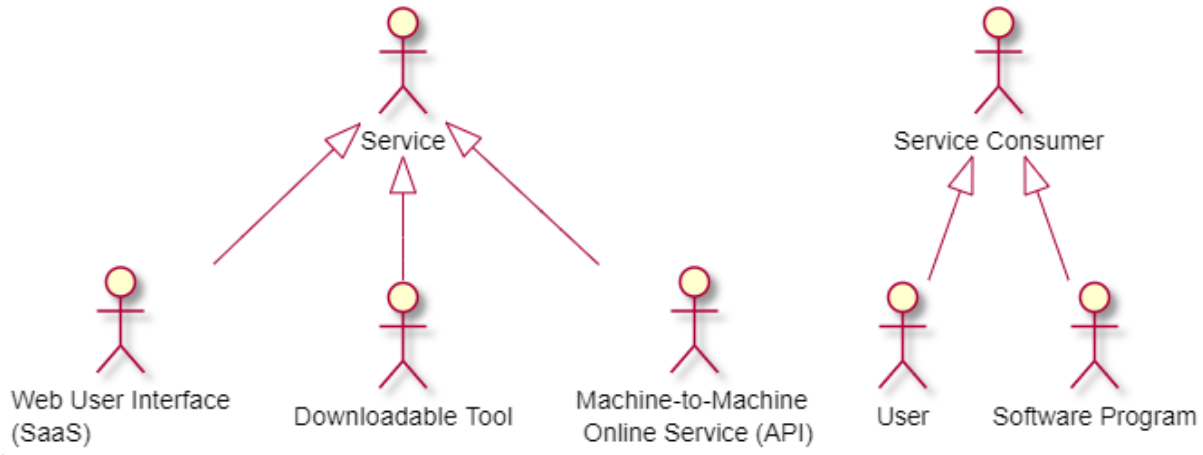

Figure 3: Service and Service Consumer specializations

The following resources can also be considered as examples of Tools or Services (or specific bindings) covered by the recommendations, if they are related to one or more collections:

- A Jupyter Notebook published in a repository (e.g. GitHub, Zenodo).
- Algorithm/software source code/scripts accessible in a repository.
- Docker image available on a public registry (e.g. DockerHub).
- An Earth Observation Application package as described in OGC 20-089 [RD-17] for deployment on an Exploitation Platform.

The objective of the current document is providing recommendations and best practices for describing ”Service” resources with metadata and supporting their discovery.

There are three groups of recommendations:

- A minimal metadata model to be supported (independent of encoding representation) is proposed in section 3.2.
- Recommendations which are encoding/format dependent are included in section 3.3.
- Recommendations related to the service discovery interface are presented in section 3.5.

2.2 Use cases

The main objective is to make EO services and tools searchable, thereby making the information better findable and facilitate sharing across CEOS agencies and other stakeholders. The following are typical use cases that are considered:

- Find Web user interfaces applicable to a collection to visualize the data.
- Find Web user interfaces applicable to a collection to process, analyse and preview the data.
- Find downloadable tools applicable to a collection for analyzing the data.
- Find downloadable tools applicable to a collection for reformatting and processing the data.
- Find online machine to machine services (including Web service access points) applicable to a collection to visualize, process, analyze, reformat, process etc. the data.

These use cases complement the “Discovery” use cases for Collections and Granules covered in [AD-1]. The metadata available for a tool or service should ideally allow for locating the repository of the software and downloading and installing the software (if applicable) and/or invoking its Web GUI or online service endpoints.

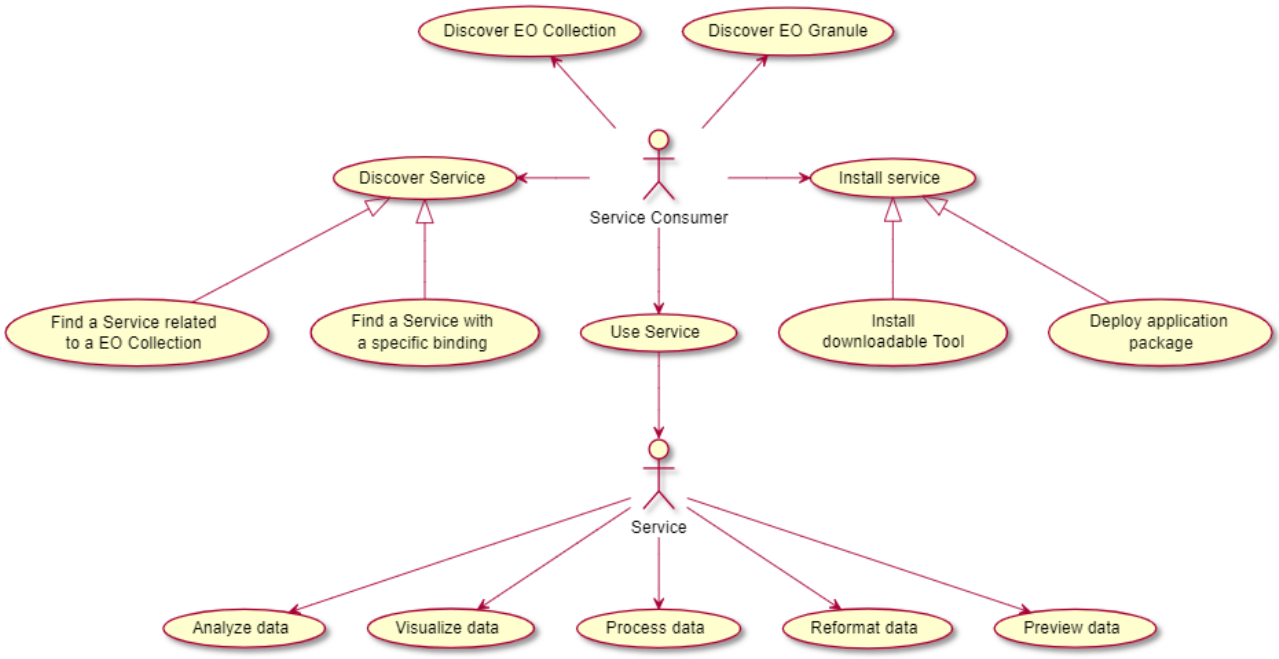

Figure 4: Actors and General Use Cases

The following are additional more detailed examples:

- Search by science keywords, by category of service/tool, by mission (platform), by instrument, by collection, by DOI, using free text, by available technical interface/representation (e.g. OGC WMS, Docker image, Jupyter Notebook, EO Application Package .. …).
- After discovery of a collection, or granule, easily find coupled services for subsequent execution.
- Discovery of online machine to machine services including web service endpoints for discovery, viewing (e.g. Web Map Service, Web Map Tiling Service), ordering, processing, data access (e.g. Web Coverage Services, …), analytics, …
- Binding to a discovered service endpoint exploiting the metadata provided about the service, …
- Discovery of available analytics applications (Jupyter notebooks) for subsequent download or online execution.
- Discovery of EO application packages [RD-12], [RD-17] available for a collection, with all required information (incl. run-time context) to deploy and execute them on a cloud-based Exploitation Platform.

Agencies may provide their service metadata in multiple formats, for their specific user communities. In addition, we encourage providing the metadata in an encoding supported by the IDN/CMR for facilitating publication through in IDN.

2.3 Detailed Scenarios

The following subsections show the typical scenarios when discovering a “Service” of one of the subtypes presented in section 2.1.

2.3.1 UC1 – Discover and use online machine to machine service

In this scenario, the metadata describes an online machine to machine interface (API) which can be invoked by a client application (User). This typically applies when service interfaces are available implementing OGC standards such as:

- OGC WM(T)S
- OGC WPS
- OGC WCS
- OGC CSW
- Etc..

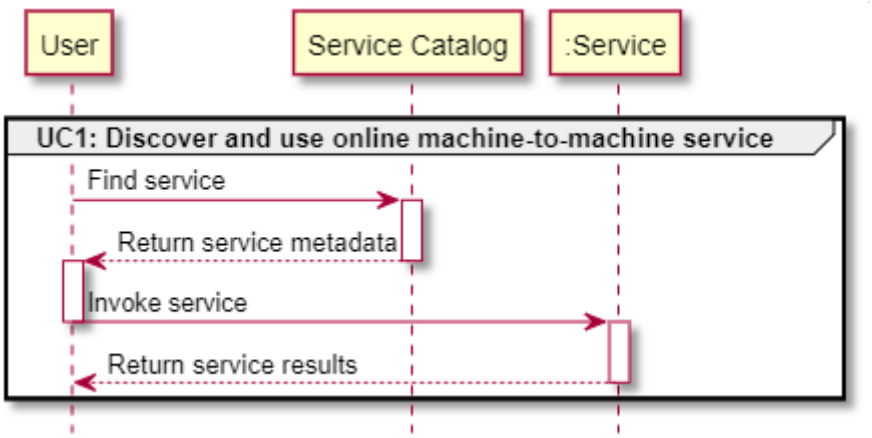

Figure 5: Discover and use online machine to machine service (UC1)

INSPIRE "Spatial Data Services", including "Invocable Spatial Data Services" [RD-6] are other examples of such online services.

2.3.2 UC2 – Discover and use downloadable tool

In this scenario, the service metadata describes a downloadable tool or toolbox and provides the download location for the tool. The user has to fulfil additional steps to download the tool or script, run it locally or on a cloud infrastructure to view or access the results of the processing, visualization etc...

This scenario also applies to:

- Software programs/scripts available for (file) download on a download location, e.g. a public repository (e.g. GitHub, Zenodo[1],..)
- Software packaged as a container published at a public registry (e.g. DockerHub[2]).

[1] https://zenodo.org/
[2] https://hub.docker.com/

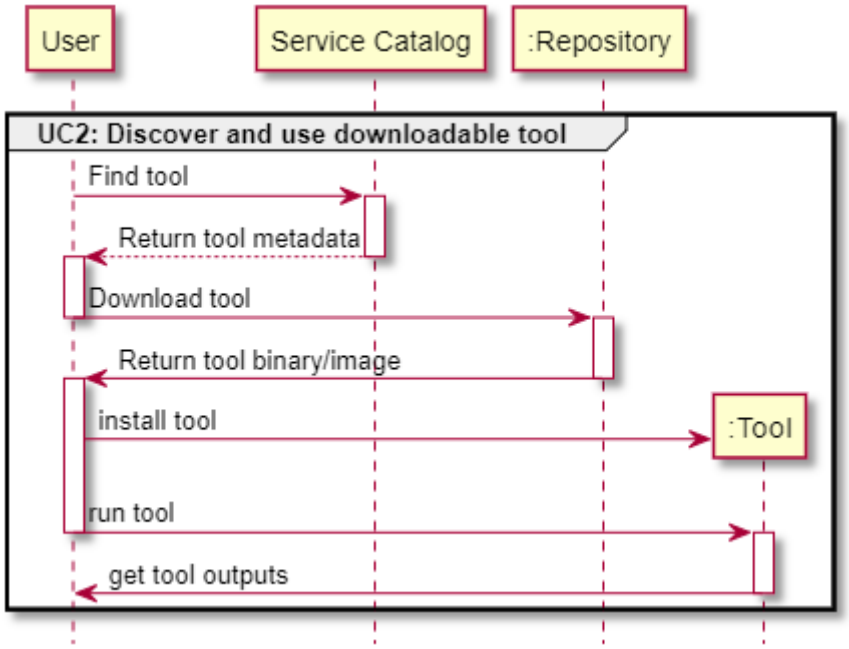

Figure 6: Discover and use downloadable tool (UC2)

2.3.3 UC3 – Discover and use Web GUI Tool

In this scenario, the service metadata describes an interactive tool or toolbox accessed online via a Web-based graphical user interface at a URL provided as part of the metadata.

This scenario applies to:

- Software or tools provided as “Software as a Service” (SaaS)[3] and accessed via a thin client (Web browser). E.g. Jupyter Notebook made available online via Google Colab[4] or Binder[5].

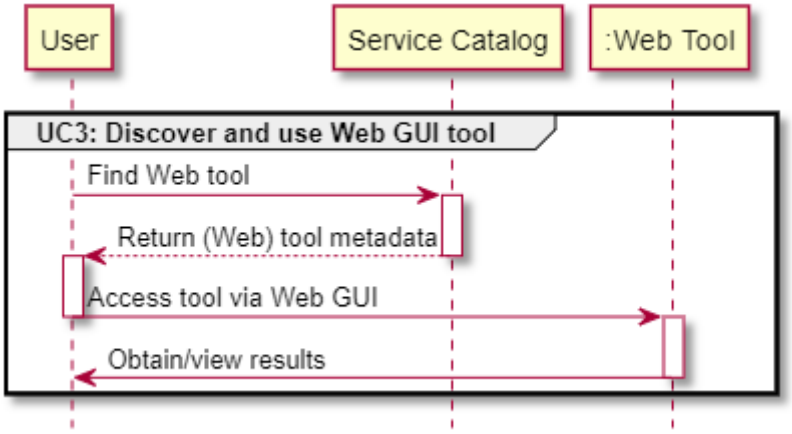

Figure 7: Discover and use Web tool (UC3)

[3] https://en.wikipedia.org/wiki/Software_as_a_service
[4] https://colab.research.google.com/
[5] https://mybinder.org/

2.3.4 UC4 – Discover application available as application package

In this scenario, a service consumer discovers services or tools relevant for his/her data which is made available as an "EO application package" (See [RD-17]). The application package describes the inputs/outputs of an application which is packaged as a container. It can be deployed and run on an Exploitation Platform, hosting the data, providing a transactional OGC API – Processes interface allowing for its deployment and execution. The detailed steps are depicted in the sequence diagram below. We refer the reader to [RD-17] for additional details.

This scenario is an extension of the scenario UC1 providing access to an online service (API). It allows for a service consumer to deploy the service, including all its dependencies (e.g. libraries, language run-time, operating system), on a compatible Exploitation Platform before its invocation.

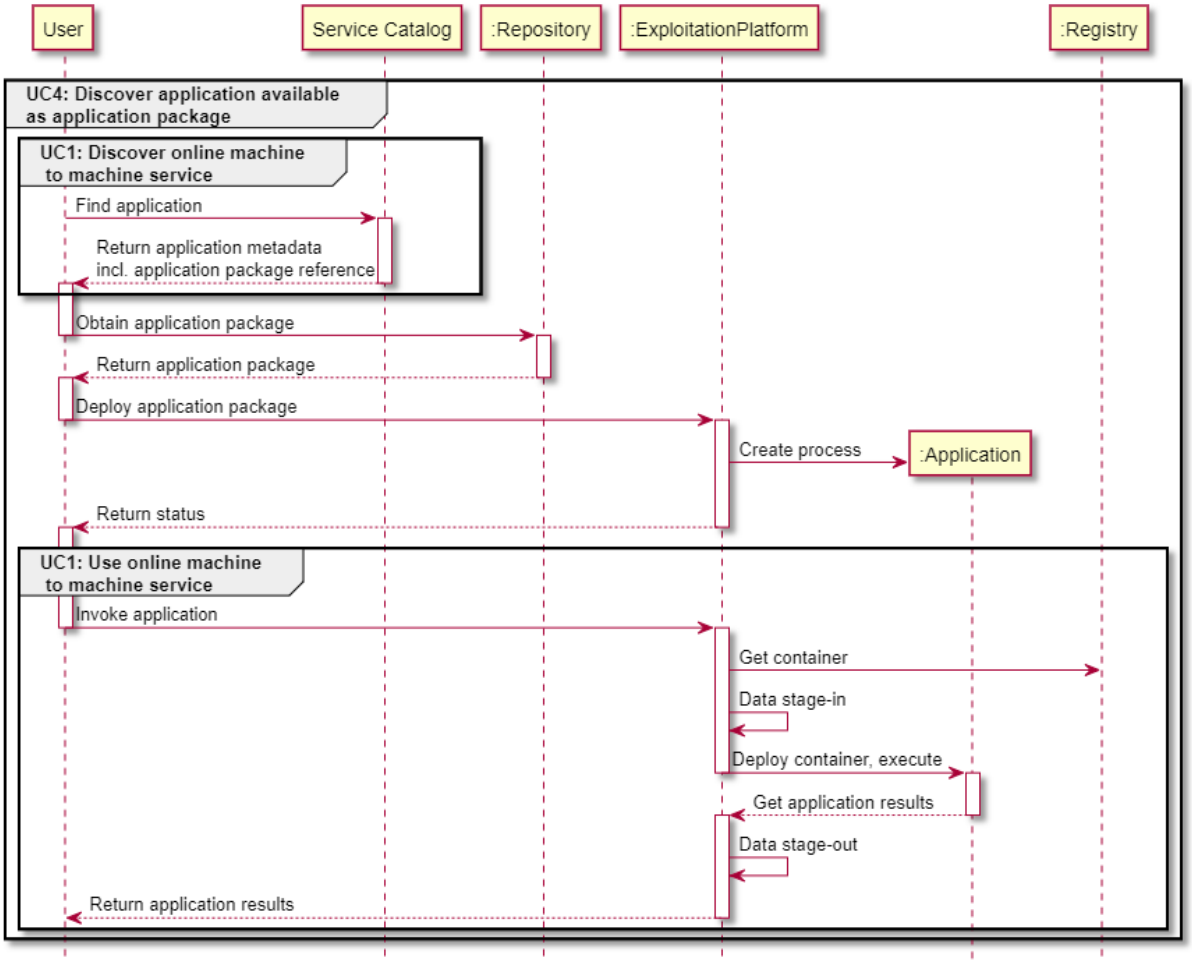

Figure 8: Discover and use service available as application package (UC4)

2.3.5 UC5 – Discover Collection with coupled services

Any of the above scenarios UC1 to UC4 can be preceeded by a Collection discovery step. The detailed collection metadata may contain information about coupled resources (Services

or tools) for which the detailed metadata can then be retrieved from the Service Catalog. The service metadata can then be exploited as described in the previous sections.

The same applies to granule discovery (not depicted). Granule metadata may equally contain information about coupled services or tools.

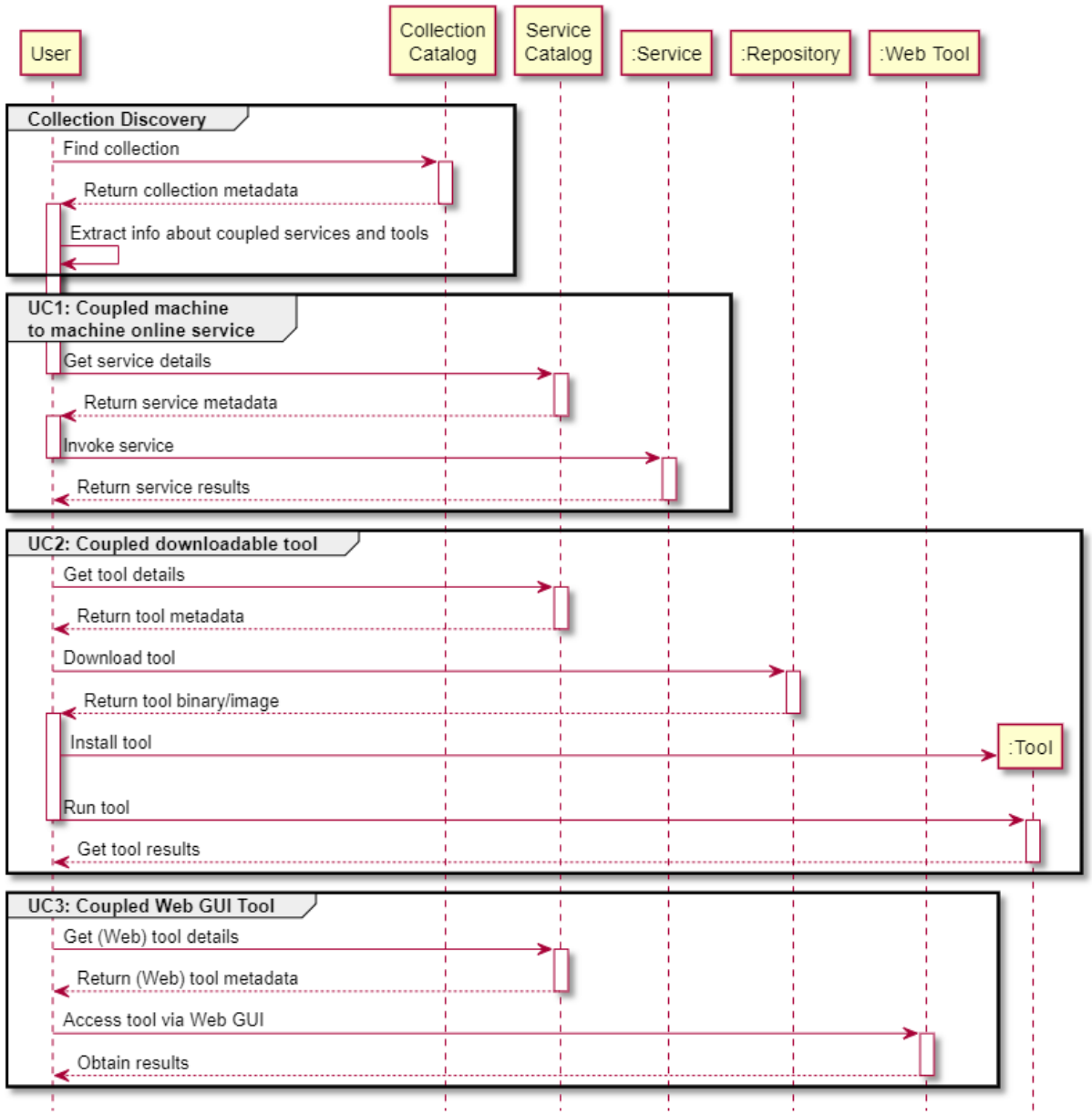

Figure 9: Discover services and (Web) tools coupled with collections (or granules) (UC5)

3 Best Practices and Recommendations

3.1 Overview

The Best Practices are presented in separate sections covering:

- Service metadata model (Section 3.2: SRV-BP-00XX),
- Service metadata encoding(s) (Section 3.3: SRV-BP-XXXX),
- Controlled vocabularies to be used in the metadata (Section 3.4: SRV-BP-04XX),
- Service discovery interface (Section 3.5: SRV-BP-05XX).

There are three different levels of obligation for the Best Practices in the current chapter:

- “Requirements” are mandatory and must be implemented,
- “Recommendations” are optional, but strongly recommended for interoperability,
- “Optional” indicates an additional good practice.

3.2 Service metadata model

The current section defines the requirements related to the service metadata model. They indicate which metadata elements have to be included in the metadata record when it is prepared or returned by a discovery interface. How these metadata elements are to be encoded depends on the encoding which is used and is described in section 3.3. The requirements in this section do not assume a particular encoding of the metadata record, e.g. using ISO19139.

The mandatory requirements presented in this section, correspond mainly to the common set of mandatory requirements defined by the UMM and INSPIRE (Service) metadata models [RD-4], [RD-5] and [RD-6]. For convenience, “Annex A: ” provides a cross-reference of the core metadata elements in [RD-4], [RD-5], [RD-6] and [RD-20]. Each of the requirements contains in the top-right corner of the requirements box a reference to the metadata models imposing a similar requirement, and where applicable, refer to the corresponding INSPIRE Technical Guidance (TG) requirement.

3.2.1 Identification information

The metadata elements covered in this section belong to the Identification Information.

SRV-BP-0001	Resource type [Requirement]	[RD-4], [RD-5], [RD-6]
Metadata records shall include the “resource type” as a controlled keyword (See section 3.4).		

SRV-BP-0003	Resource identifier [Requirement]	[RD-4], [RD-5], [RD-6], TG Rec. C.1
Metadata records shall include a unique and persistent resource identifier (i.e. “fileidentifier” or “name”).		

SRV-BP-0005	Resource title [Requirement]	[RD-4], [RD-5], [RD-6] TG Req. C.8
Metadata records shall include a “resource title” (longName).		

SRV-BP-0007	DOI [Recommendation]	[RD-5], [RD-20]
Metadata records should include a Digital Object Identifier (DOI) for the resource.		

SRV-BP-0009	DOI and Citations [Recommendation]	REC_23 of [RD-15]
DOI and citations assigned to EO services or tools should refer to the guidelines in [RD-14]		

SRV-BP-0014	Resource abstract [Requirement]	[RD-4], [RD-5], [RD-6] TG Req. C.9
Metadata records shall include an “abstract” describing the resource.		

SRV-BP-0015	Resource last revision date [Recommendation]	[RD-4], [RD-6] TG Req. C.11
Metadata records should include a “resource last revision date”.		

SRV-BP-0016	Resource version [Recommendation]	[RD-4], [RD-5]
Metadata records should include the “resource version”.		

SRV-BP-0017	Resource version description [Recommendation]	[RD-4]
Metadata records should include a “resource version description”.		

SRV-BP-0018	Responsible organization [Requirement]	[RD-4], [RD-5], [RD-6] TG Req. C.10, TG Req. 6.4

Metadata records shall include the point of contact information for the organization(s) responsible for the establishment, maintenance and distribution of the described resource.

SRV-BP-0019	Spatial resolution [Recommendation]	[RD-6] TG Req. 3.3
Metadata records should express restriction on the spatial resolution if the service or tool has such restriction.		

SRV-BP-0020	CRS identifier [Recommendation]	[RD-6] TG Req. 6.1, TG Req. 6.2
Metadata records should indicate the Coordinate Reference System (CRS) supported by the service/tool using identifiers specified in a well-known common register.		

3.2.2 Constraint information

SRV-BP-0021	Limitations on public access [Recommendation]	[RD-4], [RD-5], [RD-6] TG Req. C.17
Metadata records should include information about limitations on public access or lack of such limitations.		

SRV-BP-0022	Conditions for access and use [Recommendation]	[RD-4], [RD-5], [RD-6] TG Req. C.18
Metadata records should include information about conditions for access and use or indicate that there are no such conditions or that the conditions are unknown.		

SRV-BP-0023	Licenses [Recommendation]	[RD-6] TG Rec. C.10
Metadata records should include information about the licensing of the resource by providing a link to the license type (e.g. https://spdx.org/licenses/Apache-2.0). The SPDX License List[6] provides URI for most license types.		

3.2.3 Distribution information

The metadata elements covered in this section belong to the Distribution Information.

[6] https://spdx.org/licenses/

SRV-BP-0031	Resource URL [Requirement]	[RD-4], [RD-5], [RD-6] TG Req. 3.7
(Tool) Metadata records shall include an “URL” element describing where the Web user interface can be accessed or where the tool can be downloaded.		

SRV-BP-0032	Access points [Requirement]	[RD-4], [RD-6] TG req. 3.7
Metadata records shall include a “resource locator“ element (if available) providing the access point of the service, including a list of endpoints to allow for automatic binding and execution.		

SRV-BP-0033	No online access [Recommendation]	[RD-4], [RD-5], [RD-6] TG req. 3.7
Metadata records should include an “resource locator“ element providing access to additional information about the tool or service if no online access is available.		

The “additional information” in the recommendation above may include learning resources related to the tool or service including, but not limited to, user guides or tutorials in the form of documents, Jupyter notebooks, images or videos available for download or online access.

3.2.4 Quality information

The metadata elements covered in this section belong to the Quality Information.

SRV-BP-0041	Technical specification [Recommendation]	[RD-6] TG Req. 5.5, C.20, C.21
Metadata records should declare compliance with at least one technical specification providing all technical elements to actually invoke the service and enable its usage.		

3.2.5 Service coupling

The metadata elements covered in this section allow for referring from collection/granule metadata records and service metadata records or vice-versa.

SRV-BP-0051	Resource locator [Recommendation]	[RD-6] TG Req. 1.8
"Resource locator" information linking to the service(s) providing online access to a described collection of granule should be included in Collection and/or Granule metadata records, if such online access is available.		

SRV-BP-0052	Coupled resources [Recommendation]	[RD-6] TG Req. 3.6
Service/Tool metadata records should identify the target collections of the service/tool through their resource identifiers (URI).		

3.2.6 Metadata information

SRV-BP-0061	Metadata point of contact [Recommendation]	[RD-6] TG Req. C.6
Metadata records should provide the "point of contact" for the provided metadata.		

SRV-BP-0062	Latest update date of metadata [Recommendation]	[RD-6] TG Req. C.7
Metadata records should provide the "latest update date" of the provided metadata.		

SRV-BP-0063	Metadata language [Recommendation]	[RD-6] TG Req. C.5
Metadata records should indicate the language of the provided metadata.		

3.2.7 Descriptive keywords

SRV-BP-0071	Resource keywords [Requirement]	[RD-4], [RD-5], [RD-6]
Metadata records shall include “descriptive keywords” describing the resource.		

3.2.8 Extent information

This information includes temporal and geographical extents which are optional for service and tool metadata records.

SRV-BP-0081	Temporal extent [Recommendation]	[RD-6] TG Req. C.14
Metadata records should describe 0 to n temporal extents only if the service or tool has an explicit temporal extent.		

SRV-BP-0082	Geographical extent [Recommendation]	[RD-6] TG Req. C.19
Metadata records should describe 0 to n minimal geographic bounding boxes only if the service or tool has an explicit geographic extent.		

3.3 Service metadata encoding

This section contains general applicable recommendations and recommendations which are specific for a particular implementation or encoding technology.

3.3.1 General

SRV-BP-0910	Supported metadata formats [Requirement]
The Service discovery interface shall provide access to service metadata records encoded according to at least one of the below specifications : • ISO19139:2007 [RD-6] • ISO19115-3 [RD-8] • GeoDCAT-AP [RD-10] • UMM-JSON [RD-13] • OGC 19-020r1 [RD-12] • Schema.org	

3.3.2 ISO19139 encoding

3.3.2.1 General

SRV-BP-2105	metadata format [Recommendation]	TG Req. C.1 [RD-6]
The Service discovery interface should provide access to service metadata records in ISO19139:2007 [RD-9] format with identification info encoded using service metadata XML schema (srv namespace) as per TG Req. C.1 [RD-6].		

SRV-BP-2110	metadata format [Recommendation]	TG Req. C.1 [RD-6]
Service metadata records in ISO19139:2007 [RD-9] format should comply with the mandatory requirements for Service metadata provided in [RD-6] (where applicable).		

3.3.2.2 Identification information

SRV-BP-2210	identification information [Requirement]	TG Req. C.1, C.8, C.9, C.10 [RD-6]
Service/tool metadata records in ISO19139 format shall encode the following mandatory properties of the metadata model defined in §3.2.1 as shown below: - Resource identifier <gmd:fileIdentifier/>, (srv:SV_ServiceIdentification/gmd:citation/gmd:CI_Citation/gmd:identifier) - Resource title (srv:SV_ServiceIdentification/gmd:citation/gmd:CI_Citation/gmd:title) - Resource abstract (srv:SV_ServiceIdentification/gmd:abstract) - Responsible organisation (srv:SV_ServiceIdentification /gmd:pointOfContact/gmd:CI_ResponsibleParty)		

SRV-BP-2220	identification information [Recommendation]	[RD-6] TG C.11
Service/tool metadata records in ISO19139 format should encode the following optional properties of the metadata model defined §3.2.1 as shown below: - DOI[7] (srv:SV_ServiceIdentification/gmd:citation/gmd:CI_Citation/gmd:identifier/ gmd:RS_Identifier/gmd:code/gco:CharacterString[../../codeSpace/gco:CharacterString='http://doi.org']) - Last revision date (srv:SV_ServiceIdentification/gmd:citation/gmd:CI_Citation/gmd:date) - Resource version (srv:SV_ServiceIdentification/gmd:citation/gmd:CI_Citation/gmd:edition) - Resource version description (srv:SV_ServiceIdentification/gmd:citation/gmd:CI_Citation/gmd:otherCitationDetails/gco:CharacterString)		

[7] See DOI mapping proposed in https://docs.ogc.org/is/13-026r9/13-026r9.html.

Example 1: Identification information (ISO19139)

```
<?xml version="1.0" encoding="UTF-8"?>
<gmd:MD_Metadata xmlns:gmd="http://www.isotc211.org/2005/gmd"
xmlns:gco="http://www.isotc211.org/2005/gco" xmlns:gmi="http://www.isotc211.org/2005/gmi"
xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:gmx="http://www.isotc211.org/2005/gmx"
xmlns:srv="http://www.isotc211.org/2005/srv" xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.isotc211.org/2005/gmd ./apiso-inspire.xsd">
   <gmd:fileIdentifier>
      <gco:CharacterString>eo-pdgs-landsat-datacube</gco:CharacterString>
   </gmd:fileIdentifier>
   <gmd:language>
      <gmd:LanguageCode codeList="http://www.loc.gov/standards/iso639-2/"
codeListValue="eng"/>
   </gmd:language>
   <gmd:hierarchyLevel>
      <gmd:MD_ScopeCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources
/codelist/ML_gmxCodelists.xml#MD_ScopeCode" codeListValue="service">service</gmd:MD_ScopeCode>
   </gmd:hierarchyLevel>
   <gmd:hierarchyLevelName>
      <gco:CharacterString>Service</gco:CharacterString>
   </gmd:hierarchyLevelName>

   <gmd:contact>
   </gmd:contact>
   …
   <gmd:identificationInfo>
      <srv:SV_ServiceIdentification>
         <gmd:citation>
            <gmd:CI_Citation>
               <gmd:title>
                  <gco:CharacterString>Landsat DataCube</gco:CharacterString>
               </gmd:title>
               <gmd:date>
                  <gmd:CI_Date>
                     <gmd:date>
                        <gco:Date>2019-05-15</gco:Date>
                     </gmd:date>
                     <gmd:dateType>
                        <gmd:CI_DateTypeCode
codeList="http://standards.iso.org/iso/19139/resources/gmxCodelists.xml#CI_DateTypeCode"
codeListValue="revision">revision</gmd:CI_DateTypeCode>
                     </gmd:dateType>
                  </gmd:CI_Date>
               </gmd:date>
               <gmd:edition><gco:CharacterString>1.0</gco:CharacterString></gmd:edition>
               <gmd:identifier>
                  <gmd:RS_Identifier>
                     <gmd:code>
                        <gco:CharacterString>eo-pdgs-landsat-datacube</gco:CharacterString>
                     </gmd:code>
                  </gmd:RS_Identifier>
               </gmd:identifier>
               <gmd:otherCitationDetails><gco:CharacterString>EO PDGS Landsat DataCube.
(2020), European Space Agency.</gco:CharacterString></gmd:otherCitationDetails>
            </gmd:CI_Citation>
         </gmd:citation>
         <gmd:abstract>
            <gco:CharacterString>ESA PDGS-DataCube enables multi-temporal and pixel-based
access to a subset of the data available in the European Space Agency dissemination services,
including Heritage Missions (HM), Third-Party Missions (TPM) and Earth Explorer (EE)
data.</gco:CharacterString>
         </gmd:abstract>
         <gmd:pointOfContact>
            <gmd:CI_ResponsibleParty>
               <gmd:organisationName>
                  <gco:CharacterString>ESA/ESRIN</gco:CharacterString>
               </gmd:organisationName>
               <gmd:contactInfo>
                  <gmd:CI_Contact>
                     <gmd:phone>
                        <gmd:CI_Telephone>
                           <gmd:voice>
                              <gco:CharacterString>tel:+39 06 94180777</gco:CharacterString>
```

```
                        </gmd:voice>
                     </gmd:CI_Telephone>
                  </gmd:phone>
                  <gmd:address>
                     <gmd:CI_Address>
                        <gmd:deliveryPoint>
                           <gco:CharacterString>Via Galileo Galilei CP.
64</gco:CharacterString>
                        </gmd:deliveryPoint>
                        <gmd:city>
                           <gco:CharacterString>Frascati</gco:CharacterString>
                        </gmd:city>
                        <gmd:postalCode>
                           <gco:CharacterString>00044</gco:CharacterString>
                        </gmd:postalCode>
                        <gmd:country>
                           <gco:CharacterString>Italy</gco:CharacterString>
                        </gmd:country>
                        <gmd:electronicMailAddress>
                           <gco:CharacterString>eohelp@eo.esa.int</gco:CharacterString>
                        </gmd:electronicMailAddress>
                     </gmd:CI_Address>
                  </gmd:address>
                  <gmd:onlineResource>
                     <gmd:CI_OnlineResource>
                        <gmd:linkage>
                           <gmd:URL>https://earth.esa.int</gmd:URL>
                        </gmd:linkage>
                     </gmd:CI_OnlineResource>
                  </gmd:onlineResource>
               </gmd:CI_Contact>
            </gmd:contactInfo>
            <gmd:role>
               <gmd:CI_RoleCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources
/codelist/ML_gmxCodelists.xml#CI_RoleCode"
codeListValue="originator">originator</gmd:CI_RoleCode>
            </gmd:role>
         </gmd:CI_ResponsibleParty>
      </gmd:pointOfContact>

   </srv:SV_ServiceIdentification>
</gmd:identificationInfo>

<gmd:distributionInfo/>
<gmd:dataQualityInfo/>

</gmd:MD_Metadata>
```

SRV-BP-2230	Spatial resolution [Recommendation]	[RD-6] TG Req. 3.3
Metadata records should express restriction on the spatial resolution if the service or tool has such restriction in the abstract as per §C.2.18 of [RD-6].		

SRV-BP-2240	CRS identifier [Recommendation]	[RD-6] TG Req. 6.1, 6.2
Metadata records should indicate the CRS supported by the service/tool using identifiers specified in a well-known common register, if the service or tool has such restriction in /gmd:MD_Metadata/gmd:referenceSystemInfo as per example 3.13 of [RD-6].		

3.3.2.3 Constraint information

SRV-BP-2310	Limitations on public access [Recommendation]	[RD-4], [RD-5], [RD-6] TG Req. C.17
Metadata records in ISO19139:2007 [RD-9] format should include information about limitations on public access or lack of such limitations as per [RD-6].		

SRV-BP-2320	Conditions for access and use [Recommendation]	[RD-4], [RD-5], [RD-6] TG Req. C.18
Metadata records in ISO19139:2007 [RD-9] format should include information about conditions for access and use or indicate that there are no such conditions or that the conditions are unknown as per [RD-6].		

SRV-BP-2330	Licenses [Recommendation]	[RD-6] TG Rec. C.10
Metadata records in ISO19139:2007 [RD-9] format should include information about the licensing of the resource by providing a link to the license type (e.g. https://spdx.org/licenses/Apache-2.0) as per [RD-6]..		

Example 2: Distribution information for Access point (ISO19139)

```
      <gmd:resourceConstraints>
            <gmd:MD_LegalConstraints>
               <gmd:useConstraints>
                  <gmd:MD_RestrictionCode
codeList="http://standards.iso.org/iso/19139/resources/gmxCodelists.xml#MD_RestrictionCode"
codeListValue="otherRestrictions"/>
               </gmd:useConstraints>
               <gmd:otherConstraints>
                  <gmx:Anchor xlink:href="http://inspire.ec.europa.eu/metadata-
codelist/ConditionsApplyingToAccessAndUse/noConditionsApply">No conditions apply to access and
use.</gmx:Anchor>
               </gmd:otherConstraints>
            </gmd:MD_LegalConstraints>
         </gmd:resourceConstraints>

         <gmd:resourceConstraints>
            <gmd:MD_LegalConstraints>
               <gmd:accessConstraints>
                  <gmd:MD_RestrictionCode
codeList="http://standards.iso.org/iso/19139/resources/gmxCodelists.xml#MD_RestrictionCode"
codeListValue="otherRestrictions"/>
               </gmd:accessConstraints>
               <gmd:otherConstraints>
                  <gmx:Anchor xlink:href="http://inspire.ec.europa.eu/metadata-
codelist/LimitationsOnPublicAccess/noLimitations">no limitations to public
access.</gmx:Anchor>
               </gmd:otherConstraints>
            </gmd:MD_LegalConstraints>
         </gmd:resourceConstraints>
```

Example 3: Distribution information for Tool download (ISO19139)

```
         <gmd:resourceConstraints>
            <gmd:MD_LegalConstraints>
```

```
               <gmd:useConstraints>
                  <gmd:MD_RestrictionCode
codeList="http://standards.iso.org/iso/19139/resources/gmxCodelists.xml#MD_RestrictionCode"
codeListValue="otherRestrictions"/>
               </gmd:useConstraints>
               <gmd:otherConstraints>
                  <gmx:Anchor xlink:href="https://spdx.org/licenses/GPL-3.0-only">GNU General
Public License v3.0</gmx:Anchor>
               </gmd:otherConstraints>
            </gmd:MD_LegalConstraints>
         </gmd:resourceConstraints>
```

3.3.2.4 Distribution information

SRV-BP-2410	Resource URL [Requirement]	[RD-4], [RD-5], [RD-6] TG Req. 3.7
(Tool) Metadata records shall include an “URL” element describing where the Web user interface can be accessed or where the tool can be downloaded.		

Example 4: Distribution information for Tool download (ISO19139)

```
<gmd:distributionInfo>
      <gmd:MD_Distribution>
         <gmd:transferOptions>
            <gmd:MD_DigitalTransferOptions>
               <gmd:onLine>
                  <gmd:CI_OnlineResource>
                     <gmd:linkage>
                        <gmd:URL>https://earth.esa.int/eogateway/gut-registration</gmd:URL>
                     </gmd:linkage>
                     <gmd:name>
                        <gco:CharacterString>Download the GOCE User
Toolbox</gco:CharacterString>
                     </gmd:name>
                     <gmd:function>
                        <gmd:CI_OnLineFunctionCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources
/codelist/ML_gmxCodelists.xml#CI_OnLineFunctionCode" codeListValue="download"/>
                     </gmd:function>
                  </gmd:CI OnlineResource>
               </gmd:onLine>
            </gmd:MD_DigitalTransferOptions>
         </gmd:transferOptions>
      </gmd:MD_Distribution>
   </gmd:distributionInfo>
```

Example 5: Distribution information for Web User Interface (ISO19139)

```
<gmd:distributionInfo>
      <gmd:MD_Distribution>
         <gmd:transferOptions>
            <gmd:MD_DigitalTransferOptions>
               <gmd:onLine>
                  <gmd:CI_OnlineResource>
                     <gmd:linkage>
                        <gmd:URL>https://lpdaacsvc.cr.usgs.gov/appeears/</gmd:URL>
                     </gmd:linkage>
                     <gmd:name>
                        <gco:CharacterString>AppEEARS Landing Page</gco:CharacterString>
                     </gmd:name>
                     <gmd:function>
```

```
                        <gmd:CI_OnLineFunctionCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources
/codelist/ML_gmxCodelists.xml#CI_OnLineFunctionCode" codeListValue="information"/>
                     </gmd:function>
                  </gmd:CI_OnlineResource>
               </gmd:onLine>
            </gmd:MD_DigitalTransferOptions>
         </gmd:transferOptions>
      </gmd:MD_Distribution>
   </gmd:distributionInfo>
```

SRV-BP-2420	ISO19139 access point information [Requirement]	TG Req. 3.7 [RD-6]
Service/tool metadata records in ISO19139:2007 [RD-9] format shall include access point information encoded according to §4.1.3 of [RD-6].		

Example 6: Distribution information for Access point (ISO19139)

```
   <gmd:distributionInfo>
      <gmd:MD_Distribution>
         <gmd:transferOptions>
            <gmd:MD_DigitalTransferOptions>
               <gmd:onLine>
                  <gmd:CI_OnlineResource>
                     <gmd:linkage>

   <gmd:URL>https://datacube.pdgs.eo.esa.int/wcs?service=WCS&amp;Request=DescribeCoverage&amp;
version=2.0.0&amp;CoverageId=LE7_RGB</gmd:URL>
                     </gmd:linkage>
                     <gmd:protocol>
                        <gco:CharacterString>OGC:WCS:DescribeCoverage</gco:CharacterString>
                     </gmd:protocol>
                     <gmd:description>
                        <gmx:Anchor xlink:href="http://inspire.ec.europa.eu/metadata-
codelist/OnLineDescriptionCode/accessPoint">accessPoint</gmx:Anchor>
                     </gmd:description>
                     <gmd:function>
                        <gmd:CI_OnLineFunctionCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources
/codelist/ML_gmxCodelists.xml#CI_OnLineFunctionCode" codeListValue="information"/>
                     </gmd:function>
                  </gmd:CI_OnlineResource>
               </gmd:onLine>
               <gmd:onLine>
                  <gmd:CI_OnlineResource>
                     <gmd:linkage>

   <gmd:URL>https://datacube.pdgs.eo.esa.int/wcs?service=WCS&amp;Request=GetCapabilities&amp;v
ersion=2.0.0</gmd:URL>
                     </gmd:linkage>
                     <gmd:protocol>
                        <gmx:Anchor
xlink:href="http://www.opengis.net/def/serviceType/ogc/wcs/2.0">
          OGC:WCS:GetCapabilities</gmx:Anchor>
                     </gmd:protocol>
                     <gmd:description>
                        <gmx:Anchor xlink:href="http://inspire.ec.europa.eu/metadata-
codelist/OnLineDescriptionCode/accessPoint">accessPoint</gmx:Anchor>
                     </gmd:description>
                     <gmd:function>
                        <gmd:CI_OnLineFunctionCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources
/codelist/ML_gmxCodelists.xml#CI_OnLineFunctionCode" codeListValue="information"/>
                     </gmd:function>
                  </gmd:CI OnlineResource>
               </gmd:onLine>
            </gmd:MD_DigitalTransferOptions>
         </gmd:transferOptions>
      </gmd:MD_Distribution>
```

```
   </gmd:distributionInfo>
```

OGC API compliant endpoints can be encoded as links (<gmd:CI_OnlineResource/>) with "rel" (<gmd:protocol/>) and "href" (<gmd:linkage/>) as defined in OGC API – Processes [RD-36].

Example 7: Distribution information for OGC API - Processes (ISO19139)

```
   <gmd:distributionInfo>
      <gmd:MD_Distribution>
         <gmd:transferOptions>
            <gmd:MD_DigitalTransferOptions>
               <gmd:onLine>
                  <gmd:CI_OnlineResource>
                     <gmd:linkage>
                        <gmd:URL>
https://facility.org/processes/NdviProcess/execution</gmd:URL>
                     </gmd:linkage>
                     <gmd:protocol>
   <gco:CharacterString>http://www.opengis.net/def/rel/ogc/1.0/execute</gco:CharacterString>
                     </gmd:protocol>
                     <gmd:description>
                        <gmx:Anchor xlink:href="http://inspire.ec.europa.eu/metadata-
codelist/OnLineDescriptionCode/accessPoint">accessPoint</gmx:Anchor>
                     </gmd:description>
                     <gmd:function>
                        <gmd:CI_OnLineFunctionCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources
/codelist/ML_gmxCodelists.xml#CI_OnLineFunctionCode" codeListValue="information"/>
                     </gmd:function>
                  </gmd:CI_OnlineResource>
               </gmd:onLine>
            </gmd:MD_DigitalTransferOptions>
         </gmd:transferOptions>
      </gmd:MD_Distribution>
   </gmd:distributionInfo>
```

SRV-BP-2430	No online access [Recommendation]	[RD-4], [RD-5], [RD-6] TG req. 3.7
Metadata records should include an "resource locator" element providing access to additional information about the tool or service if no online access is available.		

Example 8: Distribution information when no online access (ISO19139)

```
   <gmd:distributionInfo>
      <gmd:MD_Distribution>
         <gmd:transferOptions>
            <gmd:MD DigitalTransferOptions>
               <gmd:onLine>
                  <gmd:CI_OnlineResource>
                     <gmd:linkage>
                        <gmd:URL> https://earth.esa.int/eogateway/documents/20142/37627/GOCE-
User-Toolbox-Tutorial-P-Knudsen.pdf</gmd:URL>
                     </gmd:linkage>
                     <gmd:name>
                        <gco:CharacterString>GOCE User Toolbox and
Tutorial</gco:CharacterString>
                     </gmd:name>
                     <gmd:function>
                        <gmd:CI_OnLineFunctionCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources
/codelist/ML_gmxCodelists.xml#CI_OnLineFunctionCode" codeListValue="information"/>
                     </gmd:function>
                  </gmd:CI_OnlineResource>
```

```
            </gmd:onLine>
         </gmd:MD_DigitalTransferOptions>
      </gmd:transferOptions>
   </gmd:MD_Distribution>
</gmd:distributionInfo>
```

3.3.2.5 Quality information

SRV-BP-2510	Technical specification [Recommendation]	[RD-6] TG Req. 5.5, C.20, C.21
Metadata records for online services (API) in ISO19139:2007 [RD-9] format should declare compliance with at least one technical specification providing all technical elements to actually invoke the service and enable its usage.		

Example 9: Compliance information for Access point (ISO19139)

```
   <gmd:dataQualityInfo>
      <gmd:DQ_DataQuality>
         <gmd:scope>
            <gmd:DQ_Scope>
               <gmd:level>
                  <gmd:MD_ScopeCode
codeList="http://standards.iso.org/iso/19139/resources/gmxCodelists.xml#MD_ScopeCode"
codeListValue="service"/>
               </gmd:level>
               <gmd:levelDescription>
                  <gmd:MD_ScopeDescription>
                     <gmd:other>
                        <gco:CharacterString>Service</gco:CharacterString>
                     </gmd:other>
                  </gmd:MD_ScopeDescription>
               </gmd:levelDescription>
            </gmd:DQ_Scope>
         </gmd:scope>

         <gmd:report>
            <gmd:DQ_DomainConsistency>
               <gmd:result>
                  <gmd:DQ_ConformanceResult>
                     <gmd:specification>
                        <gmd:CI_Citation>
                           <gmd:title>
                              <gmx:Anchor xlink:href="http://docs.opengeospatial.org/is/17-
089r1/17-089r1.html">OGC Web Coverage Service 2.0</gmx:Anchor>
                           </gmd:title>
                           <gmd:date>
                              <gmd:CI_Date>
                                 <gmd:date>
                                    <gco:Date>2010-10-27</gco:Date>
                                 </gmd:date>
                                 <gmd:dateType>
                                    <gmd:CI_DateTypeCode
codeList="http://standards.iso.org/iso/19139/resources/gmxCodelists.xml#CI_DateTypeCode"
codeListValue="publication">publication</gmd:CI_DateTypeCode>
                                 </gmd:dateType>
                              </gmd:CI_Date>
                           </gmd:date>
                        </gmd:CI_Citation>
                     </gmd:specification>
                     <gmd:explanation>
                        <gco:CharacterString>This Spatial Data Service is conformant with the
OGC Web Coverage Service 2.0 specification</gco:CharacterString>
                     </gmd:explanation>
                     <gmd:pass gco:nilReason=”unknown”/>
```

```
                </gmd:DQ_ConformanceResult>
              </gmd:result>
            </gmd:DQ_DomainConsistency>
          </gmd:report>
        </gmd:DQ_DataQuality>
    </gmd:dataQualityInfo>
```

3.3.2.6 Service coupling

SRV-BP-2610	DataIdentification id attribute [Recommendation]	TG Rec. 1.1, TG Req. 3.6 [RD-6]
<gmd:MD_DataIdentification/> sections of collection metadata records in ISO19139:2007 [RD-7B] format should have a unique "id" attribute (e.g. equal to the "fileIdentifier"[8]) to allow for linking from services/tools metadata records to collection metadata records as per TG Rec. 1.1 and TG Req. 3.6 [RD-6].		

SRV-BP-2620	Service to collection coupling [Recommendation]	TG Rec. 1.1, TG Req. 3.6 [RD-6]
Service metadata records in ISO19139:2007 [RD-7B] format should refer to online metadata records consumed or provided by the service using "srv:operatesOn" as per TG Req. 3.6 [RD-6].		

Example 10: Reference to related collections (ISO19139)

```
<srv:operatesOn
xlink:href="https://cat.ceos.org/collections/series/items/LANDSAT.ETM.GTC?httpAccept=applicati
on/vnd.iso.19139-2%2Bxml#LANDSAT.ETM.GTC"/>
```

3.3.2.7 Metadata information

SRV-BP-2710	Metadata information [Recommendation]	TG Req. C.5, C.6, C.7 [RD-6]
Service/tool metadata records in ISO19139 format should encode the following metadata information properties of the metadata model defined in 3.2.6 as shown in the example below: - Metadata point of contact (<gmd:contact/>) - Latest update date (<gmd:dateStamp/>) - Metadata language (<gmd:language/>)		

Example 11: Metadata information (ISO19139)

```
<?xml version="1.0" encoding="UTF-8"?>
<gmd:MD_Metadata xmlns:gmd="http://www.isotc211.org/2005/gmd"
xmlns:gco="http://www.isotc211.org/2005/gco" xmlns:gmi="http://www.isotc211.org/2005/gmi"
xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:gmx="http://www.isotc211.org/2005/gmx"
xmlns:srv="http://www.isotc211.org/2005/srv" xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
   <gmd:fileIdentifier>
```

```
      <gco:CharacterString>eo-pdgs-landsat-datacube</gco:CharacterString>
   </gmd:fileIdentifier>
   <gmd:language>
      <gmd:LanguageCode codeList="http://www.loc.gov/standards/iso639-2/"
codeListValue="eng"/>
   </gmd:language>
   <gmd:hierarchyLevel>
      <gmd:MD_ScopeCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources
/codelist/ML_gmxCodelists.xml#MD_ScopeCode" codeListValue="service">service</gmd:MD_ScopeCode>
   </gmd:hierarchyLevel>
   <gmd:hierarchyLevelName>
      <gco:CharacterString>Service</gco:CharacterString>
   </gmd:hierarchyLevelName>
   <gmd:contact>
      <gmd:CI_ResponsibleParty>
         <gmd:organisationName>
            <gco:CharacterString>ESA/ESRIN</gco:CharacterString>
         </gmd:organisationName>
         <gmd:contactInfo>
            <gmd:CI_Contact>
               <gmd:phone>
                  <gmd:CI_Telephone>
                     <gmd:voice>
                        <gco:CharacterString>tel:+39 06 94180777</gco:CharacterString>
                     </gmd:voice>
                  </gmd:CI_Telephone>
               </gmd:phone>
               <gmd:address>
                  <gmd:CI_Address>
                     <gmd:deliveryPoint>
                        <gco:CharacterString>Via Galileo Galilei CP. 64</gco:CharacterString>
                     </gmd:deliveryPoint>
                     <gmd:city>
                        <gco:CharacterString>Frascati</gco:CharacterString>
                     </gmd:city>
                     <gmd:postalCode>
                        <gco:CharacterString>00044</gco:CharacterString>
                     </gmd:postalCode>
                     <gmd:country>
                        <gco:CharacterString>Italy</gco:CharacterString>
                     </gmd:country>
                     <gmd:electronicMailAddress>
                        <gco:CharacterString>eohelp@eo.esa.int</gco:CharacterString>
                     </gmd:electronicMailAddress>
                  </gmd:CI_Address>
               </gmd:address>
               <gmd:onlineResource>
                  <gmd:CI_OnlineResource>
                     <gmd:linkage>
                        <gmd:URL>https://earth.esa.int</gmd:URL>
                     </gmd:linkage>
                  </gmd:CI_OnlineResource>
               </gmd:onlineResource>
            </gmd:CI_Contact>
         </gmd:contactInfo>
         <gmd:role>
            <gmd:CI_RoleCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources
/codelist/ML_gmxCodelists.xml#CI_RoleCode"
codeListValue="pointOfContact">pointOfContact</gmd:CI_RoleCode>
         </gmd:role>
      </gmd:CI_ResponsibleParty>
   </gmd:contact>
   <gmd:dateStamp>
      <gco:DateTime>2019-05-15T09:00:00</gco:DateTime>
   </gmd:dateStamp>
   <gmd:metadataStandardName>
      <gco:CharacterString>ISO19115</gco:CharacterString>
   </gmd:metadataStandardName>
   <gmd:metadataStandardVersion>
      <gco:CharacterString>2005/Cor.1:2006</gco:CharacterString>
   </gmd:metadataStandardVersion>
```

3.3.2.8 Descriptive keywords

SRV-BP-2810	Descriptive keywords [Recommendation]
Service/tool metadata records in ISO19139 format should encode descriptive keywords as shown in the example below.	

Example 12: Descriptive Keywords (ISO19139)

```
         <gmd:descriptiveKeywords>
            <gmd:MD_Keywords>
               <gmd:keyword>
                  <gmx:Anchor xlink:href="https://earth.esa.int/concept/landsat-7">Landsat-
7</gmx:Anchor>
               </gmd:keyword>
               <gmd:keyword>
                  <gmx:Anchor xlink:href="https://earth.esa.int/concept/landsat-8">Landsat-
8</gmx:Anchor>
               </gmd:keyword>
               <gmd:type>
                  <gmd:MD_KeywordTypeCode
codeList="http://www.isotc211.org/2005/resources/codeList.xml#MD_KeywordTypeCode"
codeListValue="theme"/>
               </gmd:type>
               <gmd:thesaurusName>
                  <gmd:CI_Citation>
                     <gmd:title>
                        <gmx:Anchor
xlink:href="https://earth.esa.int/concepts/concept_scheme/platforms">EO Parameter Code List -
Platforms</gmx:Anchor>
                     </gmd:title>
                     <gmd:date>
                        <gmd:CI_Date>
                           <gmd:date>
                              <gco:Date>2018</gco:Date>
                           </gmd:date>
                           <gmd:dateType>
                              <gmd:CI_DateTypeCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources
/codelist/ML_gmxCodelists.xml#CI_DateTypeCode"
codeListValue="publication">publication</gmd:CI_DateTypeCode>
                           </gmd:dateType>
                        </gmd:CI_Date>
                     </gmd:date>
                     <gmd:identifier>
                        <gmd:MD_Identifier>
                           <gmd:code>
                              <gco:CharacterString/>
                           </gmd:code>
                        </gmd:MD_Identifier>
                     </gmd:identifier>
                  </gmd:CI_Citation>
               </gmd:thesaurusName>
            </gmd:MD_Keywords>
         </gmd:descriptiveKeywords>
```

3.3.2.9 Extent information

SRV-BP-2910	Temporal extent [Recommendation]	[RD-6] TG Req. C.14
Metadata records in ISO19139 encoding should describe 0 to n temporal extents only if the service or tool has an explicit temporal extent as shown in the example below.		

SRV-BP-2920	Geographical extent [Recommendation]	[RD-6] TG Req. C.19
Metadata records in ISO19139 encoding should describe 0 to n minimal geographic bounding boxes only if the service or tool has an explicit geographic extent as shown in the example below.		

Example 13: Temporal and geographical extents (ISO19139)

```
          <gmd:extent>
             <gmd:EX_Extent>
                <gmd:temporalElement>
                   <gmd:EX_TemporalExtent>
                      <gmd:extent>
                         <gml:TimePeriod xmlns:gml="http://www.opengis.net/gml/3.2"
gml:id="timeperiod1">
                            <gml:beginPosition>2009-01-27</gml:beginPosition>
                            <gml:endPosition>2011-08-09</gml:endPosition>
                         </gml:TimePeriod>
                      </gmd:extent>
                   </gmd:EX_TemporalExtent>
                </gmd:temporalElement>
             </gmd:EX_Extent>
          </gmd:extent>
          <!-- Geographic Extent -->
          <gmd:extent>
             <gmd:EX_Extent>
                <gmd:geographicElement>
                   <gmd:EX_GeographicBoundingBox>
                      <gmd:westBoundLongitude>
                         <gco:Decimal>-100</gco:Decimal>
                      </gmd:westBoundLongitude>
                      <gmd:eastBoundLongitude>
                         <gco:Decimal>160</gco:Decimal>
                      </gmd:eastBoundLongitude>
                      <gmd:southBoundLatitude>
                         <gco:Decimal>-50</gco:Decimal>
                      </gmd:southBoundLatitude>
                      <gmd:northBoundLatitude>
                         <gco:Decimal>40</gco:Decimal>
                      </gmd:northBoundLatitude>
                   </gmd:EX_GeographicBoundingBox>
                </gmd:geographicElement>
             </gmd:EX_Extent>
          </gmd:extent>
```

3.3.3 Atom encoding

3.3.3.1 General

None.

3.3.3.2 Identification information

SRV-BP-3210	identification information [Requirement]
Service/tool metadata records in <entry/> format shall encode the following mandatory properties of the metadata model defined §3.2.1 as shown in the example below:	

- Resource identifier (<dc:identifier/>)
- Resource title (<atom:title/>)
- Resource abstract (<atom:content/>)
- Responsible organisation (<atom:author/>, <atom:contributor/>, <dc:creator/>, <dc:publisher/>)

SRV-BP-3220	identification information [Recommendation]

Service/tool metadata records in Atom <entry/> format should encode the following optional properties of the metadata model defined §3.2.1 as shown in the example below:

- DOI (<atom:link/>)
- Last revision date (<atom:updated/>)
- Resource version (TBC)

Example 14: Identification information (Atom)

```
<?xml version="1.0" encoding="UTF-8"?>
<atom:feed xmlns:atom="http://www.w3.org/2005/Atom"
xmlns:dc="http://purl.org/dc/elements/1.1/" xmlns:georss="http://www.georss.org/georss">
   <atom:entry>
      <atom:content type="html">Backend NetCDF to Zarr service option description for Harmony
data transformations. Cannot be chained with other operations from this record.</atom:content>
      <atom:title>PO.DAAC harmony-netcdf-to-zarr Service Options</atom:title>
      <atom:updated>2021-09-22T15:08:10.803Z</atom:updated>
      <dc:identifier>harmony-netcdf-to-zarr</dc:identifier>
      <atom:author>
         <atom:name>NASA/GSFC/EOS/EOSDIS/EMD</atom:name>
         <atom:uri>https://earthdata.nasa.gov/eosdis</atom:uri>
      </atom:author>
      <dc:date>2021-02-23T03:34:10.803Z/</dc:date>
      <atom:category label="EARTH SCIENCE SERVICES &gt; DATA MANAGEMENT/DATA HANDLING &gt;
DATA ACCESS/RETRIEVAL" term="https://gcmd.earthdata.nasa.gov/kms/concept/86cbb2d3-6783-4d9b-
9dc1-b0aea78f98ea"/>
      <atom:category label="EARTH SCIENCE SERVICES &gt; DATA MANAGEMENT/DATA HANDLING &gt;
DATA INTEROPERABILITY &gt; DATA REFORMATTING"
term="https://gcmd.earthdata.nasa.gov/kms/concept/dad75074-b2f7-4cb7-ae02-02d054f18251"/>
      <atom:category label="NETCDF-4" term="NETCDF-4"/>
      <atom:category label="ZARR" term="ZARR"/>
      <atom:id>https://cat.ceos.org/collections/services/items/harmony-netcdf-to-
zarr?httpAccept=application/atom%2Bxml</atom:id>
      <atom:link href="https://cat.ceos.org/collections/services/items/harmony-netcdf-to-
zarr?httpAccept=application/vnd.iso.19139%2Bxml" rel="alternate" title="ISO 19139 metadata"
type="application/vnd.iso.19139+xml"/>
      <atom:link href="https://cat.ceos.org/collections/services/items/harmony-netcdf-to-
zarr?mode=owc" rel="alternate" title="OGC 19-020r1 metadata"
type="application/geo+json;profile=&amp;quot;http://www.opengis.net/spec/eopad-
geojson/1.0&amp;quot;"/>
      <atom:link href="https://cmr.earthdata.nasa.gov/search/services.umm_json?name=PO.DAAC
harmony-netcdf-to-zarr&amp;amp;pretty=true" rel="via" title="UMM JSON format"
type="application/vnd.nasa.cmr.umm+json"/>
      <atom:link href="https://harmony.earthdata.nasa.gov" rel="describedby" title="This is
the harmony root endpoint." type="text/html"/>
      <atom:summary type="html"><![CDATA[<table>
</table>
]]></atom:summary>
   </atom:entry>
</atom:feed>
```

DOI of the resource can be included as href attribute of an atom:link (rel="describedby"), either using the "doi" URI scheme[9], or a URL with https://doi.org: prefix (preferred).

Example 15: Identification information with DOI (Atom)

```
<?xml version="1.0" encoding="UTF-8"?>
<atom:feed xmlns:atom="http://www.w3.org/2005/Atom"
xmlns:dc="http://purl.org/dc/elements/1.1/" xmlns:eo="http://a9.com/-
/opensearch/extensions/eo/1.0/" xmlns:geo="http://a9.com/-/opensearch/extensions/geo/1.0/"
xmlns:georss="http://www.georss.org/georss" xmlns:os="http://a9.com/-/spec/opensearch/1.1/"
xmlns:owc="http://www.opengis.net/owc/1.0" xmlns:referrer="http://a9.com/-
/opensearch/extensions/referrer/1.0/" xmlns:semantic="http://a9.com/-
/opensearch/extensions/semantic/1.0/" xmlns:sru="http://a9.com/-
/opensearch/extensions/sru/2.0/" xmlns:time="http://a9.com/-/opensearch/extensions/time/1.0/">
   <atom:entry>
      <atom:title>rasdaman - raster data manager</atom:title>
      <atom:updated>2021-10-20T16:12:55.511Z</atom:updated>
      <dc:identifier>rasdaman</dc:identifier>

   <atom:id>https://cat.ceos.org/collections/services/items/rasdaman?httpAccept=application/at
om%2Bxml</atom:id>
      <atom:link href="https://spdx.org/licenses/GPL-3.0-only.html" rel="license" title="GNU
General Public License v3.0"/>
      <atom:link href="http://www.rasdaman.org/" rel="describedby" title="Welcome to rasdaman
— the world's most flexible and scalable Array / Datacube Engine" type="text/html"/>
      <atom:link href="https://doi.org/10.5281/zenodo.1040170" rel="describedby"
type="text/html"/>
      <atom:link
href="https://cat.ceos.org/collections/services/items/rasdaman?httpAccept=application/vnd.iso.
19139%2Bxml" rel="alternate" title="ISO 19139 metadata" type="application/vnd.iso.19139+xml"/>
      <atom:content type="html">Rasdaman (raster data manager) is an open source array
database system, which provides flexible, fast, scalable geo services for multi-dimensional
spatio-temporal sensor, image, simulation, and statistics data of unlimited volume. ... data
with all geo data in the PostgreSQL database, support for the raster-relevant OGC standards,
Reference Implementation for WCS Core and WCPS.</atom:content>
      <atom:category label="EARTH SCIENCE SERVICES &gt; DATA MANAGEMENT/DATA HANDLING &gt;
DATA ACCESS/RETRIEVAL" term="https://gcmd.earthdata.nasa.gov/kms/concept/86cbb2d3-6783-4d9b-
9dc1-b0aea78f98ea"/>
      <atom:category label="OGC Web Coverage Service 2.0"
term="http://www.opengis.net/def/serviceType/ogc/wcs/2.0"/>
      <atom:category label="Coverage access service"
term="https://inspire.ec.europa.eu/metadata-
codelist/SpatialDataServiceCategory/infoCoverageAccessService"/>
      <atom:category label="statistics data" term="statistics data"/>
      <atom:category label="rasdaman GmbH" term="rasdaman GmbH"/>
   </atom:entry>
</atom:feed>
```

SRV-BP-3230	File identifier [Recommendation]	[AD-1]
Service/tool metadata records in Atom entry format should include a <dc:identifier/> element with a value identical to the corresponding ISO19139 "fileIdentifier".		

3.3.3.3 Constraint information

SRV-BP-3310	Use limitation URL [Recommendation]

[9] https://datatracker.ietf.org/doc/html/draft-paskin-doi-uri

Service/tool metadata records as Atom entry should include conditions applying to access and use available as URL as <atom:link/> with rel="license" attribute[10].

SRV-BP-3320	Use limitation text [Recommendation]
Service/tool metadata records as Atom entry should include textual conditions applying to access and use not available as URL as <atom:rights/> element.	

Example 16: License information for Tool download (Atom)

```
   <atom:entry>
      <atom:id>https://cat.ceos.org/collections/services/items/coastline-
classifier?httpAccept=application/atom%2Bxml</atom:id>
      <atom:link href="https://spdx.org/licenses/Apache-2.0" rel="license" title="Apache
License 2.0" />
      <atom:link href="https://raw.githubusercontent.com/ceos-
seo/data_cube_notebooks/master/notebooks/water/coastline/Coastline_Classifier.ipynb"
rel="enclosure" title="Download the Notebook" type="application/x-ipynb+json"/>

      <atom:title>Coastline Classifier</atom:title>
      <atom:updated>2021-03-17T11:41:21.000Z</atom:updated>
      <dc:identifier>coastline-classifier</dc:identifier>
   </atom:entry>
```

3.3.3.4 Distribution information

SRV-BP-3410	Tool download [Requirement]
Service/tool metadata records in Atom format shall include tool download information encoded as <atom:link/> with rel="enclosure" attribute.	

Example 17: Distribution information for Tool download (Atom)

```
   <atom:entry>
      <atom:id>https://cat.ceos.org/collections/services/items/coastline-classifier</atom:id>

      <atom:link href="https://raw.githubusercontent.com/ceos-
seo/data_cube_notebooks/master/notebooks/water/coastline/Coastline_Classifier.ipynb"
rel="enclosure" title="Download the Notebook" type="application/x-ipynb+json"/>

      <atom:summary type="html"><![CDATA[<table>
</table>
]]></atom:summary>
      <atom:content type="html">A coastal boundary algorithm is used to classify a given pixel
as either coastline or not coastline using a simple binary format. The algorithm makes a
classification by examining surrounding pixels and making a determination based on how many
pixels around it are water</atom:content>
      <atom:title>Coastline Classifier</atom:title>
      <atom:updated>2021-03-17T11:41:21.000Z</atom:updated>
      <dc:identifier>coastline-classifier</dc:identifier>
      <dc:date>1999-01-01T12:00:00.000Z/2003-12-31T11:59:59.000Z</dc:date>
   </atom:entry>
```

[10] https://datatracker.ietf.org/doc/html/rfc4946

SRV-BP-3415	Web GUI URL [Requirement]
Service/Tool Metadata records in Atom format shall include an "URL" element describing where the Web user interface can be accessed encoded as <atom:link/> with rel="describes" attribute.	

Example 18: Distribution information for Web User Interface (Atom)

```
   <atom:entry>
      <atom:id>https://cat.ceos.org/collections/services/items/appeears</atom:id>

      <atom:link href="https://lpdaacsvc.cr.usgs.gov/appeears/" rel="describes"
title="AppEEARS Landing Page" type="text/html"/>

      <atom:content type="text">The Application for Extracting and Exploring Analysis Ready
Samples (AρρEEARS) offers a simple and efficient way to access..</atom:content>
      <atom:title>Application for Extracting and Exploring Analysis Ready Samples</atom:title>
      <atom:updated>2021-03-17T11:41:21.000Z</atom:updated>
      <atom:rights>Users must have a NASA Earthdata Login account to use the AρρEEARS site and
API.</atom:rights>
      <dc:identifier>appeears</dc:identifier>
   </atom:entry>
```

SRV-BP-3420	Atom access point information [Requirement]
Service/tool metadata records in Atom format, for instance included in OpenSearch responses, shall include access point information encoded according to OGC 12-084r2 [RD-18] (<owc:offering/>).	

Example 19: *Distribution information for Access point (Atom)*

```
<?xml version="1.0" encoding="UTF-8"?>
<atom:feed xmlns:atom="http://www.w3.org/2005/Atom"
xmlns:dc="http://purl.org/dc/elements/1.1/" xmlns:eo="http://a9.com/-
/opensearch/extensions/eo/1.0/" xmlns:geo="http://a9.com/-/opensearch/extensions/geo/1.0/"
xmlns:georss="http://www.georss.org/georss" xmlns:os="http://a9.com/-/spec/opensearch/1.1/"
xmlns:owc="http://www.opengis.net/owc/1.0" xmlns:referrer="http://a9.com/-
/opensearch/extensions/referrer/1.0/" xmlns:semantic="http://a9.com/-
/opensearch/extensions/semantic/1.0/" xmlns:sru="http://a9.com/-
/opensearch/extensions/sru/2.0/" xmlns:time="http://a9.com/-/opensearch/extensions/time/1.0/">
   <atom:entry>
      <atom:id>https://cat.ceos.org/collections/services/items/eo-pdgs-landsat-
datacube?httpAccept=application/atom%2Bxml</atom:id>
      <atom:link href="https://cat.ceos.org/collections/services/items/eo-pdgs-landsat-
datacube?httpAccept=application/atom%2Bxml" rel="alternate" title="Atom format"
type="application/atom+xml"/>
      <atom:link href="http://www.opengis.net/def/serviceType/ogc/wcs/2.0" rel="profile"
title="OGC Web Coverage Service 2.0"/>
      <atom:summary type="html"><![CDATA[<table></table>
]]></atom:summary>
      <atom:content type="text">ESA PDGS-DataCube enables multi-temporal and pixel-based
access to a subset of the data available in the European Space Agency dissemination services,
including Heritage Missions (HM), Third-Party Missions (TPM) and Earth Explorer (EE)
data.</atom:content>
      <atom:title>Landsat DataCube</atom:title>
      <atom:updated>2021-09-24T12:10:29Z</atom:updated>
      <dc:identifier>eo-pdgs-landsat-datacube</dc:identifier>
      <dc:date>2020-09-29T12:00:00.000Z/</dc:date>
      <owc:offering code="http://www.opengis.net/spec/owc-atom/1.0/req/wcs">
         <owc:operation code="DescribeCoverage"
href="https://datacube.pdgs.eo.esa.int/wcs?service=WCS&amp;Request=DescribeCoverage&amp;versio
n=2.0.0&amp;CoverageId=LE7_RGB"/>
         <owc:operation code="GetCapabilities"
href="https://datacube.pdgs.eo.esa.int/wcs?service=WCS&amp;Request=GetCapabilities&amp;version
=2.0.0"/>
      </owc:offering>
   </atom:entry>
```

```
</atom:feed>
```

SRV-BP-3430	Access points [Recommendation]
Metadata records in Atom format should include an “resource locator“ element providing access to additional information about the tool or service if no online access is available encoded as <atom:link/> with rel=”describedby” attribute.	

3.3.3.5 Quality information

SRV-BP-3510	Technical specification [Recommendation]
Metadata records for online services (API) or tools in Atom format should declare compliance with technical specifications using <atom:link> with rel=”profile” and URI identifying the protocol type as per SRV-BP-0415.	

Note: a similar encoding is used by OGC 12-084r2[11].

Example 20: Technical specification (Atom)

```
<atom:link href="http://www.opengis.net/def/serviceType/ogc/wcs/2.0" rel="profile" title="OGC
Web Coverage Service 2.0"/>
```

3.3.3.6 Service coupling

SRV-BP-3610	Collection to service coupling [Recommendation]
Collection metadata records in Atom encoding should identify coupled services/tools as as <atom:link/> with rel=”service” attribute referencing the corresponding service/tool metadata record.	

SRV-BP-3620	Service to collection coupling [Recommendation]
Service metadata records in Atom format should refer to online collection metadata records consumed or provided by the service with <atom:link/> with rel=”collection” or rel=”related” attribute.	

3.3.3.7 Metadata information

SRV-BP-3710	Metadata information [Recommendation]

[11] https://docs.opengeospatial.org/is/12-084r2/12-084r2.html

Service/tool metadata records in Atom (Entry) format should encode the following metadata information properties of the metadata model defined in 3.2.6 as shown in the example below:

- Metadata point of contact (Not available)
- Latest update date (<atom:updated/>)
- Metadata language (xml:lang)

Example 21: Metadata information (Atom)

```
   <atom:entry xml:lang="en">
…
      <atom:updated>2021-03-31T00:00:00.000Z</atom:updated>

   </atom:entry>
```

3.3.3.8 Descriptive keywords

SRV-BP-3810	Atom descriptive keywords [Recommendation]
Service/tool metadata records in Atom format should include descriptive keywords encoded as <atom:category/>, including the scheme attribute and a URI for the term attribute when available.	

Example 22: Descriptive Keywords (Atom)

```
<?xml version="1.0" encoding="UTF-8"?>
<atom:feed xmlns:atom="http://www.w3.org/2005/Atom"
xmlns:dc="http://purl.org/dc/elements/1.1/" xmlns:georss="http://www.georss.org/georss">
   <atom:entry>
      <atom:content type="html">Backend NetCDF to Zarr service option description for Harmony
data transformations. Cannot be chained with other operations from this record.</atom:content>
      <atom:title>PO.DAAC harmony-netcdf-to-zarr Service Options</atom:title>
      <dc:identifier>harmony-netcdf-to-zarr</dc:identifier>

      <atom:category label="EARTH SCIENCE SERVICES &gt; DATA MANAGEMENT/DATA HANDLING &gt;
DATA ACCESS/RETRIEVAL" term="https://gcmd.earthdata.nasa.gov/kms/concept/86cbb2d3-6783-4d9b-
9dc1-b0aea78f98ea" scheme="
https://gcmd.earthdata.nasa.gov/kms/concepts/concept_scheme/sciencekeywords"/>
      <atom:category label="EARTH SCIENCE SERVICES &gt; DATA MANAGEMENT/DATA HANDLING &gt;
DATA INTEROPERABILITY &gt; DATA REFORMATTING"
term="https://gcmd.earthdata.nasa.gov/kms/concept/dad75074-b2f7-4cb7-ae02-02d054f18251"
scheme="https://gcmd.earthdata.nasa.gov/kms/concepts/concept_scheme/sciencekeywords"/>
      <atom:category label="NETCDF-4" term="NETCDF-4"/>
      <atom:category label="ZARR" term="ZARR"/>

   </atom:entry>
</atom:feed>
```

3.3.3.9 Extent information

SRV-BP-3910	Geographic extent [Recommendation]	[AD-1]
Service/tool metadata records in Atom format should include geographic extent (bounding box) - if applicable - encoded as <georss:*/> according to the Best Practice CEOS-BP-014E [AD-1].		

SRV-BP-3920	Temporal extent [Recommendation]	[AD-1]
Service/tool metadata records in Atom format should include temporal extent if applicable - encoded as <dc:date/> according to the Best Practice CEOS-BP-013B [AD-1].		

Example 23: Temporal and geographical extents (Atom)

```
<atom:entry>
    …
   <dc:date>2009-01-27T00:00:00.000Z/2011-08-09T23:59:59.999Z</dc:date>
   <georss:box> -50 -100 40 160</georss:box>
</atom:entry>
```

3.3.4 OGC 19-020r1 GeoJSON encoding

3.3.4.1 General

The OGC 19-020r1 [RD-12] is a GeoJSON encoding derived from the corresponding OGC Best Practice for EO Collection metadata encoding in GeoJSON(-LD) OGC 17-084r1 [RD-30].

3.3.4.2 Identification information

SRV-BP-4210	Identification information [Requirement]	[RD-12], [RD-30]
Service/tool metadata records in OGC 19-020r1 (GeoJSON Feature) format shall encode the following mandatory properties of the metadata model defined §3.2.1 as shown in the example below: - Resource identifier ($.properties.identifier) - Resource title ($.properties.title) - Resource abstract ($.properties.abstract) - Responsible organisation ($.properties.contactPoint)		

SRV-BP-4220	Identification information [Recommendation]	[RD-12], [RD-30]
Service/tool metadata records in OGC 19-020r1 (GeoJSON Feature) format should encode the following optional properties of the metadata model defined §3.2.1 as shown in the example below: - DOI ($.properties.doi) - Last revision date ($.properties.updated) - Resource version ($.properties.versionInfo) - Resource version description ($.properties.versionNotes)		

Example 24: Identification information (OGC 19-020r1)

```
{
   "geometry": null,
   "id": "https://cat.ceos.org/collections/services/items/rasdaman",
```

```
   "type": "Feature",
   "properties": {
      "identifier": "rasdaman",
      "kind": "http://purl.org/dc/dcmitype/Service",
      "title": "rasdaman - raster data manager",
      "doi": "10.5281/zenodo.1040170",
      "bibliographicCitation": "Peter Baumann, email: p.baumann@jacobs-university.de, &
website: rasdaman.org. (2018, January 31). rasdaman - raster data manager (Version 9.5.0).
Zenodo. http://doi.org/10.5281/zenodo.1163021",
      "abstract": "Rasdaman (raster data manager) is an open source array database system,
which provides flexible, fast, scalable geo services for multi-dimensional spatio-temporal
sensor, image, simulation, and statistics data of unlimited volume. ... data with all geo data
in the PostgreSQL database, support for the raster-relevant OGC standards, Reference
Implementation for WCS Core and WCPS.",
      "versionInfo": "9.5",
      "updated": "2018-01-31T00:00:55.511Z",

      "contactPoint": [
         {
            "type": "Organization",
            "name": "rasdaman GmbH",
            "uri": "http://rasdaman.org"
         }
      ]
   }
}
```


SRV-BP-4230	File identifier [Recommendation]	[AD-1]
Service/tool metadata records in OGC 19-020r1 (GeoJSON Feature) format should include a $.properties.identifier element with a value identical to the corresponding ISO19139 "fileIdentifier". The same applies to the $.id property returned in an OGC API – Features (GeoJSON Feature) response etc.		

3.3.4.3 Constraint information

SRV-BP-4310	Use limitation URL [Recommendation]	[RD-12], [RD-30]
Service/tool metadata records in OGC 19-020r1 (GeoJSON Feature) format should include conditions applying to access and use with $.properties.license and $.properties.accessRights.		

Example 25: Constraint information for Access point (OGC19-020r1)


```
{
   "geometry": null,
   "type": "Feature",
   "id": "https://cat.ceos.org/collections/services/items/eo-pdgs-landsat-datacube",


   "properties": {
      "kind": "http://purl.org/dc/dcmitype/Service",
      "title": "Landsat DataCube",
      "identifier": "eo-pdgs-landsat-datacube",

      "accessRights": [
         {
            "type": "RightsStatement",
            "label": "No limitations to public access."
         },
         "http://inspire.ec.europa.eu/metadata-
codelist/LimitationsOnPublicAccess/noLimitations"
      ],
      "license": [
         "http://inspire.ec.europa.eu/metadata-
codelist/ConditionsApplyingToAccessAndUse/noConditionsApply",
```

```
            {
               "type": "LicenseDocument",
               "label": "No conditions apply to access and use."
            }
         ]

      }
}
```

Example 26: License information for Tool download (OGC19-020r1)

```
{
   "geometry": null,
   "id": "https://cat.ceos.org/collections/services/items/coastline-classifier",
   "type": "Feature",
   "properties": {
      "identifier": "coastline-classifier",
      "kind": "http://purl.org/dc/dcmitype/Service",
      "title": "Coastline Classifier",
      "license": [
         "https://spdx.org/licenses/Apache-2.0"
      ]
   }
}
```

3.3.4.4 Distribution information

SRV-BP-4410	GeoJSON tool download [Requirement]	[RD-12], [RD-30]
Service/tool metadata records in GeoJSON format shall include tool download information ($.properties.link.data).		

Example 27: Distribution information for Tool download (OGC19-020r1)

```
{
   "geometry": null,
   "id": "https://cat.ceos.org/collections/services/items/coastline-classifier",
   "type": "Feature",
   "properties": {
      "identifier": "coastline-classifier",
      "kind": "http://purl.org/dc/dcmitype/Service",
      "title": "Coastline Classifier",
      "links": {
         "data": [
            {
               "href": "https://raw.githubusercontent.com/ceos-
seo/data_cube_notebooks/master/notebooks/water/coastline/Coastline_Classifier.ipynb",
               "title": "Download the Notebook",
               "type": "application/x-ipynb+json"
            }
         ]
      }
   }
}
```

Example 28: Distribution information for Container (OGC19-020r1)

```
{
   "geometry": null,
   "id": "https://cat.ceos.org/collections/services/items/rasdaman",
```

```
   "type": "Feature",
   "properties": {
      "identifier": "rasdaman",
      "kind": "http://purl.org/dc/dcmitype/Service",
      "title": "rasdaman - raster data manager",
      "abstract": "Rasdaman (raster data manager) is an open source array database system,
which provides flexible, fast, scalable geo services for multi-dimensional spatio-temporal
sensor, image, simulation, and statistics data of unlimited volume. ... data with all geo data
in the PostgreSQL database, support for the raster-relevant OGC standards, Reference
Implementation for WCS Core and WCPS.",

      "offerings": [
         {
            "type": "Offering",
            "code": "http://www.opengis.net/spec/eopad-geojson/1.0/req/docker/image",
            "contents": [
               {
                  "type": "text/plain",
                  "content": "arpasmr/rasdaman:latest"
               }
            ]
         }
      ]
   }
}
```


SRV-BP-4415	Web GUI URL [Requirement]	[RD-12], [RD-30]
Service/Tool metadata records in GeoJSON format shall include an "URL" element describing where the Web user interface can be accessed encoded as $.properties.links.describes (i.e. equivalent to link with rel="describes" attribute.		

Example 29: Distribution information for Web User Interface (OGC19-020r1)


```
{
   "geometry": null,
   "id": "https://cat.ceos.org/collections/services/items/appeears",
   "type": "Feature",
   "properties": {
      "identifier": "appeears",
      "kind": "http://purl.org/dc/dcmitype/Service",
      "title": "Application for Extracting and Exploring Analysis Ready Samples",
      "abstract": "The Application for Extracting and Exploring Analysis Ready Samples
(AppEEARS) offers a simple and efficient way to access..",

      "links": {
         "describes": [
            {
               "href": "https://lpdaacsvc.cr.usgs.gov/appeears/",
               "title": "AppEEARS Landing Page",
               "type": "text/html"
            }
         ]
      }
   }
}
```


SRV-BP-4420	GeoJSON access point information [Requirement]	[RD-19]
Service/tool metadata records in GeoJSON format shall include access point information encoded according to OGC 14-055r2 [RD-19] ("offerings").		

Example 30: Distribution information for Access point (OGC19-020r1)

```
{
   "geometry": null,
   "id": "https://cat.ceos.org/collections/services/items/eo-pdgs-landsat-datacube",
   "type": "Feature",
   "properties": {
      "identifier": "eo-pdgs-landsat-datacube",
      "kind": "http://purl.org/dc/dcmitype/Service",
      "title": "Landsat DataCube",

      "offerings": [
         {
            "code": "http://www.opengis.net/spec/owc-geojson/1.0/req/wcs",
            "operations": [
               {
                  "code": "DescribeCoverage",
                  "method": "GET",
                  "href":
"https://datacube.pdgs.eo.esa.int/wcs?service=WCS&Request=DescribeCoverage&version=2.0.0&Cover
ageId=LE7_RGB",
                  "type": "text/xml"
               },
               {
                  "code": "GetCapabilities",
                  "method": "GET",
                  "href":
"https://datacube.pdgs.eo.esa.int/wcs?service=WCS&Request=GetCapabilities&version=2.0.0",
                  "type": "text/xml"
               }
            ]
         }
      ],
      ...
   }
}
```

OGC API compliant endpoints can be encoded as links with “rel” and “href” attributes as defined in OGC API – Processes [RD-36].

Example 31: Distribution information for OGC API - Processes (OGC19-020r1)

```
{
   ...
   "links": {
         "http://www.opengis.net/def/rel/ogc/1.0/execute": [
            {
               "href": "https://facility.org/processes/NdviProcess/execution",
               "title": "Execution endpoint"
            }
         ]
   }
   ...
}
```

SRV-BP-4430	No online access [Recommendation]	[RD-12], [RD-30]
Metadata records should include an “resource locator“ element providing access to additional information about the tool or service if no online access is available, using the “describedby” relation.		

Example 32: Distribution information when no online access (OGC19-020r1)

```
{
   "geometry": null,
   "id": "https://cat.ceos.org/collections/services/items/goce-user-toolbox",
```

```
   "type": "Feature",
   "properties": {
      "identifier": "goce-user-toolbox",
      "kind": "http://purl.org/dc/dcmitype/Service",
      "title": "GOCE User Toolbox",
      "links": {
         "describedby": [
            {
               "href": "https://earth.esa.int/eogateway/documents/20142/37627/GOCE-User-
Toolbox-Tutorial-P-Knudsen.pdf",
               "title": "GOCE User Toolbox and Tutoral",
               "type": "application/pdf"
            }
         ]
      }
   }
}
```


3.3.4.5 Quality information

SRV-BP-4510	Technical specification [Recommendation]	[RD-6] TG Req. 5.5, C.20, C.21
Metadata records for online services (API) in OGC 19-020r1 format should declare compliance with technical specifications providing all technical elements to actually invoke the service and enable its usage, using the “wasUsedBy” pattern shown below and also used by GeoDCAT-AP.		

Example 33: Compliance information for Access point (OGC19-020r1)


```
{
   "type": "Feature",
   "id": "https://cat.ceos.org/collections/services/items/eo-pdgs-landsat-datacube",

   "properties": {
      "kind": "http://purl.org/dc/dcmitype/Service",
      "title": "Landsat DataCube",
      "identifier": "eo-pdgs-landsat-datacube",

      "wasUsedBy": [
         {
            "type": "Activity",
            "generated": {
               "type": "Entity",
               "degree": "http://inspire.ec.europa.eu/metadata-
codelist/DegreeOfConformity/conformant",
               "description": "See the referenced specification"
            },
            "qualifiedAssociation": {
               "type": "Association",
               "hadPlan": {
                  "type": "Plan",
                  "wasDerivedFrom": {
                     "type": "Standard",
                     "title": "COMMISSION REGULATION (EU) No 1089/2010 of 23 November 2010
implementing Directive 2007/2/EC of the European Parliament and of the Council as regards
interoperability of spatial data sets and services",
                     "issued": "2010-12-08T00:00:00Z"
                  }
               }
            }
         }
      ]
   }
```

```
}
```

3.3.4.6 Service coupling

SRV-BP-4610	Collection to service coupling [Recommendation]
Collection metadata records in GeoJSON Feature encoding should identify coupled services/tools as $.properties.links.service[*] (OGC 17-084r1) or $.link[*] with rel="service" attribute (OGC API - Features) referencing the corresponding service/tool metadata record.	

3.3.4.7 Metadata information

SRV-BP-4710	Metadata information [Recommendation]	[RD-12], [RD-30]
Service/tool metadata records in OGC 19-020r1 (GeoJSON Feature) format should encode the following metadata information properties of the metadata model defined in 3.2.6 as shown in the example below: - Metadata point of contact ($.properties.isPrimaryTopicOf.contactPoint) - Latest update date ($.properties.isPrimaryTopicOf.updated) - Metadata language ($.properties.isPrimaryTopicOf.lang)		

Example 34: Metadata information (OGC 19-020r1)

```
{
   "geometry": null,
   "id": "https://cat.ceos.org/collections/services/items/rasdaman",
   "type": "Feature",
   "properties": {
      "identifier": "rasdaman",

      "isPrimaryTopicOf": {
         "created": "2021-10-20T16:12:55.511Z",
         "type": "CatalogRecord",
         "lang": "en",
         "updated": "2021-10-20T16:12:55.511Z",
         "contactPoint": [
            {
               "type": "Organization",
               "name": "Committee on Earth Observation Satellites",
               "uri": "https://ceos.org"
            }
         ]
      }

   }
}
```

3.3.4.8 Descriptive keywords

SRV-BP-4810	Descriptive keywords [Recommendation]	[RD-12], [RD-30]

Service/tool metadata records in OGC 19-020r1 (GeoJSON Feature) format should encode descriptive keywords with $.properties.categories (preferred) or $.properties.keyword as shown in the example below.

Example 35: Descriptive Keywords (OGC19-020r1)

```
{
   "geometry": null,
   "id": "https://cat.ceos.org/collections/services/items/rasdaman",
   "type": "Feature",
   "properties": {
      "identifier": "rasdaman",
      "kind": "http://purl.org/dc/dcmitype/Service",
      "title": "rasdaman - raster data manager",

      "categories": [
         {
            "scheme":
"https://gcmd.earthdata.nasa.gov/kms/concepts/concept_scheme/sciencekeywords",
            "term": "https://gcmd.earthdata.nasa.gov/kms/concept/86cbb2d3-6783-4d9b-9dc1-
b0aea78f98ea",
            "label": "EARTH SCIENCE SERVICES > DATA MANAGEMENT/DATA HANDLING > DATA
ACCESS/RETRIEVAL"
         },
         {
            "scheme": "https://inspire.ec.europa.eu/metadata-codelist/ProtocolValue",
            "term": "http://www.opengis.net/def/serviceType/ogc/wcs/2.0",
            "label": "OGC Web Coverage Service 2.0"
         },
         {
            "scheme": "http://inspire.ec.europa.eu/metadata-
codelist/SpatialDataServiceCategory",
            "term": "https://inspire.ec.europa.eu/metadata-
codelist/SpatialDataServiceCategory/infoCoverageAccessService",
            "label": "Coverage access service"
         }
      ],
      "keyword": [
         "Big Data",
         "OGC",
         "WMS",
         "WCS",
         "WCS-T",
         "WCPS"
      ]
   }
}
```

3.3.4.9 Extent information

SRV-BP-4910	Geographic extent [Recommendation]	[RD-29]
Service/tool metadata records in GeoJSON format should include geographic extent (bounding box) - if applicable - encoded as "$.bbox" or "$.geometry" according to the GeoJSON specification [RD-29].		

SRV-BP-4920	Temporal extent [Recommendation]	[RD-19]
Service/tool metadata records in GeoJSON format should include temporal extent if applicable - encoded as $.properties.date according to [RD-19].		

Example 36: Temporal and geographical extents (OGC 19-020r1)

```
{
   "type": "Feature",
   "bbox": [ -100, -50, 160, 40 ],
   "geometry": {
      "coordinates": [
         [
            [
               -100,
               -50
            ],
            [
               160,
               -50
            ],
            [
               160,
               40
            ],
            [
               -100,
               40
            ],
            [
               -100,
               -50
            ]
         ]
      ],
      "type": "Polygon"
   },
   "properties": {
      "date": "2009-01-27T00:00:00.000Z/2011-08-09T23:59:59.999Z",
      …
   }
}
```

3.3.5 GeoDCAT-AP encoding

3.3.5.1 General

GeoDCAT-AP [RD-10] is based on DCAT [RD-37]. It provides an RDF vocabulary and the corresponding RDF syntax bindings (JSON-LD, RDF/XML, Turtle) for the union of metadata elements of the core profile of ISO 19115:2003 and those defined in the framework of the INSPIRE Directive of the European Union.

3.3.5.2 Identification information

SRV-BP-5210	Identification information [Requirement]	[RD-10]
Service/tool metadata records in GeoDCAT-AP format shall encode the following mandatory properties of the metadata model as shown in the example below: - Resource identifier (dct:identifier) - Resource title (dct:title) - Resource abstract (dct:description) - Responsible organisation (e.g. dcat:contactPoint)		

SRV-BP-5220	Identification information [Recommendation]	[RD-10]

Service/tool metadata records in GeoDCAT-AP format should encode the following optional properties of the metadata model as shown in the example below:

- DOI (adms:identifier)
- Last revision date (dct:modified)
- Resource version (owl:versionInfo)
- Resource version description (adms:versionNotes)

Example 37: Identification information (GeoDCAT-AP)


```
{
   "@context": {
      "void": "http://rdfs.org/ns/void#",
      "adms": "http://www.w3.org/ns/adms#",
      "gsp": "http://www.opengis.net/ont/geosparql#",
      "owl": "http://www.w3.org/2002/07/owl#",
      "skos": "http://www.w3.org/2004/02/skos/core#",
      "rdfs": "http://www.w3.org/2000/01/rdf-schema#",
      "vcard": "http://www.w3.org/2006/vcard/ns",
      "dct": "http://purl.org/dc/terms/",
      "iana": "http://www.iana.org/assignments/relation/",
      "owc": "http://www.opengis.net/ont/owc/1.0/",
      "dcat": "http://www.w3.org/ns/dcat#",
      "atom": "http://www.w3.org/2005/Atom",
      "locn": "http://www.w3.org/ns/locn#",
      "prov": "http://www.w3.org/ns/prov#",
      "foaf": "http://xmlns.com/foaf/0.1/"
   },
   "@type": "dcat:DataService",
   "dct:type": {
      "@id": "http://inspire.ec.europa.eu/metadata-codelist/ResourceType/service"
   },
   "dct:title": "rasdaman - raster data manager",
   "@id":
"https://cat.ceos.org/collections/services/items/rasdaman?httpAccept=application/ld%2Bjson",
   "owl:versionInfo": "9.5",
   "dct:identifier": "rasdaman",
   "adms:identifier": {
      "@type": "adms:Identifier",
      "dct:creator": {
         "@id": "https://doi.org/"
      },
      "skos:notation": "https://doi.org/10.5281/zenodo.1040170"
   },
   "dct:modified": "2018-01-31T00:00:55.511Z",
   "dct:description": "Rasdaman (raster data manager) is an open source array database system,
which provides flexible, fast, scalable geo services for multi-dimensional spatio-temporal
sensor, image, simulation, and statistics data of unlimited volume. ... data with all geo data
in the PostgreSQL database, support for the raster-relevant OGC standards, Reference
Implementation for WCS Core and WCPS.",
   "dcat:contactPoint": {
      "@type": "vcard:Organization",
      "vcard:hasName": {
         "@value": "rasdaman GmbH",
         "@language": "en"
      },
      "vcard:hasURL": {
         "@id": "http://rasdaman.org"
      }
   }
}
```


SRV-BP-5230	File identifier [Recommendation]	[AD-1]

Service/tool metadata records in GeoDCAT-AP format should include a dct:identifier element with a value identical to the corresponding ISO19139 “fileIdentifier”.

SRV-BP-5235	Spatial resolution [Recommendation]	[RD-10]
Metadata records should express restriction on the spatial resolution if the service or tool has such restriction using dcat:spatialResolutionInMeters or dqv:hasQualityMeasurement as defined in §A.2 of [RD-10].		

SRV-BP-5240	CRS identifier [Recommendation]	[RD-10]
Metadata records should indicate the CRS supported by the service/tool using identifiers specified in a well-known common register, if the service or tool has such restriction using dct:conformsTo as per [RD-10].		

Example 38: CRS identifier and spatial resolution (GeoDCAT-AP)

```
{
   "@type": "dcat:DataService",
   "dcat:spatialResolutionInMeters": "5000",
   "dct:conformsTo": {
      "@id": "http://www.opengis.net/def/crs/EPSG/0/4258",
      "@type": "dct:Standard",
      "skos:inScheme": {
         "@id": "http://www.opengis.net/def/crs/OGC"
      },
      "dct:type": {
         "@id": "http://inspire.ec.europa.eu/glossary/SpatialReferenceSystem"
      }
   }
}
```

3.3.5.3 Constraint information

SRV-BP-5310	Use limitation URL [Recommendation]	[RD-10]
Service/tool metadata records in GeoDCAT-AP format should include conditions applying to access and use with dct:license and dct:accessRights.		

Example 39: Constraint information for Access point (GeoDCAT-AP)

```
{
   "@type": "dcat:DataService",
   "@id": "https://cat.ceos.org/collections/services/items/eo-pdgs-landsat-datacube",

   "dct:type": {
         "@id": "http://purl.org/dc/dcmitype/Service"
   },
   "dct:title": "Landsat DataCube",
   "dct:identifier": "eo-pdgs-landsat-datacube",

   "dct:accessRights": [
      {
```

```
         "@type": "RightsStatement",
         "rdfs:label": "No limitations to public access."
      },
      {
         "@id" : "http://inspire.ec.europa.eu/metadata-
codelist/LimitationsOnPublicAccess/noLimitations"
      }
   ],
   "dct:license": [
      {
         "@id" : "http://inspire.ec.europa.eu/metadata-
codelist/ConditionsApplyingToAccessAndUse/noConditionsApply"
      },
      {
         "@type": "LicenseDocument",
         "rdfs:label": "No conditions apply to access and use."
      }
   ]
}
```

Example 40: License information for Tool download (GeoDCAT-AP)

```
{
   "@type": "dcat:DataService",
   "@id": "https://cat.ceos.org/collections/services/items/coastline-classifier",

   "dct:identifier": "coastline-classifier",
   "dct:type": {
         "@id": "http://purl.org/dc/dcmitype/Service"
   },
   "dct:title": "Coastline Classifier",
   "dct:license": [
      {
         "@id": "https://spdx.org/licenses/Apache-2.0"
      }
   ]
}
```

3.3.5.4 Distribution information

SRV-BP-5410	GeoDCAT-AP tool download [Requirement]	[RD-10]
Service/tool metadata records in GeoDCAT-AP format shall include tool download information.		

Example 41: Distribution information for Tool download (GeoDCAT-AP)

```
{
   "@type": "dcat:DataService",
   "@id": "https://cat.ceos.org/collections/services/items/coastline-classifier",

   "dct:identifier": "coastline-classifier",
   "dct:type": {
         "@id": "http://purl.org/dc/dcmitype/Service"
   },
   "dct:title": "Coastline Classifier",
   "dcat:endpointURL": "https://raw.githubusercontent.com/ceos-
seo/data_cube_notebooks/master/notebooks/water/coastline/Coastline_Classifier.ipynb"

}
```

SRV-BP-5415	GeoDCAT-AP Web GUI URL [Requirement]	[RD-10]
Service/Tool metadata records in GeoDCAT-AP format shall include an "URL" element describing where the Web user interface can be accessed encoded as dcat:landingPage.		

Example 42: Distribution information for Web User Interface (GeoDCAT-AP)

```
{
   "@type": "dcat:DataService",
   "@id": "https://cat.ceos.org/collections/services/items/appeears",
   "dct:identifier": "appeears",
   "dct:type": {
      "@id": "http://purl.org/dc/dcmitype/Service"
   },
   "dct:title": "Application for Extracting and Exploring Analysis Ready Samples",
   "dct:description": "The Application for Extracting and Exploring Analysis Ready Samples
(ΑρρEEARS) offers a simple and efficient way to access..",
   "dcat:landingPage": {
      "@id": "https://lpdaacsvc.cr.usgs.gov/appeears/"
   }
}
```

SRV-BP-5420	GeoDCAT-AP access point information [Requirement]	[RD-10]
Service/tool metadata records in GeoDCAT-AP format shall include access point information encoded using the "dcat:endpointDescription" property.		

Example 43: Access point information (GeoDCAT-AP)

```
{
   "@type": "dcat:DataService",
   "dct:type": {
      "@id": "http://purl.org/dc/dcmitype/Service"
   },
   "dct:identifier": "eo-pdgs-landsat-datacube",
   "@id": "https://cat.ceos.org/collections/services/items/eo-pdgs-landsat-datacube",
   "dct:title": "Landsat DataCube",

   "dcat:endpointURL":"https://datacube.pdgs.eo.esa.int/wcs",
   "dcat:endpointDescription": [
      {
         "@type": "owc:Offering",
         "owc:code": {
            "@id": "http://www.opengis.net/spec/owc-geojson/1.0/req/wcs"
         },
         "owc:operations": [
            {
               "owc:href":
"https://datacube.pdgs.eo.esa.int/wcs?service=WCS&Request=DescribeCoverage&version=2.0.0&Cover
ageId=LE7_RGB",
               "@type": "owc:Operation",
               "owc:type": "text/xml",
               "owc:code": "DescribeCoverage",
               "owc:method": "GET"
            },
            {
               "owc:href":
"https://datacube.pdgs.eo.esa.int/wcs?service=WCS&Request=GetCapabilities&version=2.0.0",
               "@type": "owc:Operation",
               "owc:type": "text/xml",
               "owc:code": "GetCapabilities",
               "owc:method": "GET"
            }
         ]
      }
   ]
```

```
}
```

SRV-BP-5430	No online access [Recommendation]	[RD-10]
Metadata records in GeoDCAT-AP format should include an “resource locator“ element providing access to additional information about the tool or service if no online access is available using foaf:isPrimaryTopicOf.		

Example 44: Distribution information when no online access (GeoDCAT-AP)

```
{
   "@type": "dcat:DataService",
   "@id": "https://cat.ceos.org/collections/services/items/goce-user-toolbox",
   "dct:identifier": "goce-user-toolbox",
   "dct:type": {
      "@id": "http://purl.org/dc/dcmitype/Service"
   },

   "foaf:isPrimaryTopicOf": [
      {
         "@type": "foaf:Document",
         "@id": "https://earth.esa.int/eogateway/documents/20142/37627/GOCE-User-Toolbox-
Tutorial-P-Knudsen.pdf",
         "dct:title": "GOCE User Toolbox and Tutoral",
         "dct:format": "application/pdf"
      }
   ]
}
```

3.3.5.5 Quality information

SRV-BP-5510	Technical specification [Recommendation]	[RD-10], [RD-6] TG Req. 5.5, C.20, C.21
Metadata records for online services (API) in GeoDCAT-AP format should declare compliance with technical specifications providing all technical elements to actually invoke the service and enable its usage, using “dcat:conformsto” (with protocol type as per SRV-BP-0415) or the “wasUsedBy” pattern shown below.		

Example 45: Technical specification (GeoDCAT-AP)

```
{
   "@type": "dcat:DataService",
   "@id": "https://cat.ceos.org/collections/services/items/eo-pdgs-landsat-datacube",
   "dct:type": {
         "@id": "http://purl.org/dc/dcmitype/Service"
   },
   "dct:conformsTo": {
         "@id": "http://www.opengis.net/def/serviceType/ogc/wcs/2.0”
   }
}
```

Example 46: Compliance information for Access point (GeoDCAT-AP)

```
{
   "@type": "dcat:DataService",
   "@id": "https://cat.ceos.org/collections/services/items/eo-pdgs-landsat-datacube",

   "dct:type": {
      "@id": "http://purl.org/dc/dcmitype/Service"
   },
   "dct:title": "Landsat DataCube",
   "dct:identifier": "eo-pdgs-landsat-datacube",

   "prov:wasUsedBy": [
         {
            "@type": "prov:Activity",
            "prov:generated": {
               "@type": "prov:Entity",
               "dct:type": "http://inspire.ec.europa.eu/metadata-
codelist/DegreeOfConformity/conformant",
               "dct:description": "See the referenced specification"
            },
            "prov:qualifiedAssociation": {
               "@type": "prov:Association",
               "prov:hadPlan": {
                  "@type": "prov:Plan",
                  "prov:wasDerivedFrom": {
                     "@type": "dct:Standard",
                     "dct:title": "COMMISSION REGULATION (EU) No 1089/2010 of 23 November 2010
implementing Directive 2007/2/EC of the European Parliament and of the Council as regards
interoperability of spatial data sets and services",
                     "dct:issued": "2010-12-08T00:00:00Z"
                  }
               }
            }
         }
      ]
}
```


3.3.5.6 Service coupling

SRV-BP-5610	Coupled resources [Recommendation]	[RD-6] TG Req. 3.6
Service/Tool metadata records in GeoDCAT-AP encoding should identify the target collections of the service/tool as shown in the example below.		

Example 47: Service to Collection coupling (GeoDCAT-AP)


```
{
   "@type": "dcat:DataService",
   "dct:type": {
      "@id": "http://inspire.ec.europa.eu/metadata-codelist/ResourceType/service"
   },
   "dct:identifier": "eo-pdgs-landsat-datacube",
   "dcat:servesDataset": {
      "@type": "dcat:Dataset",
      "@id": "https://cat.ceos.org/collections/series/items/LANDSAT.ETM.GTC",
      "dct:identifier": "LANDSAT.ETM.GTC"
   }
}
```


3.3.5.7 Metadata information

SRV-BP-5710	Metadata information [Recommendation]	[RD-10]
Service/tool metadata records in GeoDCAT-AP format should encode the following metadata information properties of the metadata model defined in 3.2.6 as shown in the example below: - Metadata point of contact (dcat:contactPoint) - Latest update date (dct:modified) - Metadata language (dct:language)		

Example 48: Metadata information (GeoDCAT-AP)

```
{
   "@id": "https://cat.ceos.org/collections/services/items/rasdaman",
   "@type": "dcat:DataService",
   "dct:identifier": "rasdaman",

   "foaf:isPrimaryTopicOf": {
         "type": "dcat:CatalogRecord",
         "dct:conformsTo": {
            "@id": "https://joinup.ec.europa.eu/release/geodcat-ap/20",
         },
         "dct:modified": "2021-10-20T16:12:55.511Z",

         "dct:language": {
            "@id": "http://publications.europa.eu/resource/authority/language/EN"
         },
         "dcat:contactPoint": [
            {
               "@type": "vcard:Organization",
               "vcard:organization-name": "Committee on Earth Observation Satellites"
            }
         ]
      }
}
```

3.3.5.8 Descriptive keywords

SRV-BP-5810	GeoDCAT-AP descriptive keywords [Recommendation]	[RD-10]
Service/tool metadata records in GeoDCAT-AP format should include descriptive keywords encoded as dcat:theme (preferred) or dcat:keyword.		

Example 49: Descriptive Keywords (GeoDCAT-AP)

```
{
   "@type": "dcat:DataService",
   "@id":
"https://cat.ceos.org/collections/services/items/rasdaman?httpAccept=application/ld%2Bjson",
   "dct:title": "rasdaman - raster data manager",
   "dct:type": {
      "@id": "http://inspire.ec.europa.eu/metadata-codelist/ResourceType/service"
   },
   "dct:identifier": "rasdaman",
   "dcat:keyword": [
      "Big Data",
      "OGC",
      "WMS",
      "WCS",
      "WCS-T",
      "WCPS"
   ],
```

```
   "dcat:theme": [
      {
         "skos:inScheme": {
            "@id":
"https://gcmd.earthdata.nasa.gov/kms/concepts/concept_scheme/sciencekeywords"
         },
         "skos:preflabel": "EARTH SCIENCE SERVICES > DATA MANAGEMENT/DATA HANDLING > DATA
ACCESS/RETRIEVAL",
         "@id": "https://gcmd.earthdata.nasa.gov/kms/concept/86cbb2d3-6783-4d9b-9dc1-
b0aea78f98ea"
      },
      {
         "skos:inScheme": {
            "@id": "https://inspire.ec.europa.eu/metadata-codelist/ProtocolValue"
         },
         "skos:preflabel": "OGC Web Coverage Service 2.0",
         "@id": "http://www.opengis.net/def/serviceType/ogc/wcs/2.0"
      },
      {
         "skos:inScheme": {
            "@id": "http://inspire.ec.europa.eu/metadata-codelist/SpatialDataServiceCategory"
         },
         "skos:preflabel": "Coverage access service",
         "@id": "https://inspire.ec.europa.eu/metadata-
codelist/SpatialDataServiceCategory/infoCoverageAccessService"
      }
   ]
}
```


3.3.5.9 Extent information

SRV-BP-5910	Geographic extent [Recommendation]	[RD-10]
Service/tool metadata records in GeoDCAT-AP format should include geographic extent (bounding box) - if applicable - encoded with dct:spatial, dcat:bbox and locn:geometry according to the GeoDCAT-AP specification [RD-10].		

SRV-BP-5920	Temporal extent [Recommendation]	[RD-10]
Service/tool metadata records in GeoDCAT-AP format should include temporal extent if applicable - encoded as dct:temporal according to [RD-25].		

Example 50: Temporal and geographical extents (GeoDCAT-AP)


```
{
   "@type": "dcat:DataService",
   "bbox": [ -100, -50, 160, 40 ],
   "dct:spatial": {
      "@type": "dct:location",
      "dcat:bbox": [
         {
            "@value": "POLYGON((-100.0 -50.0,160.0 -50.0,160.0 40.0,-100.0 40.0,-100.0 -
50.0))",
            "@type": "gsp:wktLiteral"
         },
      ],

      "locn:geometry": [
         {
            "@value": "{\"type\":\"Polygon\",\"coordinates\":[[[-100,-50],[160,-
50],[160,40],[-100,40],[-100,-50]]] }",
            "@type": "gsp:geoJSONLiteral"
         },
```

```
            {
               "@value": "POLYGON((-100.0 -50.0,160.0 -50.0,160.0 40.0,-100.0 40.0,-100.0 -
50.0))",
               "@type": "gsp:wktLiteral"
            },
            {
               "@value": "<gml:Envelope
srsName=\"http://www.opengis.net/def/crs/OGC/1.3/CRS84\"><gml:lowerCorner>-100.0 -
50.0</gml:lowerCorner><gml:upperCorner>160.0 40.0</gml:upperCorner></gml:Envelope>",
               "@type": "gsp:gmlLiteral"
            }
         ]
      },
      "dct:temporal": {
         "@type": "dct:PeriodOfTime",
         "dcat:startDate": {
            "@value": "2009-01-27T00:00:00.000Z",
            "@type": "xsd:date"
         },
         "dcat:endDate": {
            "@value": "2011-08-09T23:59:59.999Z",
            "@type": "xsd:date"
         }
      }
}
```


3.3.6 Schema.org encoding

3.3.6.1 General

None.

3.3.6.2 Identification information

SRV-BP-6210	identification information [Requirement]
Service/tool metadata records in schema.org format shall encode the following mandatory properties of the metadata model defined §3.2.1 as shown in the example below: - Resource identifier (identifier) - Resource title (name) - Resource abstract (description) - Responsible organisation (e.g. provider)	

SRV-BP-6220	identification information [Recommendation]
Service/tool metadata records in schema.org format should encode the following optional properties of the metadata model defined §3.2.1 as shown in the example below: - DOI (identifier) - Last revision date (dateModified) - Resource version (version)	

Example 51: Identification information (Schema.org)


```
{
```

```
   "@context": {
      "@vocab": "https://schema.org/"
   },
   "@type": "CreativeWork",
   "name": "rasdaman - raster data manager",
   "@id": "https://cat.ceos.org/collections/services/items/rasdaman",
   "additionalType": [
      "http://purl.org/dc/dcmitype/Service"
   ],
   "description": "Rasdaman (raster data manager) is an open source array database system,
which provides flexible, fast, scalable geo services for multi-dimensional spatio-temporal
sensor, image, simulation, and statistics data of unlimited volume. ... data with all geo data
in the PostgreSQL database, support for the raster-relevant OGC standards, Reference
Implementation for WCS Core and WCPS.",
   "alternateName": "rasdaman",
   "version": "9.5",
   "dateModified": "2018-01-31T00:00:55.511Z",
   "identifier": [
      "rasdaman",
      {
         "@type": "PropertyValue",
         "@id": "https://doi.org/10.5281/zenodo.1040170",
         "propertyID": "https://registry.identifiers.org/registry/doi",
         "value": "doi:10.5281/zenodo.1040170",
         "url": "https://doi.org/10.5281/zenodo.1040170"
      }
   ],
   "provider": [
      {
         "@type": "Organization",
         "name": "rasdaman GmbH",
         "url": "http://rasdaman.org"
      }
   ]
}
```


SRV-BP-6240	CRS identifier [Recommendation]	[RD-32]
Metadata records in schema.org format should indicate the CRS supported by the service/tool using identifiers specified in a well-known common register, if the service or tool has such restriction using schema:additionalProperty.		

Example 52: CRS identifier (Schema.org)


```
{
   "@context": {
      "@vocab": "https://schema.org/"
   },
   "@type": "CreativeWork",
   "additionalProperty": [
      {
         "@type": "PropertyValue",
         "propertyID": "http://inspire.ec.europa.eu/glossary/SpatialReferenceSystem",
         "value": "http://www.opengis.net/def/crs/EPSG/0/4258"
      }
   ]
}
```

[RD-32][12] proposes using “http://dbpedia.org/resource/Spatial_reference_system” as “propertyID” to identify the property as a spatial reference system instead.

3.3.6.3 Constraint information

SRV-BP-6310	Use limitation URL [Recommendation]
Service/tool metadata records in schema.org format should include conditions applying to access and use with license and conditionsOfAccess properties.	

Example 53: Constraint information for Access point (Schema.org)

```
{
   "@context": {
      "@vocab": "https://schema.org/"
   },
   "@type": "CreativeWork",
   "@id": "https://cat.ceos.org/collections/services/items/eo-pdgs-landsat-datacube",
   "name": "Landsat DataCube",
   "identifier": "eo-pdgs-landsat-datacube",
   "additionalType": [
      "http://purl.org/dc/dcmitype/Service"
   ],

   "conditionsOfAccess": "No limitations to public access.",

   "license": [
      "http://inspire.ec.europa.eu/metadata-
codelist/ConditionsApplyingToAccessAndUse/noConditionsApply",
      {
         "@type": "CreativeWork",
         "description": "No conditions apply to access and use."
      }
   ]
}
```

Example 54: License information for Tool download (Schema.org)

```
{
   "@context": {
      "@vocab": "https://schema.org/"
   },
   "@type": "CreativeWork",
   "@id": "https://cat.ceos.org/collections/services/items/coastline-classifier",
   "name": "Coastline Classifier",
   "identifier": [ "coastline-classifier" ],
   "additionalType": [
      "http://purl.org/dc/dcmitype/Service"
   ],

   "license": [
      "https://spdx.org/licenses/Apache-2.0"
   ]
}
```

[12] https://github.com/ESIPFed/science-on-schema.org/blob/master/guides/Dataset.md#geoshape-location-extent

3.3.6.4 Distribution information

SRV-BP-6410	Tool download [Requirement]
Service/tool metadata records in schema.org format shall include tool download information as DataDownload.	

Example 55: Distribution information for Tool download (Schema.org)

```
{
   "@context": {
      "@vocab": "https://schema.org/"
   },
   "@type": "CreativeWork",
   "name": "Coastline Classifier",
   "@id": "https://foo.ceos.org/collections/services/items/coastline-classifier",
   "additionalType": [
      "http://purl.org/dc/dcmitype/Service"
   ],
   "description": "A coastal boundary algorithm is used to classify a given pixel as either
coastline or not coastline using a simple binary format. The algorithm makes a classification
by examining surrounding pixels and making a determination based on how many pixels around it
are water",
   "alternateName": "coastline-classifier",
   "dateModified": "2021-03-17T11:41:21Z",
   "identifier": [
      "coastline-classifier"
   ],
   "license": [
      "https://spdx.org/licenses/Apache-2.0"
   ],
   "subjectOf": [
      {
         "@type": "DataDownload",
         "contentUrl": "https://raw.githubusercontent.com/ceos-
seo/data_cube_notebooks/master/notebooks/water/coastline/Coastline_Classifier.ipynb",
         "name": "Download the Notebook",
         "encodingFormat": "application/x-ipynb+json"
      }
   ],
   "provider": [
      {
         "@type": "Organization",
         "name": "CEOS",
         "url": "https://ceos.org"
      }
   ]
}
```

SRV-BP-6415	Web GUI URL [Requirement]
Service/Tool metadata records in schema.org format shall include an "URL" element describing where the Web user interface can be accessed encoded as schema:url.	

Example 56: Distribution information for Web User Interface (Schema.org)

```
{
   "@context": {
      "@vocab": "https://schema.org/"
   },
   "@type": "CreativeWork",
   "@id": "https://cat.ceos.org/collections/services/items/appeears",
   "additionalType": [
      "http://purl.org/dc/dcmitype/Service"
```

```
   ],
   "name": "Application for Extracting and Exploring Analysis Ready Samples",
   "description": "The Application for Extracting and Exploring Analysis Ready Samples
(AρρEEARS) offers a simple and efficient way to access..",
   "url": "https://lpdaacsvc.cr.usgs.gov/appeears/"
}
```


SRV-BP-6420	Access point information [Requirement]
Service/tool metadata records in schema.org format shall include access point information encoded using "schema:potentialAction" and additional "schema:Action" properties.	

Example 57: Access point information (Schema.org)


```
{
   "@context": {
      "@vocab": "https://schema.org/"
   },
   "@type": "CreativeWork",
   "name": "Landsat DataCube",
   "@id": "https://cat.ceos.org/collections/services/items/eo-pdgs-landsat-datacube",
   "identifier": [
      "eo-pdgs-landsat-datacube"
   ],
   "additionalType": [
      "http://purl.org/dc/dcmitype/Service"
   ],

   "potentialAction": [
      {
         "identifier": "http://www.opengis.net/spec/owc-geojson/1.0/req/wcs",
         "@type": "UseAction",
         "target": [
            {
               "identifier": "http://www.opengis.net/spec/owc-
geojson/1.0/req/wcs#DescribeCoverage",
               "@type": "EntryPoint",
               "urlTemplate":
"https://datacube.pdgs.eo.esa.int/wcs?service=WCS&Request=DescribeCoverage&version=2.0.0&Cover
ageId=LE7_RGB",
               "description": "DescribeCoverage",
               "httpMethod": "GET",
               "contentType": [
                  "text/xml"
               ]
            },
            {
               "identifier": "http://www.opengis.net/spec/owc-
geojson/1.0/req/wcs#GetCapabilities",
               "@type": "EntryPoint",
               "urlTemplate":
"https://datacube.pdgs.eo.esa.int/wcs?service=WCS&Request=GetCapabilities&version=2.0.0",
               "description": "GetCapabilities",
               "httpMethod": "GET",
               "contentType": [
                  "text/xml"
               ]
            }
         ]
      }
   ]
}
```


SRV-BP-6430	No online access [Recommendation]

Metadata records in schema.org format should include an “resource locator“ element providing access to additional information about the tool or service if no online access is available.

Example 58: Distribution information when no online access (Schema.org)

```
{
   "@context": {
      "@vocab": "https://schema.org/"
   },
   "@type": "CreativeWork",
   "name": "GOCE User Toolbox",
   "@id": "https://foo.ceos.org/collections/services/items/goce-user-toolbox",
   "additionalType": [
      "http://purl.org/dc/dcmitype/Service"
   ],
   "identifier": [
      "goce-user-toolbox"
   ],

   "subjectOf": [
      {
         "@type": "HowTo",
         "contentUrl": "https://earth.esa.int/eogateway/documents/20142/37627/GOCE-User-
Toolbox-Tutorial-P-Knudsen.pdf",
         "name": "GOCE User Toolbox and Tutoral",
         "encodingFormat": "application/pdf"
      }
   ]
}
```

3.3.6.5 Quality information

SRV-BP-6510	Technical specification [Recommendation]	[RD32]
Metadata records for online services (API) in schema.org format should declare compliance with technical specifications providing all technical elements to actually invoke the service and enable its usage, using the “wasUsedBy” pattern shown below.		

Schema.org does not include specific properties to describe this. We therefore propose use of the provenance vocabulary within schema.org encodings as also proposed by [RD-32][13].

Example 59: Compliance information for Access point (Schema.org)

```
{
   "@context": {
      "@vocab": "https://schema.org/",
      "prov": "http://www.w3.org/ns/prov#",
      "dct": "http://purl.org/dc/terms/"
   },
   "@type": "CreativeWork",
   "@id": "https://cat.ceos.org/collections/services/items/eo-pdgs-landsat-datacube",
   "name": "Landsat DataCube",
```

[13] https://github.com/ESIPFed/science-on-schema.org/blob/master/guides/Dataset.md#indicating-a-software-workflow-or-processing-activity-provused-and-provwasgeneratedby

```
   "prov:wasUsedBy": [
         {
            "@type": "prov:Activity",
            "prov:generated": {
               "@type": "prov:Entity",
               "dct:type": "http://inspire.ec.europa.eu/metadata-
codelist/DegreeOfConformity/conformant",
               "dct:description": "See the referenced specification"
            },
            "prov:qualifiedAssociation": {
               "@type": "prov:Association",
               "prov:hadPlan": {
                  "@type": "prov:Plan",
                  "prov:wasDerivedFrom": {
                     "@type": "dct:Standard",
                     "dct:title": "COMMISSION REGULATION (EU) No 1089/2010 of 23 November 2010
implementing Directive 2007/2/EC of the European Parliament and of the Council as regards
interoperability of spatial data sets and services",
                     "dct:issued": "2010-12-08T00:00:00Z"
                  }
               }
            }
         }
      ]
}
```


3.3.6.6 Service coupling

SRV-BP-6610	Coupled resources [Recommendation]	[RD-6] TG Req. 3.6
Service/Tool metadata records in schema.org encoding should identify the target collections of the service/tool as shown in the example below.		

Example 60: Service to Collection coupling (Schema.org)


```
"potentialAction": [
      {
         "identifier": "http://www.opengis.net/spec/owc-geojson/1.0/req/wcs",
         "@type": "UseAction",
         "object": {
            "@type": "Dataset",
            "@id": "https://cat.ceos.org/collections/series/items/LANDSAT.ETM.GTC",
            "identifier": "LANDSAT.ETM.GTC"
         },
         "target": []
      }
]
```


3.3.6.7 Metadata information

SRV-BP-6710	Metadata information [Recommendation]
Service/tool metadata records in schema.org format should encode the following metadata information properties of the metadata model defined in 3.2.6 as shown in the example below: - Metadata point of contact ($.subjectOf[*].*[*].contactPoint) - Latest update date ($.subjectOf[*].dateModified)	

- Metadata language ($.subjectOf[*].inLanguage)

Example 61: Metadata information (Schema.org)

```
{
   "@context": {
      "@vocab": "https://schema.org/"
   },
   "@type": "CreativeWork",
   "name": "rasdaman - raster data manager",
   "@id": "https://eovoc.spacebel.be/collections/services/items/rasdaman",
   "additionalType": [
      "http://purl.org/dc/dcmitype/Service"
   ],
   "identifier": [
      "rasdaman"
   ],

   "subjectOf": {
         "@type": ["CreativeWork", "ListItem"],
         "dct:conformsTo": "https://joinup.ec.europa.eu/release/geodcat-ap/20",
         "encodingFormat": "application/ld%2Bjson;profile=https://schema.org",
         "dateModified": "2021-10-20T16:12:55.511Z",

         "inLanguage": {
            "@type": "Language",
            "name": "eng",
            "@id": "http://id.loc.gov/vocabulary/iso639-1/en"
         },
         "publisher": [
            {
               "@type": "Organization",
               "name": "Committee on Earth Observation Satellites",
               "contactPoint": {
                  "@type": "ContactPoint"
               }
            }
         ]
      }
}
```

3.3.6.8 Descriptive keywords

SRV-BP-6810	Schema.org descriptive keywords [Recommendation]
Service/tool metadata records in schema.org format should include descriptive keywords encoded as keywords.	

Example 62: Descriptive Keywords (Schema.org)

```
{
   "@context": {
      "@vocab": "https://schema.org/"
   },
   "@type": "CreativeWork",
   "name": "rasdaman - raster data manager",
   "@id": "https://eovoc.spacebel.be/collections/services/items/rasdaman",
   "additionalType": [
      "http://purl.org/dc/dcmitype/Service"
   ],
   "identifier": [
      "rasdaman"
   ],
   "keywords": [
```

```
      {
         "@type": "DefinedTerm",
         "name": "EARTH SCIENCE SERVICES > DATA MANAGEMENT/DATA HANDLING > DATA
ACCESS/RETRIEVAL",
         "@id": "https://gcmd.earthdata.nasa.gov/kms/concept/86cbb2d3-6783-4d9b-9dc1-
b0aea78f98ea",
         "inDefinedTermSet":
"https://gcmd.earthdata.nasa.gov/kms/concepts/concept_scheme/sciencekeywords"
      },
      {
         "@type": "DefinedTerm",
         "name": "OGC Web Coverage Service 2.0",
         "@id": "http://www.opengis.net/def/serviceType/ogc/wcs/2.0",
         "inDefinedTermSet": "https://inspire.ec.europa.eu/metadata-codelist/ProtocolValue"
      },
      {
         "@type": "DefinedTerm",
         "name": "Coverage access service",
         "@id": "https://inspire.ec.europa.eu/metadata-
codelist/SpatialDataServiceCategory/infoCoverageAccessService",
         "inDefinedTermSet": "http://inspire.ec.europa.eu/metadata-
codelist/SpatialDataServiceCategory"
      },
      "Big Data",
      "arrays",
      "raster data",
      "OGC",
      "WMS",
      "WCS",
      "statistics data"
   ]
}
```


3.3.6.9 Extent information

SRV-BP-6910	Geographic extent [Recommendation]
Service/tool metadata records in schema.org format should include geographic extent (bounding box) - if applicable - encoded with spatialCoverage, geo and box properties.	

SRV-BP-6920	Temporal extent [Recommendation]
Service/tool metadata records in schema.org format should include temporal extent if applicable - encoded as temporalCoverage.	

Example 63: Temporal and geographical extents (Schema.org)


```
{
   "@context": {
      "@vocab": "https://schema.org/"
   },
   "@type": "CreativeWork",
   "spatialCoverage": {
      "geo": {
         "box": "-50.0 -100.0 40.0 160.0",
         "polygon": "-50.0 -100.0 -50.0 160.0 40.0 160.0 40.0 -100.0 -50.0 -100.0",
         "@type": "GeoShape"
      },
      "@type": "Place"
   },
   "temporalCoverage": "2009-01-27T00:00:00.000Z/2011-08-09T23:59:59.999Z"
}
```

3.3.7 ISO19115-3 encoding

3.3.7.1 General

None.

3.3.7.2 Identification information

SRV-BP-7210	identification information [Requirement]
Service/tool metadata records in ISO19115-3 format shall encode the following mandatory properties of the metadata model defined §3.2.1 as shown below: - Resource identifier < mdb:metadataIdentifier/>, (srv:SV_ServiceIdentification/mri:citation/cit:CI_Citation/cit:identifier) - Resource title (srv:SV_ServiceIdentification/mri:citation/cit:CI_Citation/cit:title) - Resource abstract (srv:SV_ServiceIdentification/mri:abstract) - Responsible organisation (srv:SV_ServiceIdentification /mri:pointOfContact/cit:CI_Responsibility)	

SRV-BP-7220	identification information [Recommendation]
Service/tool metadata records in ISO19115-3 format should encode the following optional properties of the metadata model defined in §3.2.1 as shown below: - DOI[14] (srv:SV_ServiceIdentification/mri:citation/cit:CI_Citation/cit:identifier/ mcc:MD_Identifier/mcc:code/gco:CharacterString[../../mcc :codeSpace/gco:CharacterString='https: //doi.org']) - Last revision date (srv:SV_ServiceIdentification/mri:citation/cit:CI_Citation/cit:date) - Resource version (srv:SV_ServiceIdentification/mri:citation/cit:CI_Citation/cit:edition) - Resource version description (srv:SV_ServiceIdentification/mri:citation/cit:CI_Citation/cit:otherCitationDetails)	

Example 64: Identification information (ISO19115-3)

```
<?xml version="1.0" encoding="UTF-8"?>
<mdb:MD_Metadata xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:mdb="http://standards.iso.org/iso/19115/-3/mdb/1.0"
xmlns:mac="http://standards.iso.org/iso/19115/-3/mac/1.0"
xmlns:mcc="http://standards.iso.org/iso/19115/-3/mcc/1.0"
xmlns:gco="http://standards.iso.org/iso/19115/-3/gco/1.0"
xmlns:gcx="http://standards.iso.org/iso/19115/-3/gcx/1.0"
xmlns:gex="http://standards.iso.org/iso/19115/-3/gex/1.0"
xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:mri="http://standards.iso.org/iso/19115/-
3/mri/1.0" xmlns:srv="http://standards.iso.org/iso/19115/-3/srv/2.0"
xmlns:mrd="http://standards.iso.org/iso/19115/-3/mrd/1.0"
xmlns:lan="http://standards.iso.org/iso/19115/-3/lan/1.0"
xmlns:cit="http://standards.iso.org/iso/19115/-3/cit/1.0"
xmlns:xlink="http://www.w3.org/1999/xlink"
xsi:schemaLocation="http://standards.iso.org/iso/19115/-3/mds/1.0 ./standards.iso.org/19115/-
3/mds/1.0/mds.xsd">
   <mdb:metadataIdentifier>
      <mcc:MD_Identifier>
         <mcc:code>
            <gco:CharacterString>goce-user-toolbox</gco:CharacterString>
         </mcc:code>
      </mcc:MD_Identifier>
   </mdb:metadataIdentifier>
   <mdb:defaultLocale>
```

[14] See DOI mapping proposed in https://docs.ogc.org/is/13-026r9/13-026r9.html.

```
      <lan:PT_Locale>
         <lan:language>
            <lan:LanguageCode codeList="codeListLocation#LanguageCode"
codeListValue="eng">eng</lan:LanguageCode>
         </lan:language>
         <lan:characterEncoding/>
      </lan:PT_Locale>
   </mdb:defaultLocale>
   <mdb:metadataScope>
      <mdb:MD_MetadataScope>
         <mdb:resourceScope>
            <mcc:MD_ScopeCode codeList="codeListLocation#MD_ScopeCode"
codeListValue="service">service</mcc:MD_ScopeCode>
         </mdb:resourceScope>
      </mdb:MD_MetadataScope>
   </mdb:metadataScope>

…
   <mdb:identificationInfo>
      <srv:SV_ServiceIdentification>
         <mri:citation>
            <cit:CI_Citation>
               <cit:title>
                  <gco:CharacterString>GOCE User Toolbox</gco:CharacterString>
               </cit:title>
               <cit:date>
                  <cit:CI_Date>
                     <cit:date>
                        <gco:DateTime>2020-12-04T00:00:00</gco:DateTime>
                     </cit:date>
                     <cit:dateType>
                        <cit:CI_DateTypeCode codeList="codeListLocation#CI_DateTypeCode"
codeListValue="revision">revision</cit:CI_DateTypeCode>
                     </cit:dateType>
                  </cit:CI_Date>
               </cit:date>
               <cit:edition>
                  <gco:CharacterString>1.0</gco:CharacterString>
               </cit:edition>
               <cit:identifier>
                  <mcc:MD_Identifier>
                     <mcc:code>
                        <gco:CharacterString>goce-user-toolbox</gco:CharacterString>
                     </mcc:code>
                  </mcc:MD_Identifier>
               </cit:identifier>
            </cit:CI_Citation>
         </mri:citation>

         <mri:abstract>
            <gco:CharacterString>The GOCE User Toolbox (GUT) is a compilation of tools for the
utilisation and analysis of GOCE products. GUT supports applications in Geodesy, Oceanography
and Solid Earth Physics.</gco:CharacterString>
         </mri:abstract>

         <mri:pointOfContact>
            <cit:CI_Responsibility>
               <cit:role>
                  <cit:CI_RoleCode codeList="codeListLocation#CI_RoleCode"
codeListValue="pointOfContact">pointOfContact</cit:CI_RoleCode>
               </cit:role>
               <cit:party>
                  <cit:CI_Organisation>
                     <cit:name>
                        <gco:CharacterString>ESA/ESRIN</gco:CharacterString>
                     </cit:name>
                     <cit:contactInfo>
                        <cit:CI_Contact>
                           <cit:phone>
                              <cit:CI_Telephone>
                                 <cit:number>
                                    <gco:CharacterString>+3906941801</gco:CharacterString>
                                 </cit:number>
                                 <cit:numberType>
```

```
                                    <cit:CI_TelephoneTypeCode
codeList="codeListLocation#CI_TelephoneTypeCode"
codeListValue="voice">voice</cit:CI TelephoneTypeCode>
                                 </cit:numberType>
                              </cit:CI_Telephone>
                           </cit:phone>
                           <cit:phone>
                              <cit:CI_Telephone>
                                 <cit:number>
                                    <gco:CharacterString>+390694180280</gco:CharacterString>
                                 </cit:number>
                                 <cit:numberType>
                                    <cit:CI_TelephoneTypeCode
codeList="codeListLocation#CI TelephoneTypeCode"
codeListValue="facsimile">facsimile</cit:CI_TelephoneTypeCode>
                                 </cit:numberType>
                              </cit:CI_Telephone>
                           </cit:phone>
                           <cit:address>
                              <cit:CI_Address>
                                 <cit:deliveryPoint>
                                    <gco:CharacterString>Largo Galileo Galilei
1</gco:CharacterString>
                                 </cit:deliveryPoint>
                                 <cit:city>
                                    <gco:CharacterString>Frascati (Roma)</gco:CharacterString>
                                 </cit:city>
                                 <cit:postalCode>
                                    <gco:CharacterString>00044</gco:CharacterString>
                                 </cit:postalCode>
                                 <cit:country>
                                    <gco:CharacterString>Italy</gco:CharacterString>
                                 </cit:country>
                                 <cit:electronicMailAddress>
                                    <gco:CharacterString>eohelp@esa.int</gco:CharacterString>
                                 </cit:electronicMailAddress>
                              </cit:CI_Address>
                           </cit:address>
                           <cit:onlineResource>
                              <cit:CI_OnlineResource>
                                 <cit:linkage>

   <gco:CharacterString>https://www.esa.int</gco:CharacterString>
                                 </cit:linkage>
                              </cit:CI_OnlineResource>
                           </cit:onlineResource>
                        </cit:CI_Contact>
                     </cit:contactInfo>
                     <cit:individual>
                        <cit:CI_Individual>
                           <cit:positionName>
                              <gco:CharacterString>ESRIN Earth Observation Help
Desk</gco:CharacterString>
                           </cit:positionName>
                        </cit:CI_Individual>
                     </cit:individual>
                  </cit:CI_Organisation>
               </cit:party>
            </cit:CI_Responsibility>
         </mri:pointOfContact>
         <mri:extent>
         </mri:extent>
         <mri:descriptiveKeywords>
         <srv:serviceType>
            <gco:ScopedName codeSpace="http://inspire.ec.europa.eu/metadata-
codelist/SpatialDataServiceType">transformation</gco:ScopedName>
         </srv:serviceType>
      </srv:SV_ServiceIdentification>
   </mdb:identificationInfo>

</mdb:MD_Metadata>
```

Example 65: Identification information with DOI (ISO19115-3)

```
<mdb:identificationInfo>
      <srv:SV_ServiceIdentification>
         <mri:citation>
            <cit:CI_Citation>
               <cit:title>
                  <gco:CharacterString>rasdaman - raster data manager</gco:CharacterString>
               </cit:title>
               <cit:date>
                  <cit:CI_Date>
                     <cit:date>
                        <gco:DateTime>2020-12-04T00:00:00</gco:DateTime>
                     </cit:date>
                     <cit:dateType>
                        <cit:CI_DateTypeCode codeList="codeListLocation#CI_DateTypeCode"
codeListValue="revision">revision</cit:CI_DateTypeCode>
                     </cit:dateType>
                  </cit:CI_Date>
               </cit:date>
               <cit:edition>
                  <gco:CharacterString>9.5</gco:CharacterString>
               </cit:edition>
               <cit:identifier>
                  <mcc:MD_Identifier>
                     <mcc:code>
                        <gco:CharacterString>rasdaman</gco:CharacterString>
                     </mcc:code>
                  </mcc:MD_Identifier>
               </cit:identifier>
               <cit:identifier>
                  <mcc:MD_Identifier>
                     <mcc:code>
                        <gco:CharacterString>10.5281/zenodo.1040170</gco:CharacterString>
                     </mcc:code>
                     <mcc:codeSpace>
                        <gco:CharacterString>https://doi.org</gco:CharacterString>
                     </mcc:codeSpace>
                     <mcc:description>
                        <gco:CharacterString>Baumann, P., Email: P.Baumann@Jacobs-
University.De, &amp;amp; Website: Rasdaman.Org. (2017). Rasdaman - Raster Data Manager. Zenodo.
https://doi.org/10.5281/ZENODO.1040170</gco:CharacterString>
                     </mcc:description>
                  </mcc:MD_Identifier>
               </cit:identifier>
            </cit:CI_Citation>
         </mri:citation>
```

SRV-BP-7230	Spatial resolution [Recommendation]	[RD-2], [RD-6] TG Req. 3.3
Metadata records should express restriction on the spatial resolution if the service or tool has such restriction in MD_Metadata.identificationInfo > MD_Identification/spatialResolution as per table G.2 of [RD-2].		

SRV-BP-7240	CRS identifier [Recommendation]	[RD-2], [RD-6] TG Req. 6.1, 6.2
Metadata records should indicate the CRS supported by the service/tool using identifiers specified in a well-known common register, if the service or tool has such restriction in MD_Metadata.referenceSystemInfo as per Table B.2 of [RD-2].		

3.3.7.3 Constraint information

The proposed encoding is a straight translation of the equivalent encoding with ISO19139.

SRV-BP-7310	Limitations on public access [Recommendation]	[RD-8]
Metadata records in ISO19115-3 format should include information about limitations on public access or lack of such limitations.		

SRV-BP-7320	Conditions for access and use [Recommendation]	[RD-8]
Metadata records in ISO19115-3 format should include information about conditions for access and use or indicate that there are no such conditions or that the conditions are unknown.		

SRV-BP-7330	Licenses [Recommendation]	[RD-8]
Metadata records in ISO19115-3 format should include information about the licensing of the resource by providing a link to the license type (e.g. https://spdx.org/licenses/Apache-2.0).		

Example 66: Constraint information for Access point (ISO19115-3)

```
      <mri:resourceConstraints>
            <mco:MD_LegalConstraints>
               <mco:useConstraints>
                  <mco:MD_RestrictionCode
codeList="https://schemas.isotc211.org/19115/resources/Codelist/cat/codeLists.xml#MD_Restricti
onCode" codeListValue="otherRestrictions"/>
               </mco:useConstraints>
               <mco:otherConstraints>
                  <gcx:Anchor xlink:href="http://inspire.ec.europa.eu/metadata-
codelist/ConditionsApplyingToAccessAndUse/noConditionsApply">No conditions apply to access and
use.</gcx:Anchor>
               </mco:otherConstraints>
            </mco:MD_LegalConstraints>
         </mri:resourceConstraints>
         <mri:resourceConstraints>
            <mco:MD_LegalConstraints>
               <mco:accessConstraints>
                  <mco:MD_RestrictionCode
codeList="https://schemas.isotc211.org/19115/resources/Codelist/cat/codeLists.xml#MD_Restricti
onCode" codeListValue="otherRestrictions"/>
               </mco:accessConstraints>
               <mco:otherConstraints>
                  <gcx:Anchor xlink:href="http://inspire.ec.europa.eu/metadata-
codelist/LimitationsOnPublicAccess/noLimitations">no limitations to public
access.</gcx:Anchor>
               </mco:otherConstraints>
            </mco:MD_LegalConstraints>
         </mri:resourceConstraints>
```

Example 67: Constraint information for Tool download (ISO19115-3)

```
         <mri:resourceConstraints>
            <mco:MD_LegalConstraints>
               <mco:useConstraints>
```

```
                <mco:MD_RestrictionCode
codeList="https://schemas.isotc211.org/19115/resources/Codelist/cat/codeLists.xml#MD_Restricti
onCode" codeListValue="otherRestrictions"/>
             </mco:useConstraints>
             <mco:otherConstraints>
                <gcx:Anchor xlink:href="https://spdx.org/licenses/GPL-3.0-only">GNU General
Public License v3.0</gcx:Anchor>
             </mco:otherConstraints>
          </mco:MD_LegalConstraints>
       </mri:resourceConstraints>
```

3.3.7.4 Distribution information

SRV-BP-7410	Resource URL [Requirement]	[RD-8]
(Tool) metadata records in ISO19115-3 format shall include an “URL” element describing where the Web user interface can be accessed or where the tool can be downloaded.		

Example 68: Distribution information for Tool download (ISO19115-3)

```
<mdb:distributionInfo>
      <mrd:MD_Distribution>
         <mrd:transferOptions>
            <mrd:MD_DigitalTransferOptions>
               <mrd:onLine>
                  <cit:CI_OnlineResource>
                     <cit:linkage>
                        <gco:CharacterString>https://earth.esa.int/eogateway/gut-
registration</gco:CharacterString>
                     </cit:linkage>
                     <cit:name>
                        <gco:CharacterString>Download the GOCE User
Toolbox</gco:CharacterString>
                     </cit:name>
                     <cit:function>
                        <cit:CI_OnLineFunctionCode
codeList="https://schemas.isotc211.org/19115/resources/Codelist/cat/codelists.xml#CI_OnLineFun
ctionCode" codeListValue="download"/>
                     </cit:function>
                  </cit:CI_OnlineResource>
               </mrd:onLine>
            </mrd:MD_DigitalTransferOptions>
         </mrd:transferOptions>
      </mrd:MD_Distribution>
   </mdb:distributionInfo>
```

SRV-BP-7420	Access point information [Requirement]	[RD-8]
Service/tool metadata records in ISO19115-3 format shall include access point information encoded according to [RD-8].		

Example 69: Distribution information for Access point (ISO19115-3)

```
<mdb:distributionInfo>
      <mrd:MD_Distribution>
         <mrd:transferOptions>
            <mrd:MD_DigitalTransferOptions>
               <mrd:onLine>
                  <cit:CI_OnlineResource>
                     <cit:linkage>
```

```
   <gco:CharacterString>https://datacube.pdgs.eo.esa.int/wcs?service=WCS&amp;Request=DescribeC
overage&amp;version=2.0.0&amp;CoverageId=LE7_RGB</gco:CharacterString>
                     </cit:linkage>
                     <cit:protocol>
                        <gco:CharacterString>OGC:WCS:DescribeCoverage</gco:CharacterString>
                     </cit:protocol>
                     <cit:name>
                        <gco:CharacterString>DescribeCoverage</gco:CharacterString>
                     </cit:name>
                     <cit:description>
                        <gcx:Anchor xlink:href="http://inspire.ec.europa.eu/metadata-
codelist/OnLineDescriptionCode/accessPoint">accessPoint</gcx:Anchor>
                     </cit:description>
                     <cit:function>
                        <cit:CI_OnLineFunctionCode codeList="
https://schemas.isotc211.org/19115/resources/Codelist/cat/codeLists.xml#CI_OnLineFunctionCode"
codeListValue="information"/>
                     </cit:function>
                  </cit:CI_OnlineResource>
               </mrd:onLine>
               <mrd:onLine>
                  <cit:CI_OnlineResource>
                     <cit:linkage>

   <gco:CharacterString>https://datacube.pdgs.eo.esa.int/wcs?service=WCS&amp;Request=GetCapabi
lities&amp;version=2.0.0</gco:CharacterString>
                     </cit:linkage>
                     <cit:protocol>
                        <gcx:Anchor
xlink:href="http://www.opengis.net/def/serviceType/ogc/wcs/2.0">
          OGC:WCS:GetCapabilities</gcx:Anchor>
                     </cit:protocol>
                     <cit:name>
                        <gco:CharacterString>GetCapabilities</gco:CharacterString>
                     </cit:name>
                     <cit:description>
                        <gcx:Anchor xlink:href="http://inspire.ec.europa.eu/metadata-
codelist/OnLineDescriptionCode/accessPoint">accessPoint</gcx:Anchor>
                     </cit:description>
                     <cit:function>
                        <cit:CI_OnLineFunctionCode
codeList="https://schemas.isotc211.org/19115/resources/Codelist/cat/codeLists.xml#CI_OnLineFun
ctionCode" codeListValue="information"/>
                     </cit:function>
                  </cit:CI_OnlineResource>
               </mrd:onLine>
            </mrd:MD_DigitalTransferOptions>
         </mrd:transferOptions>
      </mrd:MD_Distribution>
   </mdb:distributionInfo>
```

SRV-BP-7430	No online access [Recommendation]	[RD-8]
Metadata records in ISO19115-3 should include an “resource locator“ element providing access to additional information about the tool or service if no online access is available.		

Example 70: Distribution information when no online access (ISO19115-3)

```
   <mdb:distributionInfo>
      <mrd:MD_Distribution>
         <mrd:transferOptions>
            <mrd:MD_DigitalTransferOptions>
               <mrd:onLine>
                  <cit:CI_OnlineResource>
                     <cit:linkage>
```

```
   <gco:CharacterString>https://earth.esa.int/eogateway/documents/20142/37627/GOCE-User-
Toolbox-Tutorial-P-Knudsen.pdf</gco:CharacterString>
                     </cit:linkage>
                     <cit:name>
                        <gco:CharacterString>GOCE User Toolbox and
Tutoral</gco:CharacterString>
                     </cit:name>
                     <cit:function>
                        <cit:CI_OnLineFunctionCode
codeList="https://schemas.isotc211.org/19115/resources/Codelist/cat/codeLists.xml#CI_OnLineFun
ctionCode" codeListValue="information"/>
                     </cit:function>
                  </cit:CI OnlineResource>
               </mrd:onLine>
            </mrd:MD_DigitalTransferOptions>
         </mrd:transferOptions>
      </mrd:MD_Distribution>
   </mdb:distributionInfo>
```

3.3.7.5 Quality information

SRV-BP-7510	Technical specification [Recommendation]	[RD-8]
Metadata records for online services (API) in ISO19115-3 format should declare compliance with at least one technical specification providing all technical elements to actually invoke the service and enable its usage.		

Example 71: Compliance information for Access point (ISO19115-3)

```
<mdb:dataQualityInfo>
      <mdq:DQ_DataQuality>
         <mdq:scope>
            <mcc:MD_Scope>
               <mcc:level>
                  <mcc:MD_ScopeCode
codeList="http://standards.iso.org/iso/19115/resources/Codelist/cat/CodeLists.xml#MD_ScopeCode
" codeListValue="service"/>
               </mcc:level>
               <mcc:levelDescription/>
            </mcc:MD_Scope>
         </mdq:scope>
         <mdq:report>
            <mdq:DQ_DomainConsistency>
               <mdq:result>
                  <mdq:DQ_ConformanceResult>
                     <mdq:specification>
                        <cit:CI Citation>
                           <cit:title>
                              <gcx:Anchor xlink:href="http://docs.opengeospatial.org/is/17-
089r1/17-089r1.html">OGC Web Coverage Service 2.0</gcx:Anchor>
                           </cit:title>
                           <cit:date>
                              <cit:CI_Date>
                                 <cit:date>
                                    <gco:Date>2010-10-27</gco:Date>
                                 </cit:date>
                                 <cit:dateType>
                                    <cit:CI_DateTypeCode
codeList="http://standards.iso.org/iso/19115/resources/Codelist/cat/codeLists.xml#CI_DateTypeC
ode" codeListValue="publication"/>
                                 </cit:dateType>
                              </cit:CI_Date>
                           </cit:date>
```

```
                        </cit:CI_Citation>
                     </mdq:specification>
                     <mdq:explanation>
                        <gco:CharacterString>This Spatial Data Service is conformant with the
OGC Web Coverage Service 2.0 specification</gco:CharacterString>
                     </mdq:explanation>
                     <mdq:pass gco:nilReason="unknown"/>
                  </mdq:DQ_ConformanceResult>
               </mdq:result>
            </mdq:DQ_DomainConsistency>
         </mdq:report>
      </mdq:DQ_DataQuality>
   </mdb:dataQualityInfo>
```

3.3.7.6 Service coupling

SRV-BP-7620	operatesOn [Recommendation]	[RD-8]
Service metadata records in ISO19115-3 format should refer to online metadata records consumed or provided by the service using "mri:associatedResource" as defined in [RD-8].		

Example 72: Reference to related collection (ISO19115-3)

```
      <mri:associatedResource>
            <mri:MD_AssociatedResource>
               <mri:associationType>
                  <mri:DS_AssociationTypeCode
codeList="http://standards.iso.org/iso/19115/resources/Codelist/cat/codelists.xml#DS_Associati
onTypeCode" codeListValue="dependency"/>
               </mri:associationType>
               <mri:metadataReference>
                  <cit:CI_Citation>
                     <cit:title>
                        <gco:CharacterString>Landsat 7 ETM+ (Enhanced Thematic Mapper Plus)
Geolocated Terrain Corrected Systematic processing</gco:CharacterString>
                     </cit:title>
                     <cit:identifier>
                        <mcc:MD_Identifier>
                           <mcc:code>
                              <gco:CharacterString>C1532648148-ESA</gco:CharacterString>
                           </mcc:code>
                           <mcc:codeSpace>
                              <gco:CharacterString>https://idn.ceos.org</gco:CharacterString>
                           </mcc:codeSpace>
                        </mcc:MD_Identifier>
                     </cit:identifier>
                     <cit:onlineResource>
                        <cit:CI_OnlineResource>
                           <cit:linkage>

   <gco:CharacterString>https://eovoc.spacebel.be/collections/series/items/LANDSAT.ETM.GTC</gc
o:CharacterString>
                           </cit:linkage>
                        </cit:CI_OnlineResource>
                     </cit:onlineResource>
                  </cit:CI_Citation>
               </mri:metadataReference>
            </mri:MD_AssociatedResource>
         </mri:associatedResource>
```

3.3.7.7 Metadata information

SRV-BP-7710	Metadata information [Recommendation]	[RD-8]

Service/tool metadata records in ISO19115-3 format should encode the following metadata information properties of the metadata model defined in 3.2.6 as follows:

- Metadata point of contact (mdb:MD_Metadata/mdb:contact)
- Latest update date (mdb:MD_Metadata/mdb:dateInfo)
- Metadata language (mdb:MD_Metadata/mdb:defaultLocale/lan:PT_Locale/lan:language)

Example 73: Metadata information (ISO19115-3)

```
<?xml version="1.0" encoding="UTF-8"?>
<mdb:MD_Metadata xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:mdb="http://standards.iso.org/iso/19115/-3/mdb/1.0"
xmlns:mac="http://standards.iso.org/iso/19115/-3/mac/1.0"
xmlns:mcc="http://standards.iso.org/iso/19115/-3/mcc/1.0"
xmlns:gco="http://standards.iso.org/iso/19115/-3/gco/1.0"
xmlns:gcx="http://standards.iso.org/iso/19115/-3/gcx/1.0"
xmlns:gex="http://standards.iso.org/iso/19115/-3/gex/1.0"
xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:mri="http://standards.iso.org/iso/19115/-
3/mri/1.0" xmlns:srv="http://standards.iso.org/iso/19115/-3/srv/2.0"
xmlns:mrd="http://standards.iso.org/iso/19115/-3/mrd/1.0"
xmlns:lan="http://standards.iso.org/iso/19115/-3/lan/1.0"
xmlns:cit="http://standards.iso.org/iso/19115/-3/cit/1.0"
xmlns:xlink="http://www.w3.org/1999/xlink"
xsi:schemaLocation="http://standards.iso.org/iso/19115/-3/mds/1.0 ./standards.iso.org/19115/-
3/mds/1.0/mds.xsd">
   <mdb:metadataIdentifier>
      <mcc:MD_Identifier>
         <mcc:code>
            <gco:CharacterString>eo-pdgs-landsat-datacube</gco:CharacterString>
         </mcc:code>
      </mcc:MD_Identifier>
   </mdb:metadataIdentifier>
   <mdb:defaultLocale>
      <lan:PT_Locale>
         <lan:language>
            <lan:LanguageCode
codeList="http://standards.iso.org/iso/19115/resources/Codelist/lan/LanguageCode.xml#LanguageC
ode" codeListValue="eng"/>
         </lan:language>
         <lan:characterEncoding/>
      </lan:PT_Locale>
   </mdb:defaultLocale>
   <mdb:metadataScope>
      <mdb:MD_MetadataScope>
         <mdb:resourceScope>
            <mcc:MD_ScopeCode
codeList="http://standards.iso.org/iso/19115/resources/Codelist/cat/codeLists.xml#MD_ScopeCode
" codeListValue="service"/>
         </mdb:resourceScope>
      </mdb:MD_MetadataScope>
   </mdb:metadataScope>
   <mdb:contact>
      <cit:CI_Responsibility>
         <cit:role>
            <cit:CI_RoleCode
codeList="http://standards.iso.org/iso/19115/resources/Codelist/cat/codeLists.xml#CI_RoleCode"
codeListValue="pointOfContact"/>
         </cit:role>
         <cit:party>
            <cit:CI_Organisation>
               <cit:name>
                  <gco:CharacterString>ESA/ESRIN</gco:CharacterString>
               </cit:name>
               <cit:contactInfo>
                  <cit:CI_Contact>
                     <cit:phone>
                        <cit:CI_Telephone>
                           <cit:number>
                              <gco:CharacterString>+3906941801</gco:CharacterString>
                           </cit:number>
                           <cit:numberType>
```

```
                              <cit:CI_TelephoneTypeCode
codeList="http://standards.iso.org/iso/19115/resources/Codelist/cat/codeLists.xml#CI_Telephone
TypeCode" codeListValue="voice"/>
                           </cit:numberType>
                        </cit:CI_Telephone>
                     </cit:phone>
                     <cit:phone>
                        <cit:CI_Telephone>
                           <cit:number>
                              <gco:CharacterString>+390694180280</gco:CharacterString>
                           </cit:number>
                           <cit:numberType>
                              <cit:CI_TelephoneTypeCode
codeList="http://standards.iso.org/iso/19115/resources/Codelist/cat/codeLists.xml#CI_Telephone
TypeCode" codeListValue="facsimile"/>
                           </cit:numberType>
                        </cit:CI_Telephone>
                     </cit:phone>
                     <cit:address>
                        <cit:CI_Address>
                           <cit:deliveryPoint>
                              <gco:CharacterString>Largo Galileo Galilei
1</gco:CharacterString>
                           </cit:deliveryPoint>
                           <cit:city>
                              <gco:CharacterString>Frascati (Roma)</gco:CharacterString>
                           </cit:city>
                           <cit:postalCode>
                              <gco:CharacterString>00044</gco:CharacterString>
                           </cit:postalCode>
                           <cit:country>
                              <gco:CharacterString>Italy</gco:CharacterString>
                           </cit:country>
                           <cit:electronicMailAddress>
                              <gco:CharacterString>eohelp@esa.int</gco:CharacterString>
                           </cit:electronicMailAddress>
                        </cit:CI_Address>
                     </cit:address>
                     <cit:onlineResource>
                        <cit:CI_OnlineResource>
                           <cit:linkage>
                              <gco:CharacterString>https://earth.esa.int</gco:CharacterString>
                           </cit:linkage>
                        </cit:CI_OnlineResource>
                     </cit:onlineResource>
                  </cit:CI_Contact>
               </cit:contactInfo>
               <cit:individual>
                  <cit:CI_Individual>
                     <cit:positionName>
                        <gco:CharacterString>ESRIN Earth Observation Help
Desk</gco:CharacterString>
                     </cit:positionName>
                  </cit:CI_Individual>
               </cit:individual>
            </cit:CI_Organisation>
         </cit:party>
      </cit:CI_Responsibility>
   </mdb:contact>
   <mdb:dateInfo>
      <cit:CI_Date>
         <cit:date>
            <gco:DateTime>2019-05-15T09:00:00</gco:DateTime>
         </cit:date>
         <cit:dateType>
            <cit:CI_DateTypeCode codeList="codeListLocation#CI_DateTypeCode"
codeListValue="revision">revision</cit:CI_DateTypeCode>
         </cit:dateType>
      </cit:CI_Date>
   </mdb:dateInfo>
   <mdb:metadataStandard>
      <cit:CI_Citation>
         <cit:title>
            <gco:CharacterString>ISO 19115-3</gco:CharacterString>
         </cit:title>
         <cit:edition>
```

```
            <gco:CharacterString>2016-08-15</gco:CharacterString>
         </cit:edition>
      </cit:CI Citation>
   </mdb:metadataStandard>
   <mdb:identificationInfo>
   </mdb:identificationInfo>
   <mdb:distributionInfo>
   </mdb:distributionInfo>
</mdb:MD_Metadata>
```

3.3.7.8 Descriptive keywords

SRV-BP-7810	Descriptive keywords [Recommendation]	[RD-8]
Service/tool metadata records in ISO19115-3 format should encode descriptive keywords as shown in the example below.		

Example 74: Descriptive Keywords (ISO19115-3)

```
         <mri:descriptiveKeywords>
            <mri:MD_Keywords>
               <mri:keyword>
                  <gcx:Anchor xlink:href="https://earth.esa.int/concept/gravity-gravitational-
field">Gravity and Gravitational Field</gcx:Anchor>
               </mri:keyword>
               <mri:keyword>
                  <gcx:Anchor xlink:href="https://earth.esa.int/concept/solid-earth">Solid
Earth</gcx:Anchor>
               </mri:keyword>
               <mri:keyword>
                  <gcx:Anchor
xlink:href="https://earth.esa.int/concept/oceans">Oceans</gcx:Anchor>
               </mri:keyword>
               <mri:type>
                  <mri:MD_KeywordTypeCode codeList="theme"
codeListValue="http://www.isotc211.org/2005/resources/codeList.xml#MD_KeywordTypeCode"/>
               </mri:type>
               <mri:thesaurusName>
                  <cit:CI_Citation>
                     <cit:title>
                        <gcx:Anchor
xlink:href="https://earth.esa.int/concepts/concept_scheme/earth-topics">EO Parameter Code List
- Earth Topics</gcx:Anchor>
                     </cit:title>
                     <cit:date>
                        <cit:CI_Date>
                           <cit:date>
                              <gco:DateTime>2019-05-13T00:00:00</gco:DateTime>
                           </cit:date>
                           <cit:dateType>
                              <cit:CI_DateTypeCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources
/codelist/ML_gmxCodelists.xml#CI_DateTypeCode"
codeListValue="publication">publication</cit:CI_DateTypeCode>
                           </cit:dateType>
                        </cit:CI_Date>
                     </cit:date>
                  </cit:CI_Citation>
               </mri:thesaurusName>
            </mri:MD_Keywords>
         </mri:descriptiveKeywords>
```

3.3.7.9 Extent information

SRV-BP-7910	Temporal extent [Recommendation]	[RD-8]
Metadata records in ISO19115-3 encoding should describe 0 to n temporal extents only if the service or tool has an explicit temporal extent using MD_Metadata/mdb:identificationInfo/srv:SV_ServiceIdentification/mri:extent as shown in the example below.		

SRV-BP-7920	Geographical extent [Recommendation]	[RD-8]
Metadata records in ISO19115-3 encoding should describe 0 to n minimal geographic bounding boxes only if the service or tool has an explicit geographic extent using MD_Metadata/mdb:identificationInfo/srv:SV_ServiceIdentification/mri:extent as shown in the example below.		

Example 75: Temporal and geographical extents (ISO19115-3)

```
<mri:extent>
   <gex:EX_Extent>
      <gex:temporalElement>
         <gex:EX_TemporalExtent>
            <gex:extent>
               <gml:TimePeriod gml:id="timeperiod1">
                  <gml:beginPosition>2009-01-01</gml:beginPosition>
                  <gml:endPosition>2011-08-09</gml:endPosition>
               </gml:TimePeriod>
            </gex:extent>
         </gex:EX_TemporalExtent>
      </gex:temporalElement>
   </gex:EX_Extent>
</mri:extent>
<mri:extent>
   <gex:EX Extent>
      <gex:geographicElement>
         <gex:EX_GeographicBoundingBox>
            <gex:westBoundLongitude>
               <gco:Decimal>-100</gco:Decimal>
            </gex:westBoundLongitude>
            <gex:eastBoundLongitude>
               <gco:Decimal>160</gco:Decimal>
            </gex:eastBoundLongitude>
            <gex:southBoundLatitude>
               <gco:Decimal>-50</gco:Decimal>
            </gex:southBoundLatitude>
            <gex:northBoundLatitude>
               <gco:Decimal>40</gco:Decimal>
            </gex:northBoundLatitude>
         </gex:EX_GeographicBoundingBox>
      </gex:geographicElement>
   </gex:EX_Extent>
</mri:extent>
```

3.3.8 UMM-JSON encoding

3.3.8.1 General

SRV-BP-8110	UMM-JSON [Requirement]	[RD-4], [RD-5], [RD-13]
Service/tool metadata records in UMM-JSON format shall encode the metadata according to UMM-JSON UMM-T [RD-5] (for downloadable tool or Web tool) or UMM-JSON UMM-S[15] [RD-4] (for headless services or API).		

3.3.8.2 Identification information

SRV-BP-8210	Identification information [Requirement]	[RD-4], [RD-5], [RD-13]

Service/tool metadata records in UMM-JSON format shall encode the following mandatory properties of the metadata model defined in §3.2.1 as shown below:
- Resource identifier ($.umm.Name)
- Resource title ($.umm.LongName)
- Resource abstract ($.umm.Description)
- Responsible organisation
  o UMM-S: ($.umm.ServiceOrganizations[*])
  o UMM-T: ($.umm.Organizations[*], $.umm.ContactPersons[*])		

SRV-BP-8220	Identification information [Recommendation]	[RD-4], [RD-5], [RD-13]
Service/tool metadata records in UMM-JSON format should encode the following optional properties of the metadata model defined §3.2.1 as shown below: - DOI ($.umm.DOI allowed for UMM-T encoding only) - Last revision date ($.umm.LastUpdatedDate) - Resource version ($.umm.Version) - Resource version description ($.umm.VersionDescription)		

Example 76: Identification information (UMM-S)


```
{
   "meta": {
      "native-id": "mmt_service_14322",
      "provider-id": "POCLOUD",
      "concept-type": "service",
      "concept-id": "S2009180097-POCLOUD",
      "revision-date": "2021-02-23T03:34:10.803Z",
      "user-id": "mgangl",
      "deleted": false,
      "revision-id": 2,
      "format": "application/vnd.nasa.cmr.umm+json"
   },
   "umm": {
      "URL": {
```


[15] https://cdn.earthdata.nasa.gov/umm/service/v1.4

```
         "Description": "This is the harmony root endpoint.",
         "URLValue": "https://harmony.earthdata.nasa.gov"
      },
      "Type": "Harmony",
      "ServiceKeywords": [
         {
            "ServiceCategory": "EARTH SCIENCE SERVICES",
            "ServiceTopic": "DATA MANAGEMENT/DATA HANDLING",
            "ServiceTerm": "DATA ACCESS/RETRIEVAL"
         },
         {
            "ServiceCategory": "EARTH SCIENCE SERVICES",
            "ServiceTopic": "DATA MANAGEMENT/DATA HANDLING",
            "ServiceTerm": "DATA INTEROPERABILITY",
            "ServiceSpecificTerm": "DATA REFORMATTING"
         }
      ],
      "ServiceOrganizations": [
         {
            "Roles": [
               "PUBLISHER",
               "SERVICE PROVIDER"
            ],
            "ShortName": "NASA/GSFC/EOS/EOSDIS/EMD",
            "LongName": "Maintenance and Development, Earth Observing System Data and
Information System, Earth Observing System,Goddard Space Flight Center, NASA"
         }
      ],
      "Description": "Backend NetCDF to Zarr service option description for Harmony data
transformations. Cannot be chained with other operations from this record.",
      "VersionDescription": "Data operation version\r\n\r\n",
      "Version": "0.9.0",
      "LastUpdatedDate": "2021-02-23T03:34:10.803Z",
      "Name": "PO.DAAC harmony-netcdf-to-zarr",
      "ServiceOptions": {
         "SupportedReformattings": [
            {
               "SupportedInputFormat": "NETCDF-4",
               "SupportedOutputFormats": [
                  "ZARR"
               ]
            }
         ]
      },
      "MetadataSpecification": {
         "URL": "https://cdn.earthdata.nasa.gov/umm/service/v1.4",
         "Name": "UMM-S",
         "Version": "1.4"
      },
      "LongName": "PO.DAAC harmony-netcdf-to-zarr Service Options"
   }
}
```


SRV-BP-8240	CRS identifier [Recommendation]	[RD-4], [RD-5], [RD-13]
Metadata records should indicate the CRS supported by the service/tool using identifiers "4326", "3395", "3785", "9807", "2000.63", "2163", "3408", "3410", "6931", "6933", "3411", "9822", "54003", "54004", "54008", "54009", "26917" or "900913", if the service or tool has such restriction in $.umm/ServiceOptions.SupportedInputProjections and SupportedOutputProjections.		

Example 77: CRS identifier (UMM-S)


```
{
   "meta": {
      "native-id": "mmt_service_7097",
      "provider-id": "PODAAC",
      "concept-type": "service",
      "concept-id": "S1607544506-PODAAC",
```

```
      ...
      "format": "application/vnd.nasa.cmr.umm+json"
   },
   "umm": {
      "URL": {
         "Description": "PO.DAAC OPeNDAP server URL",
         "URLValue": "https://opendap.jpl.nasa.gov/"
      },
      "Type": "OPeNDAP",
      ...
      "Name": "OPeNDAP",
      "ServiceOptions": {
         "SupportedInputProjections": [
            {
               "ProjectionName": "Geographic",
               "ProjectionAuthority": "4326"
            }
         ],
         …
      },
      …
   }
}
```

3.3.8.3 Constraint information

SRV-BP-8310	Use limitation URL [Recommendation]
Service/tool metadata records in UMM-JSON format should include conditions applying to access and use with $.umm.UseConstraints and $.umm.accessConstraints.	

Example 78: Constraint information for Access point (UMM-S)

```
{
   "meta": {
      "native-id": "mmt_service_7097",
      "provider-id": "PODAAC",
      "concept-type": "service",
      "concept-id": "S1607544506-PODAAC",
      …
      "format": "application/vnd.nasa.cmr.umm+json"
   },
   "umm": {
      "URL": {
         "Description": "PO.DAAC OPeNDAP server URL",
         "URLValue": "https://opendap.jpl.nasa.gov/"
      },
      "Type": "OPeNDAP",
      …
      "AccessConstraints": "None",
      …
      "UseConstraints": {
         "LicenseText": "None. "
      },
      "Name": "OPeNDAP",
…
      "LongName": "Open-source Project for a Network Data Access Protocol/Hyrax"
   }
}
```

SRV-BP-8320	Conditions for access and use [Recommendation]	[RD-4], [RD-5], [RD-13]
Metadata records in UMM-JSON format should include information about conditions for access and use or indicate that there are no such conditions or that the conditions are unknown.		

Example 79: Constraint information for Access (UMM-T)

```
{
   "meta": {
      "native-id": "AppEEARS",
      "provider-id": "LPDAAC_ECS",
      "concept-type": "tool",
      "concept-id": "TL1860232272-LPDAAC_ECS",
      ...
      "format": "application/vnd.nasa.cmr.umm+json"
   },
   "umm": {
      ...
      "Type": "Web User Interface",
      "AccessConstraints": "Users must have a NASA Earthdata Login account to use the AppEEARS
site and API.",
      ...
   }
}
```

SRV-BP-8330	Licenses [Recommendation]	[RD-4], [RD-5], [RD-13]
Metadata records in UMM-JSON format should include information about the licensing of the resource by providing a link to the license type (e.g. https://spdx.org/licenses/Apache-2.0) as value of $.umm.UseConstraints.LicenseUrl.		

Example 80: License information for Tool download (UMM-T)

```
{
   "meta": {
      "concept-type": "tool",
      ...
      "format": "application/vnd.nasa.cmr.umm+json"
   },
   "umm": {
      ...
      "Name": "Coastline Classifier",
      "Type": "Downloadable Tool",

      "UseConstraints": {
         "LicenseUrl": "https://spdx.org/licenses/Apache-2.0"
      },

      ...
   }
}
```

3.3.8.4 Distribution information

The URLContentType[16] property of "$.umm.URL" can have multiple specializations ("Type", "Subtype") in KMS depending on the use case:

- DistributionURL

[16] See https://gcmd.earthdata.nasa.gov/KeywordViewer/scheme/rucontenttype?gtm_scheme=rucontenttype.

- DOWNLOAD SOFTWARE
- GET CAPABILITIES
- GOTO WEB TOOL
- USE SERVICE API
  - WEB MAP SERVICE (WMS)
  - WEB COVERAGE SERVICE (WCS)
  - …

- PublicationURL
  - HOW-TO
  - USER'S GUIDE
  - …

SRV-BP-8410	tool download [Recommendation]	[RD-5]
Tool metadata records in UMM-JSON format should include tool download information encoded as $.umm.URL "DistributionURL" with "Type" equal to "DOWNLOAD SOFTWARE".		

Example 81: Distribution information for Tool download (UMM-T)

```
{
   "meta": {
      "native-id": "ACON",
      "provider-id": "SCIOPS",
      "concept-type": "tool",
      "concept-id": "TL1860342070-SCIOPS",
      ...
      "format": "application/vnd.nasa.cmr.umm+json"
   },
   "umm": {
      "URL": {
         "Description": "Download the ACON software.",
         "URLValue": "http://www.bio.gc.ca/science/data-donnees/acon-en.php",
         "URLContentType": "DistributionURL",
         "Type": "DOWNLOAD SOFTWARE"
      },
      "Type": "Downloadable Tool",
      "Name": "ACON",
      …
   }
}
```

SRV-BP-8415	Web GUI URL [Requirement]	[RD-5], [RD-13]
Service/Tool Metadata records shall include an "URL" element describing where the Web user interface can be accessed encoded as $.umm.URL "DistributionURL" with "Type" equal to "GOTO WEB TOOL".		

Example 82: Distribution information for Web User Interface (UMM-T)

```
{
```

```
   "meta": {
      "native-id": "AppEEARS",
      "provider-id": "LPDAAC ECS",
      "concept-type": "tool",
      "concept-id": "TL1860232272-LPDAAC_ECS",
      ...
      "format": "application/vnd.nasa.cmr.umm+json"
   },
   "umm": {
      "URL": {
         "Description": "AppEEARS Landing Page",
         "URLValue": "https://lpdaacsvc.cr.usgs.gov/appeears/",
         "URLContentType": "DistributionURL",
         "Type": "GOTO WEB TOOL"
      },
      "Type": "Web User Interface",
      ...
}
```


SRV-BP-8420	access point information [Recommendation]	[RD-4]
Service/tool metadata records in UMM-JSON format should include access point information encoded with $.umm.URL "DistributionURL" and $.umm.ServiceOptions to [RD-4].		

Example 83: Distribution information for Access point (UMM-S)


```
{
   "meta": {
      "native-id": "mmt_service_7097",
      "provider-id": "PODAAC",
      "concept-type": "service",
      "concept-id": "S1607544506-PODAAC",
      ...
      "format": "application/vnd.nasa.cmr.umm+json"
   },
   "umm": {
      "URL": {
         "Description": "PO.DAAC OPeNDAP server URL",
         "URLValue": "https://opendap.jpl.nasa.gov/"
      },
      "Type": "OPeNDAP",
      …
      "ServiceOptions": {
         "SupportedInputProjections": [
            {
               "ProjectionName": "Geographic"
            }
         ],
         …
      },
      "MetadataSpecification": {
         "URL": "https://cdn.earthdata.nasa.gov/umm/service/v1.4",
         "Name": "UMM-S",
         "Version": "1.4"
      },
      "LongName": "Open-source Project for a Network Data Access Protocol/Hyrax"
   }
}
```


SRV-BP-8430	No online access [Recommendation]	[RD-8]
Metadata records in UMM-JSON format should include an "resource locator" element encoded with $.umm.URL "PublicationURL" providing access to additional information about the tool or service if no online access is available.		

3.3.8.5 Quality information

None.

3.3.8.6 Service coupling

SRV-BP-8620	Service to collection coupling [Recommendation]
Service/tool metadata records in UMM-JSON should refer to online collection metadata records consumed or provided by the service as $.umm.RelatedURLs with URLContentType "CollectionURL" with "Type" equal to "DATA SET LANDING PAGE" or the CoupledResource property.	

Example 84: Reference to related collection (UMM-S)

```
{
   "meta": {

      "concept-type": "service",
      ...
   },
   "umm": {
      ...
         "OperationMetadata": [
            {
               "CoupledResource": {
                  "DataResource": {
                     "DataResourceIdentifier": "C1532648148-ESA",
                     "DataResourceSourceType": "Collection"
                  }
               }
            }
         ]
   }
}
```

3.3.8.7 Metadata information

SRV-BP-8710	Metadata information [Recommendation]

Service/tool metadata records in UMM-JSON format should encode the following metadata information properties of the metadata model defined in 3.2.6 as shown in the example below:
- Metadata point of contact[17]
  o UMM-S: $.umm.ServiceOrganizations[] with Role="PUBLISHER"
  o UMM-T: $.umm.Organizations[] with Role="PUBLISHER"
- Latest update date ($umm.meta.revision-date)
- Metadata language (Not available)	

Example 85: Metadata information (UMM-S)

[17] Not available in UMM-T and UMM-S. Role values for Service/Tool Organization have to match the available enumeration values "SERVICE PROVIDER", "DEVELOPER", "PUBLISHER", "AUTHOR", "PUBLISHER", "AUTHOR", "ORIGINATOR" but do not allow distinguish between responsibility for metadata and responsibility for the actual service or tool.

```
{
   "meta": {
      "native-id": "mmt_service_14322",
      "provider-id": "POCLOUD",
      "concept-type": "service",
      "concept-id": "S2009180097-POCLOUD",
      "revision-date": "2021-02-23T03:34:10.803Z",
      "user-id": "mgangl",
      "deleted": false,
      "revision-id": 2,
      "format": "application/vnd.nasa.cmr.umm+json"
   },
   "umm": {

      "ServiceOrganizations": [
         {
            "Roles": [
               "PUBLISHER",
               "SERVICE PROVIDER"
            ],
            "ShortName": "NASA/GSFC/EOS/EOSDIS/EMD",
            "LongName": "Maintenance and Development, Earth Observing System Data and
Information System, Earth Observing System,Goddard Space Flight Center, NASA"
         }
      ],

      "MetadataSpecification": {
         "URL": "https://cdn.earthdata.nasa.gov/umm/service/v1.4",
         "Name": "UMM-S",
         "Version": "1.4"
      }
   }
}
```


Example 86: Metadata information (UMM-T)


```
{
   "meta": {
      "native-id": "Proba-V_MEP",
      "provider-id": "ESA",
      "concept-type": "tool",
      "concept-id": "TL2093861884-ESA",
      "revision-date": "2021-10-04T20:04:50.558Z",
      "user-id": "mmorahan",
      "deleted": false,
      "revision-id": 2,
      "format": "application/vnd.nasa.cmr.umm+json"
   },
   "umm": {
      ...
      "ContactPersons": [
         {
            "Roles": [
               "SERVICE PROVIDER"
            ],
            "LastName": "VITO Helpdesk/Operations",
            "ContactInformation": {
               "ContactMechanisms": [
                  {
                     "Type": "Email",
                     "Value": "remotesensing@vito.be"
                  },
                  {
                     "Type": "Telephone",
                     "Value": "+32 14 33 68 55"
                  }
               ]
            }
         }
      ],
      "Organizations": [
         {
            "Roles": [
               "SERVICE PROVIDER"
```

```
            ],
            "ShortName": "VITO",
            "LongName": "Flemish Institute for Technological Research",
            "URLValue": "https://www.vito.be/"
         },
         {
            "Roles": [
               "PUBLISHER"
            ],
            "ShortName": "ESA/EO",
            "LongName": "Observing the Earth, European Space Agency",
            "URLValue": "http://www.esa.int/esaEO/"
         }
      ],
      "MetadataSpecification": {
         "URL": "https://cdn.earthdata.nasa.gov/umm/tool/v1.1",
         "Name": "UMM-T",
         "Version": "1.1"
      },
      ...
   }
}
```


3.3.8.8 Descriptive keywords

SRV-BP-8810	Descriptive keywords [Recommendation]	[RD-4], [RD-5]
Service/tool metadata records in UMM-JSON format should include descriptive keywords encoded as $.umm.ServiceKeywords (UMM-S), $.umm.ToolKeywords (UMM-T) and $.umm.AncillaryKeywords.		

Example 87: Descriptive Keywords (UMM-S)


```
{
   "meta": {
      "native-id": "mmt_service_14322",
      "provider-id": "POCLOUD",
      "concept-type": "service",
      "concept-id": "S2009180097-POCLOUD",
      ...
   },
   "umm": {
      ...
      "Type": "Harmony",
      "ServiceKeywords": [
         {
            "ServiceCategory": "EARTH SCIENCE SERVICES",
            "ServiceTopic": "DATA MANAGEMENT/DATA HANDLING",
            "ServiceTerm": "DATA ACCESS/RETRIEVAL"
         },
         {
            "ServiceCategory": "EARTH SCIENCE SERVICES",
            "ServiceTopic": "DATA MANAGEMENT/DATA HANDLING",
            "ServiceTerm": "DATA INTEROPERABILITY",
            "ServiceSpecificTerm": "DATA REFORMATTING"
         }
      ],
      ...
   }
}
```


Example 88: Descriptive Keywords (UMM-T)

```
{
   "meta": {
      "native-id": "Proba-V_MEP",
      "provider-id": "ESA",
      "concept-type": "tool",
      "concept-id": "TL2093861884-ESA",
      ...
   },
   "umm": {
      ...
      "AncillaryKeywords": [
         "Sentinel satellites",
         "ESA",
         "Imagery",
         "Urban development",
         "Natural disaster management",
         "Satellite data",
         "CEOS"
      ],
      "Type": "Web User Interface",
      ...
      "ToolKeywords": [
         {
            "ToolCategory": "EARTH SCIENCE SERVICES",
            "ToolTopic": "DATA MANAGEMENT/DATA HANDLING",
            "ToolTerm": "CATALOGING"
         }
      ],
      ...
}
```

3.3.8.9 Extent information

SRV-BP-8910	Temporal extent [Recommendation]	[RD-13]
Service metadata records in UMM-JSON format should describe 0 to n temporal extents only if the service or tool has an explicit temporal extent using the DataResourceTemporalExtent property as shown in the example below.		

SRV-BP-8920	Geographical extent [Recommendation]	[RD-13]
Service metadata records in UMM-JSON format should describe 0 to n minimal geographic bounding boxes only if the service has an explicit geographic extent with the DataResourceSpatialExtent property as shown in the example below.		

Example 89: Temporal and geographical extents (UMM-S)

```
{
   "meta": {

      "concept-type": "service",
      ...
   },
   "umm": {
      ...
         "OperationMetadata": [
            {
               "CoupledResource": {
                  "DataResource": {
                     "DataResourceIdentifier": "C1532648148-ESA",
                     "DataResourceSourceType": "Collection",
```

```
                    "DataResourceTemporalExtent": {
                       "DataResourceTimePoints": [
                          {
                             "TimeValue": "2009-01-01"
                          },
                          {
                             "TimeValue": "2011-08-09"
                          }
                       ]
                    },
                    "DataResourceSpatialExtent": {
                       "SpatialBoundingBox": {
                          "WestBoundingCoordinate": -100,
                          "NorthBoundingCoordinate": 40,
                          "EastBoundingCoordinate": 160,
                          "SouthBoundingCoordinate": -50,
                          "CRSIdentifier": "EPSG:4326"
                       }
                    }
                 }
              }
           ]
    }
}
```


3.4 Controlled vocabularies

It is recommended to encode some of the information in the metadata with terminology from a controlled vocabulary (a.k.a codelist, thesaurus, taxonomy), typically represented as a concept with label, URI and explicit thesaurus identification (e.g. scheme URI). The current section identifies the information that should be encoded in this way and the taxonomies to be used.

- Service/tool types / categories from agreed thesaurus
- Science keywords from agreed thesaurus
- Platform names from agreed thesaurus
- Instrument names from agreed thesaurus
- Organization names from agreed thesaurus

SRV-BP-0402	Multiple vocabularies [Recommendation]	[RD-6]
Metadata records should be annotated with keywords for a specific keyword type (e.g. science keyword, platform, instrument, organization, ..) originating from multiple controlled vocabularies, but at least one of the recommended controlled vocabularies should be used for each of the keyword types covered in the next subsections.		

For example: European agencies may prefer using INSPIRE code lists and ESA Thesauri while others may prefer the NASA KMS (GCMD) Thesauri.

SRV-BP-0403	Keyword information [Recommendation]	[RD-6]
Keyword information from a controlled vocabulary included in metadata records should include label, URI and corresponding thesaurus identification (i.e. scheme URI).		

3.4.1 Service types

SRV-BP-0411	Service and Tool type [Recommendation]	[RD-4], [RD-5]
Service, tool and application metadata records should include a "type" metadata element with a value from a controlled vocabulary identifying the type of service or tool.		

Note: UMM-S and UMM-T list a number of enumeration values for "service type" and "tool type". These are not available in KMS. An ESA thesaurus with service and tool types is not available either.

SRV-BP-0412	Service and Tool type keywords [Recommendation]	[RD-4], [RD-5], TG Req 3.4 [RD-6]
For service and tool type keywords, the NASA KMS[18] thesaurus (concept scheme: https://gcmd.earthdata.nasa.gov/kms/concepts/concept_scheme/sciencekeywords), in particular the branch "Earth Science Services" or ESA Thesaurus should be used as controlled vocabulary.		

Note: this is also current practice for UMM-T and UMM-S metadata encodings in UMM-JSON.

Examples:

- *"EARTH SCIENCE SERVICES > DATA MANAGEMENT/DATA HANDLING > DATA ACCESS/RETRIEVAL" (86cbb2d3-6783-4d9b-9dc1-b0aea78f98ea)*
- *"EARTH SCIENCE SERVICES > DATA MANAGEMENT/DATA HANDLING > TRANSFORMATION/CONVERSION" (31ab3c10-1f10-4372-82d4-4c0c4be5999f)*
- *"EARTH SCIENCE SERVICES > DATA MANAGEMENT/DATA HANDLING > SUBSETTING/SUPERSETTING" (cc9e67fc-eafa-43cc-879f-0cb56b25bc39)*

SRV-BP-0413	Resource Type [Recommendation]	[RD-6]
Service, tool and application metadata records should include the controlled keyword http://inspire.ec.europa.eu/metadata-codelist/ResourceType/service from the INSPIRE Registry identifying the resource type.		

SRV-BP-0414	Spatial Data Service Type [Recommendation]	[RD-6] TG Req. 3.5
Service, tool and application metadata records should include a controlled keyword from the INSPIRE Registry https://inspire.ec.europa.eu/metadata-codelist/SpatialDataServiceType identifying the spatial data service type.		

Examples:

- *http://inspire.ec.europa.eu/metadata-codelist/SpatialDataServiceType/view*

[18] https://gcmd.earthdata.nasa.gov/static/kms/

- *http://inspire.ec.europa.eu/metadata-codelist/SpatialDataServiceType/download*
- *http://inspire.ec.europa.eu/metadata-codelist/SpatialDataServiceType/invoke*
- *http://inspire.ec.europa.eu/metadata-codelist/SpatialDataServiceType/transformation*
- *http://inspire.ec.europa.eu/metadata-codelist/SpatialDataServiceType/other*

SRV-BP-0415	Protocol Type [Recommendation]	[RD-10] §5.2
Service, tool and application metadata records should include a controlled keyword from the INSPIRE Registry https://inspire.ec.europa.eu/metadata-codelist/ProtocolValue whenever it is possible to recognise the service protocol.		

Examples:

- *http://www.opengis.net/def/serviceType/ogc/wcs,*
- *http://www.opengis.net/def/serviceType/ogc/wms*

Alternative, identifiers from Wikidata can be used as proposed by https://github.com/earthcubearchitecture-project418/p419dcatservices#wikidata-api-types.

SRV-BP-0416	Spatial Data Service Category [Recommendation]	[RD-6] TG Rec 3.2, TG Rec 3.3, TG Req. 3.4
Service, tool and application metadata records should include controlled keywords from the INSPIRE Registry http://inspire.ec.europa.eu/metadata-codelist/SpatialDataServiceCategory identifying the spatial data service category.		

Example values:

- *http://inspire.ec.europa.eu/metadata-codelist/SpatialDataServiceCategory/spatialCoordinateConversionService*
- *http://inspire.ec.europa.eu/metadata-codelist/SpatialDataServiceCategory/thematicImageSynthesisService*
- *https://inspire.ec.europa.eu/metadata-codelist/SpatialDataServiceCategory/infoCoverageAccessService*
- *http://inspire.ec.europa.eu/metadata-codelist/SpatialDataServiceCategory/humanGeographicViewer*

3.4.2 Science keywords

SRV-BP-0421	Science keywords [Recommendation]
For science keywords (label, URI, scheme), the NASA KMS[19] thesaurus (concept scheme: https://gcmd.earthdata.nasa.gov/kms/concepts/concept_scheme/sciencekeywords) or ESA	

[19] https://gcmd.earthdata.nasa.gov/static/kms/

Thesaurus (concept scheme: https://earth.esa.int/concepts/concept_scheme/earth-topics) should be used as controlled vocabulary.

3.4.3 Platforms

SRV-BP-0431	Platform names [Recommendation]
For platform information, the NASA KMS thesaurus (concept scheme: https://gcmd.earthdata.nasa.gov/kms/concepts/concept_scheme/platforms) or ESA Thesaurus (concept scheme: https://earth.esa.int/concepts/concept_scheme/platforms) should be used as controlled vocabulary.	

3.4.4 Instruments

SRV-BP-0441	Instrument names [Recommendation]
For instrument information, the NASA KMS thesaurus (concept scheme: https://gcmd.earthdata.nasa.gov/kms/concepts/concept_scheme/instruments) or ESA Thesaurus (concept scheme: https://earth.esa.int/concepts/concept_scheme/instruments) should be used as controlled vocabulary.	

3.4.5 Organisations

SRV-BP-0451	Organization names [Recommendation]
For organization names, the NASA KMS thesaurus (concept scheme: https://gcmd.earthdata.nasa.gov/kms/concepts/concept_scheme/providers) should be used as controlled vocabulary (See https://gcmd.earthdata.nasa.gov/kms/concepts/concept_scheme/providers/?format=csv).	

SRV-BP-0452	Organization names [Recommendation]
For organization names in Schema.org[20] encode metadata, the Research Organization Registry (https://ror.org/) vocabulary for organisations thesaurus should be used as controlled vocabulary for organisations in addition to the NASA KMS thesauri (See also https://ror.readme.io/docs/include-ror-ids-in-doi-metadata).	

[20] https://developers.google.com/search/docs/advanced/structured-data/dataset

3.5 Service discovery interface

3.5.1 General

The current Best practices do not impose implementing a specific service binding but allow for multiple alternative bindings. For each of the allowed alternatives, additional requirements and recommendations are expressed in subsequent sections.

SRV-BP-0511	Service bindings [Requirement]
The service discovery interface shall offer at least one of the following service bindings: • OpenSearch [AD-1], [RD-22], [RD-23], • OGC API – Features (Part 1) [RD-34], • OGC API – Records [RD-35], • OGC CSW (e.g. ISO AP Profile) [RD-27], • STAC API [RD-33].	

Note that using the STAC API implies that it is used with Items representing a single service or tools as GeoJSON so that it can be searched. The STAC Overview[21] allows using the different parts of the core SpatioTemporal Asset Catalog specification separately, thus using the STAC API, STAC Catalog, STAC Collection without the original STAC Item specification.

SRV-BP-0512	Search parameters [Requirement]
Service discovery interfaces shall support the following search parameters: • Number of records, • Start index or start page • Free text (e.g. matching title, abstract, keywords, platform, instrument, .. etc.) • Service identifier/name • DOI (optional) • Service category (optional) • Organisation name (optional)	

SRV-BP-0513	Hyperlink media relations [Requirement]	CEOS-BP-012 CEOS-BP-012C CEOS-BP-012D
When the service discovery response includes links to other resources using hyperlinks, the following relations "rel" shall be used:		

hyperlink "rel"	*Description of artifact*

[21] https://github.com/radiantearth/stac-api-spec/blob/master/stac-spec/overview.md

"via"	Preferred to convey the authoritative metadata resource or the source of the information from where the catalog entry is made.
"alternate"	Refers to alternate representations of the metadata.
"describedby"	Used to reference the documentation (a file with human-readable information about the resources) Use "type" to reference to documentation in Markdown format.
"enclosure"	Link allowing to download the tool/application.
"license"	Link to document identifying access and use constraints for the resource.

SRV-BP-0514	Hyperlink media types [Requirement]	CEOS-BP-012C
When the service discovery response make available links to metadata records or resources using hyperlinks, the following relations "type" (media type) shall be used:		

Resource	*hyperlink "type"*
ISO19139:2007 metadata	application/vnd.iso.19139+xml
ISO19115-3 metadata	application/vnd.iso.19115-3+xml
GeoDCAT-AP metadata	application/ld+json; profile="http://data.europa.eu/930/" application/rdf+xml; profile="http://data.europa.eu/930/" text/turtle; profile="http://data.europa.eu/930/"
UMM-JSON metadata	application/vnd.nasa.cmr.umm+json
OGC 19-020r1	application/geo+json profile="http://www.opengis.net/spec/eopad-geojson/1.0"
Documentation in Markdown format	text/markdown[22]
Jupyter Notebook	application/x-ipynb+json

Table 3 – Hyperlink media types

SRV-BP-0515	Coupled resources [Requirement]
The service discovery interface shall allow clients to find services/applications given a collection or find collections given a service/application.	

[22] https://datatracker.ietf.org/doc/html/rfc7763

The above requirement can be implemented in various ways e.g. using an associations endpoint or by including coupled resource information in the service and/or collection metadata as proposed by [RD-6].

3.5.2 OpenSearch

SRV-BP-0521	OpenSearch Best Practices [Requirement]	[AD-1]
Service discovery interfaces offering an OpenSearch binding shall apply the Best Practices defined in [AD-1] which are not specific for granule and/or collection discovery.		

SRV-BP-0522	OSDD URL template relation [Requirement]	[AD-1]
Service discovery interfaces offering an OpenSearch binding shall use "service" as relation type for the corresponding URL template in the OSDD document as per CEOS-BP-003 of [AD-1].		

SRV-BP-0523	Response formats [Requirement]	[AD-1]
Service discovery interfaces offering an OpenSearch binding shall support at least one of the below response formats: • Atom/XML [RD-22], [RD-23] • GeoJSON [RD-25]		

SRV-BP-0524	Search parameters [Requirement]	[AD-1] CEOS-BP-005
OpenSearch service discovery interfaces shall support at least the following search parameters: • count, • startIndex or startPage, • searchTerms, • geo:uid, • geo:box • time:start, time:end		

SRV-BP-0525	Additional search parameters [Recommendation]
OpenSearch service discovery interfaces shall by preference implement search parameters defined in well-known OpenSearch extensions (and namespaces), before deciding to use proprietary search parameter names e.g. • Geo and Time extensions [RD-22], geo: and time: namespace, • Earth Observation extension [RD-23], eo: namespace.	

Note that several "OpenSearch parameters listed for collection search" (table-4) and most of the "INSPIRE OpenSearch parameters for collection search" (table-5) in [RD-23] apply to service search as well.

3.5.3 OGC API – Features

SRV-BP-0534	Search parameters [Requirement]	[RD-34] [AD-1] CEOS-BP-005
Service discovery interfaces shall support at least the following search parameters: • limit [RD-34], • bbox [RD-34] • datetime [RD-34]		

3.5.4 OGC API – Records

SRV-BP-0542	Record type [Recommendation]	[RD-35]
Service discovery interfaces should support the "type" search parameter for record type with value "service" to filter records representing "services" or "tools" if the catalog contains multiple record types.		

SRV-BP-0544	Search parameters [Requirement]	[RD-35] [AD-1] CEOS-BP-005
Service discovery interfaces shall support at least the following search parameters: • limit [RD-34], • q [RD-35], • externalId [RD-35], • bbox [RD-34] • datetime [RD-34] • doi (via /queryables or /collections/{collectionId}/queryables) – optional • classifiedAs (via /queryables or /collections/{collectionId}/queryables) – optional		

3.5.5 OGC CSW

SRV-BP-0531	CSW ISO AP [Recommendation]	[RD-27]
CSW service discovery interfaces should implement the mandatory requirements of OGC 07-045r1 [RD-27].		

4 Current Implementations

This chapter gives an overview of existing implementations: Additional implementations may be added in future versions of this document.

4.1 NASA CMR

Supported Search parameters for Services and Tools include:

- Name
- Type
- Provider
- Native_id
- Concept_id
- Keyword (free text)

Responses are available in XML, JSON and UMM JSON.

For more information, refer to the online documentation at:

- https://cmr.earthdata.nasa.gov/search/site/docs/search/api.html#searching-for-services
- https://cmr.earthdata.nasa.gov/search/site/docs/search/api.html#searching-for-tools
- UMM-Service schema: https://git.earthdata.nasa.gov/projects/EMFD/repos/unified-metadata-model/browse/service
- UMM-Tool schema: https://git.earthdata.nasa.gov/projects/EMFD/repos/unified-metadata-model/browse/tool

Example requests:

- https://cmr.earthdata.nasa.gov/search/services.json?pretty=true
- https://cmr.earthdata.nasa.gov/search/tools.json?pretty=true
- https://cmr.earthdata.nasa.gov/search/services.umm_json?name=OpenDAP&pretty=true
- https://cmr.earthdata.nasa.gov/search/services.umm_json?name=PO.DAAC%20harmony-netcdf-to-zarr&pretty=true
- https://cmr.earthdata.nasa.gov/search/tools.umm_json?name=AppEEARS&pretty=true
- https://cmr.earthdata.nasa.gov/search/tools.umm_json?keyword=CEOS&pretty=true

4.2 ESA FedEO

The operational version of FedEO does currently not support service discovery. An

experimental implementation accessible via OpenSearch, OGC API-Features and STAC interfaces is available at https://eovoc.spacebel.be and https://eovoc.spacebel.be/readme.html.

Supported search parameters for Services and Tools are advertised in the OpenSearch Description Document and OpenAPI definition available at:

- https://eovoc.spacebel.be/api?httpAccept=application/opensearchdescription%2Bxml
- https://eovoc.spacebel.be/api?httpAccept=application/openapi%2Bjson;version=3.0
- https://petstore.swagger.io/?url=https://eovoc.spacebel.be/api

They include:

- dc:title
- eo:organisationName
- eo:platform
- eo:offering
- geo:uid
- semantic:classifiedAs (e.g. tool or service category URI)
- dc:subject (keywords)
- searchTerms (free text)

Responses are available in:

- GeoJSON (OGC 19-020r1, OGC 17-069r3)
- XML (ISO19139, Atom). Additional ISO19139 INSPIRE compliant and ISO19115-3 responses are planned.
- JSON-LD (schema.org, GeoDCAT-AP).
- RDF/XML (schema.org, GeoDCAT-AP).
- Turtle (schema.org, GeoDCAT-AP).
- HTML (including schema.org annotations)

Example requests:

- https://eovoc.spacebel.be/collections/services/items?httpAccept=text/html
- https://eovoc.spacebel.be/collections/services/items/OPeNDAP?mode=owc (Service)
- https://eovoc.spacebel.be/collections/services/items/harmony-netcdf-to-zarr?mode=owc (Service)
- https://eovoc.spacebel.be/collections/services/items/appeears?mode=owc (Tool)
- https://eovoc.spacebel.be/collections/services/items/eo-pdgs-landsat-datacube?mode=owc (DataCube with WCS interfaces)
- https://eovoc.spacebel.be/collections/services/items/coastline-classifier?mode=owc (Jupyter Notebook)

The HTML representation lists all alternative representations available:

- https://eovoc.spacebel.be/collections/services/items/appeears?httpAccept=text/html
- https://eovoc.spacebel.be/collections/services/items?httpAccept=text/html

The above interfaces are expected to be supported in the operational ESA FedEO and/or EOCAT Catalog in 2023.

Annex A: SERVICE AND TOOL METADATA ELEMENTS

This appendix gives an overview of the main service metadata elements required by the relevant INSPIRE Technical Guidance [RD-6], ISO 19115-1 [RD-2], UMM-Service [RD-4], UMM-Tool [RD-5] and DataCite [RD-20] metadata models.

ISO19115-1 [RD-2] §F.3[23]	*UMM-S [RD-4] §D.2.2*[24]	*INSPIRE [RD-6] § C.1.2*	*INSPIRE MD TG [RD-6]*	*UMM-T [RD-5]*	*GeoDCAT-AP [RD-10] Annex B*	*DataCite (Software) [RD-20]*[25]	*CEOS Best Practice / Recommendation*
Metadata reference information (O/1)	Name [R] - §2.2.1	File identifier	TG Recommendation C.1	Name [R] – (F.2.2.1)	Metadata file identifier – B.6.17	Identifier (1) [M]	SRV-BP-0003
Resource Identifier (O/N)				DOI (F.2.2.9)	Unique resource identifier – B.6.5	Identifier (1) [M]	SRV-BP-0007
Resource Title (M/1)	LongName [R] - §2.2.2	B1.1 Resource Title (Mandatory)	TG Requirement C.8	LongName [R] – (F.2.2.2)	Resource title – B.6.1	Title (3) [M]	SRV-BP-0005
Resource type (M/1)		B1.3 Resource Type (Mandatory) – fixed value.	TG Requirement 3.1		Resource type – B.6.3	ResourceType (10) [M]	
	Type [R] with valid values from KMS - §2.2.3	B2.2 Spatial data service type (Mandatory) B3.1 Keyword	TG Requirement 3.5, TG Requirement 4.1, TG Requirement 5.1	Type [R] with valid values from KMS. (F.2.2.3)	Spatial data service type – B.6.9	ResourceType (10) [M] Subject (6) [R]	SRV-BP-0001 SRV-BP-4005

[23] ISO19115-1 obligations: [M]=Mandatory, [O]=Optional
[24] UMM-S and UMM-T obligations: [R]=Required (Mandatory).
[25] DataCite obligations: [M]=Mandatory, [R]=Recommended, [O]=Optional

ISO19115-1 [RD-2] §F.3[23]	*UMM-S [RD-4] §D.2.2[24]*	*INSPIRE [RD-6] § C.1.2*	*INSPIRE MD TG [RD-6]*	*UMM-T [RD-5]*	*GeoDCAT-AP [RD-10] Annex B*	*DataCite (Software) [RD-20][25]*	*CEOS Best Practice / Recommendation*
		value (Mandatory) B1 Category (Conditional)	TG Requirement 3.4 TG Requirement 3.4, TG Requirement 5.4				
	Version [R] - §2.2.4			Version [R] – (F.2.2.4)		Version (15) [O]	SRV-BP-0016
	VersionDescription - §2.2.5						SRV-BP-0017
Reference Date (O/1)	LastUpdatedDate - §2.2.6	D5.3 Temporal reference – Date of last revision (Conditional)	TG Requirement C.11, TG Requirement C.13		Temporal reference and metadata date – B.6.11	Date (8) [R]	SRV-BP-0015
		D5.4 Temporal reference – Date of creation (Conditional)	TG Requirement C.11, TG Requirement C.12		Temporal reference and metadata date – B.6.11	Date (8) [R]	
		D5.2 Temporal reference – Date of	TG Requirement C.11		Temporal reference and metadata	PublicationYear (5) [M]	

ISO19115-1 [RD-2] §F.3[23]	*UMM-S [RD-4] §D.2.2[24]*	*INSPIRE [RD-6] § C.1.2*	*INSPIRE MD TG [RD-6]*	*UMM-T [RD-5]*	*GeoDCAT-AP [RD-10] Annex B*	*DataCite (Software) [RD-20][25]*	*CEOS Best Practice / Recommendation*
		publication (Conditional)			date – B.6.11		
		B5.1 Temporal reference – Temporal extent (Conditional)	TG Requirement C.14				SRV-BP-0081
Resource abstract (M/1)	Description [R] - §2.2.7	B1.2 Resource abstract (Mandatory)	TG Requirement C.9	Description [R] – (F.2.2.5)	Resource abstract - B.6.2	Description (17) [R]	SRV-BP-0014
Online Link (O/N)	URL [R] - §2.2.8	B1.4 Resource locator	TG Requirement 3.7	URL [R] – (F.2.2.8)	Resource locator – B.6.4		SRV-BP-0031
Service topic category (O/N) Keywords (O/N)	ServiceKeywords [R] - §2.2.9 (values from KMS)	B3.1 Keyword value (Mandatory) B3.2 Originating controlled vocabulary (Conditional)	TG Requirement 3.4 TG Requirement C.15	ToolKeyword [R] – (F.2.2.6)	Keyword in services – B.6.8.2	Subject (6) [R]	SRV-BP-4010, SRV-BP-4020, SRV-BP-4030, SRV-BP-0071
	OperationMetadata - §2.2.11	B1.4 Resource	TG Requirement 1.8 (collections and granules),	RelatedURLs (F.2.2.21)			SRV-BP-0032 SRV-BP-0033

ISO19115-1 [RD-2] §F.3[23]	*UMM-S [RD-4] §D.2.2*[24]	*INSPIRE [RD-6] § C.1.2*	*INSPIRE MD TG [RD-6]*	*UMM-T [RD-5]*	*GeoDCAT-AP [RD-10] Annex B*	*DataCite (Software) [RD-20]*[25]	*CEOS Best Practice / Recommendation*
		locator (Conditional) B3 Invocation metadata (Conditional)	TG Requirement 3.7 TG Requirement 7.1, TG Requirement 7.2, TG Requirement 7.3	SearchAction (F.2.2.22)			SRV-BP-0051
Coupled Resource (O) Coupled resource type (O)	Coupled Resource - §2.2.11.7	B1.6 Coupled resource (Conditional)	TG Requirement 3.6		Coupled resource – B.6.6	RelatedIdentifier (12) [R]	SRV-BP-0515 SRV-BP-0052
	ServiceOptions - §2.2.10			SupportedOutputFormats (F.2.2.10)			
	ServiceOptions - §2.2.10			SupportedInputFormats (F.2.2.11)			
				SupportedOperatingSystem (F.2.2.12)			
				SupportedBrowsers (F.2.2.13)			
				SupportedSoftwareLanguage (F.2.2.14)			

ISO19115-1 [RD-2] §F.3[23]	*UMM-S [RD-4] §D.2.2*[24]	*INSPIRE [RD-6] § C.1.2*	*INSPIRE MD TG [RD-6]*	*UMM-T [RD-5]*	*GeoDCAT-AP [RD-10] Annex B*	*DataCite (Software) [RD-20]*[25]	*CEOS Best Practice / Recommendation*
Responsible party (O/N)	ServiceOrganizations [R] - §2.2.12 (values from KMS)	B.9 Responsible organization (Mandatory)	TG Requirement C.10	Organizations [R] – (F.2.2.7) (from a controlled vocabulary).	Responsible party and metadata point of contact – B.6.16	Creator (2) [M] Publisher (4) [M] Contributor (7) [R]	SRV-BP-0018
	ContactPersons - §2.2.13			ContactPersons (F.2.2.19)			SRV-BP-0018
	ContactGroups - - §2.2.14			ContactGroups (F.2.2.20)			SRV-BP-0018
	ServiceQuality - §2.2.15	B4 Quality of Service (Conditional)	TG Requirement 6.5	Quality (F.2.2.15)			
Constraints on access and use (O/N)	AccessConstraints - §2.2.16	B8.1 Conditions applying to access and use B8.2 Limitations on public access	TG Requirement C.17	AccessConstraints (F.2.2.16)	Conditions for access and use and limitations … - B.6.15	Rights (16) [O]	SRV-BP-0021
Constraints on access and use (O/N)	UseConstraints - §2.2.17		TG Requirement C.18	UseConstraints (F.2.2.17)	Conditions for access and use and	Rights (16) [O]	SRV-BP-0022 SRV-BP-0023

ISO19115-1 [RD-2] §F.3[23]	*UMM-S [RD-4] §D.2.2*[24]	*INSPIRE [RD-6] § C.1.2*	*INSPIRE MD TG [RD-6]*	*UMM-T [RD-5]*	*GeoDCAT-AP [RD-10] Annex B*	*DataCite (Software) [RD-20]*[25]	*CEOS Best Practice / Recommendation*
			TG Recommendation C.10		limitations … - B.6.15		
	AncillaryKeywords - §2.2.18	B3.1 Keyword value (Mandatory)	TG Requirement 3.4	AncillaryKeywords (F.2.2.18)	Keyword in services – B.6.8.2		SRV-BP-4010, SRV-BP-4020, SRV-BP-4030
Geographic location (M/1)		B4.1 Geographic bounding box (Conditional)	TG Requirement C.19		Geographic bounding box – B.6.10	GeoLocation (18) [R]	SRV-BP-0082
		B6.2 Spatial resolution (Conditional)	TG Requirement 3.3		Spatial resolution – B.6.13		SRV-BP-0019
		B7 Conformity (Mandatory)	TG Requirement C.20, TG Requirement C.22, TG Requirement C.21, TG Requirement 1.10, TG Requirement 5.3, TG Requirement 5.5		Conformity and data quality – B.6.14		SRV-BP-0041

ISO19115-1 [RD-2] §F.3[23]	*UMM-S [RD-4] §D.2.2*[24]	*INSPIRE [RD-6] § C.1.2*	*INSPIRE MD TG [RD-6]*	*UMM-T [RD-5]*	*GeoDCAT-AP [RD-10] Annex B*	*DataCite (Software) [RD-20]*[25]	*CEOS Best Practice / Recommendation*
Metadata point of contact (M/N)		B10.1 Metadata point of contact (Mandatory)	TG Requirement C.6		Responsible party and metadata point of contact – B.6.16		SRV-BP-0061
Metadata date stamp (M/N)		B10.2 Metadata date (Mandatory)	TG Requirement C.7		Temporal reference and metadata date – B.6.11		SRV-BP-0062
		B10.3 Metadata language (Mandatory)	TG Requirement C.5		Resource language and metadata language – B.6.7		SRV-BP-0063
		B3 CRS Identifier (Conditional)	TG Requirement 6.1, TG Requirement 6.2		Coordinate reference systems and temporal reference systems – B.6.23		SRV-BP-0020

Annex B: BEST PRACTICES OVERVIEW PER ENCODING

CEOS Best Practice ID	*CEOS Best Practice Topic*	*ISO19139*	*Atom*	*OGC 19-020r1*	*GeoDCAT-AP*	*Schema.org*	*ISO19115-3*	*UMM-JSON*
SRV-BP-0001	Resource type							
SRV-BP-0003	Resource identifier	SRV-BP-2210	SRV-BP-3210 SRV-BP-3230	SRV-BP-4210 SRV-BP-4230	SRV-BP-5210 SRV-BP-5230	SRV-BP-6210	SRV-BP-7210	SRV-BP-8210
SRV-BP-0005	Resource title	SRV-BP-2210	SRV-BP-3210	SRV-BP-4210	SRV-BP-5210	SRV-BP-6210	SRV-BP-7210	SRV-BP-8210
SRV-BP-0007	DOI	SRV-BP-2220	SRV-BP-3220	SRV-BP-4220	SRV-BP-5220	SRV-BP-6220	SRV-BP-7220	SRV-BP-8220
SRV-BP-0009	DOI and citations							
SRV-BP-0014	Resource abstract	SRV-BP-2210	SRV-BP-3210	SRV-BP-4210	SRV-BP-5210	SRV-BP-6210	SRV-BP-7210	SRV-BP-8210
SRV-BP-0015	Resource last revision date	SRV-BP-2220	SRV-BP-3220	SRV-BP-4220	SRV-BP-5220	SRV-BP-6220	SRV-BP-7220	SRV-BP-8220
SRV-BP-0016	Resource version	SRV-BP-2220		SRV-BP-4220	SRV-BP-5220	SRV-BP-6220	SRV-BP-7220	SRV-BP-8220
SRV-BP-0017	Resource version description	SRV-BP-2220		SRV-BP-4220	SRV-BP-5220		SRV-BP-7220	SRV-BP-8220
SRV-BP-0018	Responsible organization	SRV-BP-2210	SRV-BP-3210	SRV-BP-4210	SRV-BP-5210	SRV-BP-6210	SRV-BP-7210	SRV-BP-8210

CEOS Best Practice ID	*CEOS Best Practice Topic*	*ISO19139*	*Atom*	*OGC 19-020r1*	*GeoDCAT-AP*	*Schema.org*	*ISO19115-3*	*UMM-JSON*
SRV-BP-0019	Spatial resolution	SRV-BP-2230			SRV-BP-5235		SRV-BP-7230	
SRV-BP-0020	CRS	SRV-BP-2240			SRV-BP-5240	SRV-BP-6240	SRV-BP-7240	SRV-BP-8240
SRV-BP-0021	Limitations public access	SRV-BP-2310	SRV-BP-3320	SRV-BP-4310	SRV-BP-5310	SRV-BP-6310	SRV-BP-7310	SRV-BP-8310
SRV-BP-0022	Conditions for access and use	SRV-BP-2320	SRV-BP-3310	SRV-BP-4310	SRV-BP-5310	SRV-BP-6310	SRV-BP-7320	SRV-BP-8320
SRV-BP-0023	Licenses	SRV-BP-2330	SRV-BP-3310	SRV-BP-4310	SRV-BP-5310	SRV-BP-6310	SRV-BP-7330	SRV-BP-8330
SRV-BP-0031	Resource URL	SRV-BP-2410	SRV-BP-3410 SRV-BP-3415	SRV-BP-4410 SRV-BP-4415	SRV-BP-5410 SRV-BP-5415	SRV-BP-6410 SRV-BP-6415	SRV-BP-7410	SRV-BP-8410 SRV-BP-8415
SRV-BP-0032	Access points	SRV-BP-2420	SRV-BP-3420	SRV-BP-4420	SRV-BP-5420	SRV-BP-6420	SRV-BP-7420	
SRV-BP-0033	No online access	SRV-BP-2430	SRV-BP-3430	SRV-BP-4430	SRV-BP-5430	SRV-BP-6430	SRV-BP-7430	SRV-BP-8430
SRV-BP-0041	Technical specification	SRV-BP-2510	SRV-BP-3510	SRV-BP-4510	SRV-BP-5510	SRV-BP-6510	SRV-BP-7510	
SRV-BP-0051	Resource locator		SRV-BP-3610					
SRV-BP-0052	Coupled resource	SRV-BP-2610 SRV-BP-2620	SRV-BP-3620	SRV-BP-4610	SRV-BP-5610		SRV-BP-7620	SRV-BP-8620
SRV-BP-0061	Metadata point of contact	SRV-BP-2710		SRV-BP-4710	SRV-BP-5710	SRV-BP-6710	SRV-BP-7710	SRV-BP-8710

CEOS Best Practice ID	*CEOS Best Practice Topic*	*ISO19139*	*Atom*	*OGC 19-020r1*	*GeoDCAT-AP*	*Schema.org*	*ISO19115-3*	*UMM-JSON*
SRV-BP-0062	Last update date of metadata	SRV-BP-2710	SRV-BP-3710	SRV-BP-4710	SRV-BP-5710	SRV-BP-6710	SRV-BP-7710	SRV-BP-8710
SRV-BP-0063	Metadata language	SRV-BP-2710	SRV-BP-3710	SRV-BP-4710	SRV-BP-5710	SRV-BP-6710	SRV-BP-7710	
SRV-BP-0071	Resource keywords	SRV-BP-2810	SRV-BP-3810	SRV-BP-4810	SRV-BP-5810	SRV-BP-6810	SRV-BP-7810	SRV-BP-8810
SRV-BP-0081	Temporal extent	SRV-BP-2910	SRV-BP-3910	SRV-BP-4910	SRV-BP-5910	SRV-BP-6910	SRV-BP-7910	SRV-BP-8910
SRV-BP-0082	Geographical extent	SRV-BP-2920	SRV-BP-3920	SRV-BP-4920	SRV-BP-5920	SRV-BP-6920	SRV-BP-7920	SRV-BP-8920
SRV-BP-0910	Metadata formats	SRV-BP-2105 SRV-BP-2110						
SRV-BP-0402	Multiple vocabularies							
SRV-BP-0403	Keyword information							
SRV-BP-0411	Service and Tool type							
SRV-BP-0412	Service and Tool type keywords							
SRV-BP-0413	Resource type							

CEOS Best Practice ID	*CEOS Best Practice Topic*	*ISO19139*	*Atom*	*OGC 19-020r1*	*GeoDCAT-AP*	*Schema.org*	*ISO19115-3*	*UMM-JSON*
SRV-BP-0414	Spatial Data Service type							
SRV-BP-0415	Protocol type							
SRV-BP-0416	Spatial Data Service Category							
SRV-BP-0421	Science keywords							
SRV-BP-0431	Platform names							
SRV-BP-0441	Instrument names							
SRV-BP-0451	Organization names					SRV-BP-0452		
SRV-BP-0511	Service bindings							
SRV-BP-0512	Search parameters							
SRV-BP-0513	Hyperlink media relations							
SRV-BP-0514	Hyperlink media types							

CEOS Best Practice ID	*CEOS Best Practice Topic*	*ISO19139*	*Atom*	*OGC 19-020r1*	*GeoDCAT-AP*	*Schema.org*	*ISO19115-3*	*UMM-JSON*
SRV-BP-0515	Coupled resources							

Annex C: EXAMPLES

The current section includes complete examples for each of the proposed metadata encodings.

C.1 ISO19139

Example 90: Complete example (ISO19139)

```
<?xml version="1.0" encoding="UTF-8"?>
<gmd:MD_Metadata xmlns:gmd="http://www.isotc211.org/2005/gmd"
xmlns:gco="http://www.isotc211.org/2005/gco" xmlns:gmi="http://www.isotc211.org/2005/gmi"
xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:gmx="http://www.isotc211.org/2005/gmx"
xmlns:srv="http://www.isotc211.org/2005/srv" xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.isotc211.org/2005/gmd ./apiso-inspire.xsd">
   <gmd:fileIdentifier>
      <gco:CharacterString>eo-pdgs-landsat-datacube</gco:CharacterString>
   </gmd:fileIdentifier>
   <gmd:language>
      <gmd:LanguageCode codeList="http://www.loc.gov/standards/iso639-2/" codeListValue="eng"/>
   </gmd:language>
   <gmd:hierarchyLevel>
      <gmd:MD_ScopeCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/co
delist/ML_gmxCodelists.xml#MD_ScopeCode" codeListValue="service">service</gmd:MD_ScopeCode>
   </gmd:hierarchyLevel>
   <gmd:hierarchyLevelName>
      <gco:CharacterString>Service</gco:CharacterString>
   </gmd:hierarchyLevelName>
   <gmd:contact>
      <gmd:CI_ResponsibleParty>
         <gmd:organisationName>
            <gco:CharacterString>ESA/ESRIN</gco:CharacterString>
         </gmd:organisationName>
         <gmd:contactInfo>
            <gmd:CI_Contact>
               <gmd:phone>
                  <gmd:CI_Telephone>
                     <gmd:voice>
                        <gco:CharacterString>tel:+39 06 94180777</gco:CharacterString>
                     </gmd:voice>
                  </gmd:CI_Telephone>
               </gmd:phone>
               <gmd:address>
                  <gmd:CI_Address>
                     <gmd:deliveryPoint>
                        <gco:CharacterString>Via Galileo Galilei CP. 64</gco:CharacterString>
                     </gmd:deliveryPoint>
                     <gmd:city>
                        <gco:CharacterString>Frascati</gco:CharacterString>
                     </gmd:city>
                     <gmd:postalCode>
                        <gco:CharacterString>00044</gco:CharacterString>
                     </gmd:postalCode>
                     <gmd:country>
                        <gco:CharacterString>Italy</gco:CharacterString>
                     </gmd:country>
                     <gmd:electronicMailAddress>
                        <gco:CharacterString>eohelp@eo.esa.int</gco:CharacterString>
                     </gmd:electronicMailAddress>
                  </gmd:CI_Address>
               </gmd:address>
               <gmd:onlineResource>
                  <gmd:CI_OnlineResource>
```

```
                     <gmd:linkage>
                        <gmd:URL>https://earth.esa.int</gmd:URL>
                     </gmd:linkage>
                  </gmd:CI_OnlineResource>
               </gmd:onlineResource>
            </gmd:CI_Contact>
         </gmd:contactInfo>
         <gmd:role>
            <gmd:CI_RoleCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/co
delist/ML_gmxCodelists.xml#CI_RoleCode"
codeListValue="pointOfContact">pointOfContact</gmd:CI_RoleCode>
         </gmd:role>
      </gmd:CI_ResponsibleParty>
   </gmd:contact>
   <gmd:dateStamp>
      <gco:DateTime>2019-05-15T09:00:00</gco:DateTime>
   </gmd:dateStamp>
   <gmd:metadataStandardName>
      <gco:CharacterString>ISO19115</gco:CharacterString>
   </gmd:metadataStandardName>
   <gmd:metadataStandardVersion>
      <gco:CharacterString>2005/Cor.1:2006</gco:CharacterString>
   </gmd:metadataStandardVersion>
   <gmd:identificationInfo>
      <srv:SV_ServiceIdentification>
         <gmd:citation>
            <gmd:CI_Citation>
               <gmd:title>
                  <gco:CharacterString>Landsat DataCube</gco:CharacterString>
               </gmd:title>
               <gmd:date>
                  <gmd:CI_Date>
                     <gmd:date>
                        <gco:Date>2019-05-15</gco:Date>
                     </gmd:date>
                     <gmd:dateType>
                        <gmd:CI_DateTypeCode
codeList="http://standards.iso.org/iso/19139/resources/gmxCodelists.xml#CI_DateTypeCode"
codeListValue="creation">Creation</gmd:CI_DateTypeCode>
                     </gmd:dateType>
                  </gmd:CI_Date>
               </gmd:date>
               <gmd:edition>
                  <gco:CharacterString>1.0</gco:CharacterString>
               </gmd:edition>
               <gmd:identifier>
                  <gmd:RS_Identifier>
                     <gmd:code>
                        <gco:CharacterString>eo-pdgs-landsat-datacube</gco:CharacterString>
                     </gmd:code>
                  </gmd:RS_Identifier>
               </gmd:identifier>
               <gmd:otherCitationDetails>
                  <gco:CharacterString>EO PDGS Landsat DataCube. (2020), European Space
Agency.</gco:CharacterString>
               </gmd:otherCitationDetails>
            </gmd:CI_Citation>
         </gmd:citation>
         <gmd:abstract>
            <gco:CharacterString>ESA PDGS-DataCube enables multi-temporal and pixel-based access
to a subset of the data available in the European Space Agency dissemination services, including
Heritage Missions (HM), Third-Party Missions (TPM) and Earth Explorer (EE)
data.</gco:CharacterString>
         </gmd:abstract>
         <gmd:pointOfContact>
            <gmd:CI_ResponsibleParty>
               <gmd:organisationName>
                  <gco:CharacterString>ESA/ESRIN</gco:CharacterString>
               </gmd:organisationName>
               <gmd:contactInfo>
```

```
                  <gmd:CI_Contact>
                     <gmd:phone>
                        <gmd:CI_Telephone>
                           <gmd:voice>
                              <gco:CharacterString>tel:+39 06 94180777</gco:CharacterString>
                           </gmd:voice>
                        </gmd:CI_Telephone>
                     </gmd:phone>
                     <gmd:address>
                        <gmd:CI_Address>
                           <gmd:deliveryPoint>
                              <gco:CharacterString>Via Galileo Galilei CP.
64</gco:CharacterString>
                           </gmd:deliveryPoint>
                           <gmd:city>
                              <gco:CharacterString>Frascati</gco:CharacterString>
                           </gmd:city>
                           <gmd:postalCode>
                              <gco:CharacterString>00044</gco:CharacterString>
                           </gmd:postalCode>
                           <gmd:country>
                              <gco:CharacterString>Italy</gco:CharacterString>
                           </gmd:country>
                           <gmd:electronicMailAddress>
                              <gco:CharacterString>eohelp@eo.esa.int</gco:CharacterString>
                           </gmd:electronicMailAddress>
                        </gmd:CI_Address>
                     </gmd:address>
                     <gmd:onlineResource>
                        <gmd:CI_OnlineResource>
                           <gmd:linkage>
                              <gmd:URL>https://earth.esa.int</gmd:URL>
                           </gmd:linkage>
                        </gmd:CI_OnlineResource>
                     </gmd:onlineResource>
                  </gmd:CI_Contact>
               </gmd:contactInfo>
               <gmd:role>
                  <gmd:CI_RoleCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/co
delist/ML_gmxCodelists.xml#CI_RoleCode" codeListValue="originator">originator</gmd:CI_RoleCode>
               </gmd:role>
            </gmd:CI_ResponsibleParty>
         </gmd:pointOfContact>
         <gmd:descriptiveKeywords>
            <gmd:MD_Keywords>
               <gmd:keyword>
                  <gmx:Anchor xlink:href="https://earth.esa.int/concept/landsat-7">Landsat-
7</gmx:Anchor>
               </gmd:keyword>
               <gmd:keyword>
                  <gmx:Anchor xlink:href="https://earth.esa.int/concept/landsat-8">Landsat-
8</gmx:Anchor>
               </gmd:keyword>
               <gmd:type>
                  <gmd:MD_KeywordTypeCode
codeList="http://www.isotc211.org/2005/resources/codeList.xml#MD_KeywordTypeCode"
codeListValue="theme"/>
               </gmd:type>
               <gmd:thesaurusName>
                  <gmd:CI_Citation>
                     <gmd:title>
                        <gmx:Anchor
xlink:href="https://earth.esa.int/concepts/concept_scheme/platforms">EO Parameter Code List -
Platforms</gmx:Anchor>
                     </gmd:title>
                     <gmd:date>
                        <gmd:CI_Date>
                           <gmd:date>
                              <gco:Date>2018</gco:Date>
                           </gmd:date>
```

```
                        <gmd:dateType>
                           <gmd:CI_DateTypeCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/co
delist/ML_gmxCodelists.xml#CI_DateTypeCode"
codeListValue="publication">publication</gmd:CI_DateTypeCode>
                        </gmd:dateType>
                     </gmd:CI_Date>
                  </gmd:date>
                  <gmd:identifier>
                     <gmd:MD_Identifier>
                        <gmd:code>
                           <gco:CharacterString/>
                        </gmd:code>
                     </gmd:MD_Identifier>
                  </gmd:identifier>
               </gmd:CI_Citation>
            </gmd:thesaurusName>
         </gmd:MD_Keywords>
      </gmd:descriptiveKeywords>
      <gmd:descriptiveKeywords>
         <gmd:MD_Keywords>
            <gmd:keyword>
               <gmx:Anchor xlink:href="http://inspire.ec.europa.eu/metadata-
codelist/SpatialDataServiceCategory/infoCoverageAccessService">infoCoverageAccessService</gmx:Anc
hor>
            </gmd:keyword>
            <gmd:thesaurusName>
               <gmd:CI_Citation>
                  <gmd:title>
                     <gco:CharacterString>COMMISSION REGULATION (EC) No 1205/2008 of 3
December 2008 implementing Directive 2007/2/EC of the European Parliament and of the Council as
regards metadata, Part D 4, Classification of Spatial Data Services</gco:CharacterString>
                  </gmd:title>
                  <gmd:date>
                     <gmd:CI_Date>
                        <gmd:date>
                           <gco:Date>2008-12-03</gco:Date>
                        </gmd:date>
                        <gmd:dateType>
                           <gmd:CI_DateTypeCode
codeList="http://standards.iso.org/iso/19139/resources/gmxCodelists.xml#CI_DateTypeCode"
codeListValue="publication"/>
                        </gmd:dateType>
                     </gmd:CI_Date>
                  </gmd:date>
               </gmd:CI_Citation>
            </gmd:thesaurusName>
         </gmd:MD_Keywords>
      </gmd:descriptiveKeywords>
      <gmd:resourceConstraints>
         <gmd:MD_LegalConstraints>
            <gmd:useConstraints>
               <gmd:MD_RestrictionCode
codeList="http://standards.iso.org/iso/19139/resources/gmxCodelists.xml#MD_RestrictionCode"
codeListValue="otherRestrictions"/>
            </gmd:useConstraints>
            <gmd:otherConstraints>
               <gmx:Anchor xlink:href="http://inspire.ec.europa.eu/metadata-
codelist/ConditionsApplyingToAccessAndUse/noConditionsApply">No conditions apply to access and
use</gmx:Anchor>
            </gmd:otherConstraints>
         </gmd:MD_LegalConstraints>
      </gmd:resourceConstraints>
      <gmd:resourceConstraints>
         <gmd:MD_LegalConstraints>
            <gmd:accessConstraints>
               <gmd:MD_RestrictionCode
codeList="http://standards.iso.org/iso/19139/resources/gmxCodelists.xml#MD_RestrictionCode"
codeListValue="otherRestrictions"/>
            </gmd:accessConstraints>
            <gmd:otherConstraints>
```

```
                  <gmx:Anchor xlink:href="http://inspire.ec.europa.eu/metadata-
codelist/LimitationsOnPublicAccess/noLimitations">no limitations to public access.</gmx:Anchor>
               </gmd:otherConstraints>
            </gmd:MD_LegalConstraints>
         </gmd:resourceConstraints>
         <srv:serviceType>
            <gco:LocalName codeSpace="http://inspire.ec.europa.eu/metadata-
codelist/SpatialDataServiceType">other</gco:LocalName>
         </srv:serviceType>
         <srv:extent>
            <gmd:EX_Extent>
               <gmd:temporalElement>
                  <gmd:EX_TemporalExtent>
                     <gmd:extent>
                        <gml:TimePeriod gml:id="IDcd3b1c4f-b5f7-439a-afc4-3317a4cd89be">
                           <gml:beginPosition>2019-04-29</gml:beginPosition>
                           <gml:endPosition indeterminatePosition="now"/>
                        </gml:TimePeriod>
                     </gmd:extent>
                  </gmd:EX_TemporalExtent>
               </gmd:temporalElement>
            </gmd:EX_Extent>
         </srv:extent>
         <srv:extent>
            <gmd:EX_Extent>
               <gmd:geographicElement>
                  <gmd:EX_GeographicBoundingBox>
                     <gmd:westBoundLongitude>
                        <gco:Decimal>-180.0</gco:Decimal>
                     </gmd:westBoundLongitude>
                     <gmd:eastBoundLongitude>
                        <gco:Decimal>180.0</gco:Decimal>
                     </gmd:eastBoundLongitude>
                     <gmd:southBoundLatitude>
                        <gco:Decimal>-90.0</gco:Decimal>
                     </gmd:southBoundLatitude>
                     <gmd:northBoundLatitude>
                        <gco:Decimal>90.0</gco:Decimal>
                     </gmd:northBoundLatitude>
                  </gmd:EX_GeographicBoundingBox>
               </gmd:geographicElement>
            </gmd:EX_Extent>
         </srv:extent>
         <srv:couplingType gco:nilReason="missing"/>
         <srv:containsOperations gco:nilReason="missing"/>
         <srv:operatesOn xlink:href="
https://cat.ceos.org/collections/series/items/LANDSAT.ETM.GTC?httpAccept=application/vnd.iso.1913
9-2%2Bxml#LANDSAT.ETM.GTC"/>
      </srv:SV_ServiceIdentification>
   </gmd:identificationInfo>
   <gmd:distributionInfo>
      <gmd:MD_Distribution>
         <gmd:transferOptions>
            <gmd:MD_DigitalTransferOptions>
               <gmd:onLine>
                  <gmd:CI_OnlineResource>
                     <gmd:linkage>

   <gmd:URL>https://datacube.pdgs.eo.esa.int/wcs?service=WCS&amp;Request=DescribeCoverage&amp;ver
sion=2.0.0&amp;CoverageId=LE7_RGB</gmd:URL>
                     </gmd:linkage>
                     <gmd:protocol>
                        <gco:CharacterString>OGC:WCS:DescribeCoverage</gco:CharacterString>
                     </gmd:protocol>
                     <gmd:description>
                        <gmx:Anchor xlink:href="http://inspire.ec.europa.eu/metadata-
codelist/OnLineDescriptionCode/accessPoint">accessPoint</gmx:Anchor>
                     </gmd:description>
                     <gmd:function>
```

```
                        <gmd:CI_OnLineFunctionCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/co
delist/ML_gmxCodelists.xml#CI_OnLineFunctionCode" codeListValue="information"/>
                     </gmd:function>
                  </gmd:CI_OnlineResource>
               </gmd:onLine>
               <gmd:onLine>
                  <gmd:CI_OnlineResource>
                     <gmd:linkage>

   <gmd:URL>https://datacube.pdgs.eo.esa.int/wcs?service=WCS&amp;Request=GetCapabilities&amp;vers
ion=2.0.0</gmd:URL>
                     </gmd:linkage>
                     <gmd:protocol>
                        <gmx:Anchor
xlink:href="http://www.opengis.net/def/serviceType/ogc/wcs/2.0">
          OGC:WCS:GetCapabilities
      </gmx:Anchor>
                     </gmd:protocol>
                     <gmd:description>
                        <gmx:Anchor xlink:href="http://inspire.ec.europa.eu/metadata-
codelist/OnLineDescriptionCode/accessPoint">accessPoint</gmx:Anchor>
                     </gmd:description>
                     <gmd:function>
                        <gmd:CI_OnLineFunctionCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/co
delist/ML_gmxCodelists.xml#CI_OnLineFunctionCode" codeListValue="information"/>
                     </gmd:function>
                  </gmd:CI_OnlineResource>
               </gmd:onLine>
            </gmd:MD_DigitalTransferOptions>
         </gmd:transferOptions>
      </gmd:MD_Distribution>
   </gmd:distributionInfo>
   <gmd:dataQualityInfo>
      <gmd:DQ_DataQuality>
         <gmd:scope>
            <gmd:DQ_Scope>
               <gmd:level>
                  <gmd:MD_ScopeCode
codeList="http://standards.iso.org/iso/19139/resources/gmxCodelists.xml#MD_ScopeCode"
codeListValue="service"/>
               </gmd:level>
               <gmd:levelDescription>
                  <gmd:MD_ScopeDescription>
                     <gmd:other>
                        <gco:CharacterString>Service</gco:CharacterString>
                     </gmd:other>
                  </gmd:MD_ScopeDescription>
               </gmd:levelDescription>
            </gmd:DQ_Scope>
         </gmd:scope>
         <gmd:report>
            <gmd:DQ_DomainConsistency>
               <gmd:result>
                  <gmd:DQ_ConformanceResult>
                     <gmd:specification>
                        <gmd:CI_Citation>
                           <gmd:title>
                              <gmx:Anchor
xlink:href="http://data.europa.eu/eli/reg/2010/1089">COMMISSION REGULATION (EU) No 1089/2010 of
23 November 2010 implementing Directive 2007/2/EC of the European Parliament and of the Council
as regards interoperability of spatial data sets and services</gmx:Anchor>
                           </gmd:title>
                           <gmd:date>
                              <gmd:CI_Date>
                                 <gmd:date>
                                    <gco:Date>2010-12-08</gco:Date>
                                 </gmd:date>
                                 <gmd:dateType>
```

```
                                    <gmd:CI_DateTypeCode
codeList="http://standards.iso.org/iso/19139/resources/gmxCodelists.xml#CI_DateTypeCode"
codeListValue="publication">publication</gmd:CI_DateTypeCode>
                                 </gmd:dateType>
                              </gmd:CI_Date>
                           </gmd:date>
                        </gmd:CI_Citation>
                     </gmd:specification>
                     <gmd:explanation>
                        <gco:CharacterString>This data set is conformant with the INSPIRE
Implementing Rules for the interoperability of spatial data sets and
services</gco:CharacterString>
                     </gmd:explanation>
                     <gmd:pass>
                        <gco:Boolean>true</gco:Boolean>
                     </gmd:pass>
                  </gmd:DQ_ConformanceResult>
               </gmd:result>
            </gmd:DQ_DomainConsistency>
         </gmd:report>
         <gmd:report>
            <gmd:DQ_DomainConsistency>
               <gmd:result>
                  <gmd:DQ_ConformanceResult>
                     <gmd:specification>
                        <gmd:CI_Citation>
                           <gmd:title>
                              <gmx:Anchor xlink:href="
http://inspire.ec.europa.eu/id/ats/metadata/2.0/sds-invocable" xlink:title="INSPIRE Invocable
Spatial Data Services metadata">invocable</gmx:Anchor>
                           </gmd:title>
                           <gmd:date>
                              <gmd:CI_Date>
                                 <gmd:date>
                                    <gco:Date>2016-05-01</gco:Date>
                                 </gmd:date>
                                 <gmd:dateType>
                                    <gmd:CI_DateTypeCode
codeList="http://standards.iso.org/iso/19139/resources/gmxCodelists.xml#CI_DateTypeCode"
codeListValue="publication">publication</gmd:CI_DateTypeCode>
                                 </gmd:dateType>
                              </gmd:CI_Date>
                           </gmd:date>
                        </gmd:CI_Citation>
                     </gmd:specification>
                     <gmd:explanation>
                        <gco:CharacterString>This Spatial Data Service set is conformant with the
INSPIRE requirements for Invocable Spatial Data Services</gco:CharacterString>
                     </gmd:explanation>
                     <gmd:pass>
                        <gco:Boolean>true</gco:Boolean>
                     </gmd:pass>
                  </gmd:DQ_ConformanceResult>
               </gmd:result>
            </gmd:DQ_DomainConsistency>
         </gmd:report>
         <gmd:report>
            <gmd:DQ_DomainConsistency>
               <gmd:result>
                  <gmd:DQ_ConformanceResult>
                     <gmd:specification>
                        <gmd:CI_Citation>
                           <gmd:title>
                              <gmx:Anchor xlink:href="http://docs.opengeospatial.org/is/17-
089r1/17-089r1.html">OGC Web Coverage Service 2.0</gmx:Anchor>
                           </gmd:title>
                           <gmd:date>
                              <gmd:CI_Date>
                                 <gmd:date>
                                    <gco:Date>2010-10-27</gco:Date>
                                 </gmd:date>
```

```
                                    <gmd:dateType>
                                       <gmd:CI_DateTypeCode
codeList="http://standards.iso.org/iso/19139/resources/gmxCodelists.xml#CI_DateTypeCode"
codeListValue="publication">publication</gmd:CI_DateTypeCode>
                                    </gmd:dateType>
                                 </gmd:CI_Date>
                              </gmd:date>
                           </gmd:CI_Citation>
                        </gmd:specification>
                        <gmd:explanation>
                           <gco:CharacterString>This Spatial Data Service is conformant with the OGC
Web Coverage Service 2.0 specification</gco:CharacterString>
                        </gmd:explanation>
                        <gmd:pass>
                           <gco:Boolean>true</gco:Boolean>
                        </gmd:pass>
                     </gmd:DQ_ConformanceResult>
                  </gmd:result>
               </gmd:DQ_DomainConsistency>
            </gmd:report>
         </gmd:DQ_DataQuality>
      </gmd:dataQualityInfo>
</gmd:MD_Metadata>
```

C.2 Atom

Example 91: Complete example (Atom)

```
<?xml version="1.0" encoding="UTF-8"?>
<atom:feed xmlns:atom="http://www.w3.org/2005/Atom" xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:eo="http://a9.com/-/opensearch/extensions/eo/1.0/" xmlns:geo="http://a9.com/-
/opensearch/extensions/geo/1.0/" xmlns:georss="http://www.georss.org/georss"
xmlns:os="http://a9.com/-/spec/opensearch/1.1/" xmlns:owc="http://www.opengis.net/owc/1.0"
xmlns:referrer="http://a9.com/-/opensearch/extensions/referrer/1.0/"
xmlns:semantic="http://a9.com/-/opensearch/extensions/semantic/1.0/" xmlns:sru="http://a9.com/-
/opensearch/extensions/sru/2.0/" xmlns:time="http://a9.com/-/opensearch/extensions/time/1.0/">
   <atom:entry>
      <atom:id>https://cat.ceos.org/collections/services/items/eo-pdgs-landsat-
datacube?httpAccept=application/atom%2Bxml</atom:id>
      <atom:link href="https://cat.ceos.org/collections/services/items/eo-pdgs-landsat-
datacube?httpAccept=application/atom%2Bxml" rel="alternate" title="Atom format"
type="application/atom+xml"/>
      <atom:link href="https://cat.ceos.org/collections/services/items/eo-pdgs-landsat-
datacube?httpAccept=application/vnd.iso.19139-2%2Bxml" rel="via" title="ISO19139 format"
type="application/vnd.iso.19139%2Bxml"/>
      <atom:link
href="https://cat.ceos.org/collections/series/items/LANDSAT.ETM.GTC?httpAccept=application/vnd.is
o.19139-2%2Bxml" rel="related" title="ISO19139 format" type="application/vnd.iso.19139-2%2Bxml"/>
      <atom:category label="EARTH SCIENCE SERVICES &gt; DATA MANAGEMENT/DATA HANDLING &gt; DATA
ACCESS/RETRIEVAL" term="https://gcmd.earthdata.nasa.gov/kms/concept/86cbb2d3-6783-4d9b-9dc1-
b0aea78f98ea"/>
      <atom:category label="OGC Web Coverage Service 2.0"
term="http://www.opengis.net/def/serviceType/ogc/wcs/2.0"/>
      <atom:category label="Landsat-7" term="https://earth.esa.int/concept/landsat-7"/>
      <atom:category label="Landsat-8" term="https://earth.esa.int/concept/landsat-8"/>
      <atom:summary type="html"><![CDATA[<table>
</table>
]]></atom:summary>
      <atom:content type="text">The ESA PDGS-DataCube enables multi-temporal and pixel-based
access to a subset of the data available in the European Space Agency dissemination services,
including Heritage Missions (HM), Third-Party Missions (TPM) and Earth Explorer (EE)
data.</atom:content>
      <atom:title>Landsat DataCube</atom:title>
      <atom:updated>2021-09-24T12:10:29Z</atom:updated>
      <dc:identifier>eo-pdgs-landsat-datacube</dc:identifier>
```

```
      <dc:date>2020-09-29T12:00:00.000Z/</dc:date>
      <owc:offering code="http://www.opengis.net/spec/owc-atom/1.0/req/wcs">
         <owc:operation code="DescribeCoverage"
href="https://datacube.pdgs.eo.esa.int/wcs?service=WCS&amp;Request=DescribeCoverage&amp;version=2
.0.0&amp;CoverageId=LE7_RGB"/>
         <owc:operation code="GetCapabilities"
href="https://datacube.pdgs.eo.esa.int/wcs?service=WCS&amp;Request=GetCapabilities&amp;version=2.
0.0"/>
      </owc:offering>
   </atom:entry>
</atom:feed>
```

C.3 OGC 19-020r1

Example 92: Complete example (OGC 19-020r1)

```
{
   "geometry": null,
   "id": " https://cat.ceos.org/collections/services/items/rasdaman",
   "type": "Feature",
   "properties": {
      "identifier": "rasdaman",
      "kind": "http://purl.org/dc/dcmitype/Service",
      "title": "rasdaman - raster data manager",
      "doi": "10.5281/zenodo.1040170",
      "bibliographicCitation": "Peter Baumann, email: p.baumann@jacobs-university.de, & website:
rasdaman.org. (2018, January 31). rasdaman - raster data manager (Version 9.5.0). Zenodo.
http://doi.org/10.5281/zenodo.1163021",
      "abstract": "Rasdaman (raster data manager) is an open source array database system, which
provides flexible, fast, scalable geo services for multi-dimensional spatio-temporal sensor,
image, simulation, and statistics data of unlimited volume. ... data with all geo data in the
PostgreSQL database, support for the raster-relevant OGC standards, Reference Implementation for
WCS Core and WCPS.",
      "versionInfo": "9.5",
      "updated": "2018-01-31T00:00:55.511Z",
      "lang": "en",
      "isPrimaryTopicOf": {
         "created": "2021-10-20T16:12:55.511Z",
         "type": "CatalogRecord",
         "lang": "en",
         "updated": "2021-10-20T16:12:55.511Z",
         "contactPoint": [
            {
               "type": "Organization",
               "name": "Committee on Earth Observation Satellites",
               "uri": "https://ceos.org"
            }
         ]
      },
      "contactPoint": [
         {
            "type": "Organization",
            "name": "rasdaman GmbH",
            "uri": "http://rasdaman.org"
         }
      ],
      "categories": [
         {
            "scheme":
"https://gcmd.earthdata.nasa.gov/kms/concepts/concept_scheme/sciencekeywords",
            "term": "https://gcmd.earthdata.nasa.gov/kms/concept/86cbb2d3-6783-4d9b-9dc1-
b0aea78f98ea",
            "label": "EARTH SCIENCE SERVICES > DATA MANAGEMENT/DATA HANDLING > DATA
ACCESS/RETRIEVAL"
         },
```

```
            {
               "scheme": "https://inspire.ec.europa.eu/metadata-codelist/ProtocolValue",
               "term": "http://www.opengis.net/def/serviceType/ogc/wcs/2.0",
               "label": "OGC Web Coverage Service 2.0"
            },
            {
               "scheme": "http://inspire.ec.europa.eu/metadata-codelist/SpatialDataServiceCategory",
               "term": "https://inspire.ec.europa.eu/metadata-
codelist/SpatialDataServiceCategory/infoCoverageAccessService",
               "label": "Coverage access service"
            }
         ],
         "keyword": [
            "Big Data",
            "arrays",
            "raster data",
            "OGC",
            "WMS",
            "WCS",
            "WCS-T",
            "WCPS",
            "fast",
            "scalable",
            "flexible",
            "open standards",
            "free",
            "cost-efficient",
            "sensor",
            "image",
            "simulation",
            "statistics data"
         ],
         "offerings": [
            {
               "type": "Offering",
               "code": "http://www.opengis.net/spec/eopad-geojson/1.0/req/docker/image",
               "contents": [
                  {
                     "type": "text/plain",
                     "content": "arpasmr/rasdaman:latest"
                  }
               ]
            }
         ],
         "links": {
            "describedby": [
               {
                  "href": "http://www.rasdaman.org/",
                  "title": "Welcome to rasdaman — the world's most flexible and scalable Array /
Datacube Engine",
                  "type": "text/html"
               },
               {
                  "href": "https://doi.org/10.5281/zenodo.1040170",
                  "title": "rasdaman - raster data manager",
                  "type": "text/html"
               }
            ],
            "profiles": [
               {
                  "href": "http://www.opengis.net/spec/owc-geojson/1.0/req/core"
               },
               {
                  "href": "http://www.opengis.net/spec/eopad-geojson/1.0/req/core"
               }
            ]
         }
      }
}
```

C.4 GeoDCAT-AP

Example 93: Complete example (GeoDCAT-AP)


```
{
   "@context": {
      "void": "http://rdfs.org/ns/void#",
      "adms": "http://www.w3.org/ns/adms#",
      "gsp": "http://www.opengis.net/ont/geosparql#",
      "owl": "http://www.w3.org/2002/07/owl#",
      "skos": "http://www.w3.org/2004/02/skos/core#",
      "rdfs": "http://www.w3.org/2000/01/rdf-schema#",
      "vcard": "http://www.w3.org/2006/vcard/ns",
      "dct": "http://purl.org/dc/terms/",
      "iana": "http://www.iana.org/assignments/relation/",
      "owc": "http://www.opengis.net/ont/owc/1.0/",
      "dcat": "http://www.w3.org/ns/dcat#",
      "atom": "http://www.w3.org/2005/Atom",
      "locn": "http://www.w3.org/ns/locn#",
      "prov": "http://www.w3.org/ns/prov#",
      "foaf": "http://xmlns.com/foaf/0.1/"
   },
   "@type": "dcat:DataService",
   "dct:type": {
      "@id": "http://inspire.ec.europa.eu/metadata-codelist/ResourceType/service"
   },
   "dct:title": "rasdaman - raster data manager",
   "@id": "
https://cat.ceos.org/collections/services/items/rasdaman?httpAccept=application/ld%2Bjson",
   "owl:versionInfo": "9.5",
   "dct:identifier": "rasdaman",
   "adms:identifier": {
      "@type": "adms:identifier",
      "dct:creator": "https://doi.org/",
      "skos:notation": "https://doi.org/10.5281/zenodo.1040170"
   },
   "dct:modified": "2018-01-31T00:00:55.511Z",
   "dct:description": "Rasdaman (raster data manager) is an open source array database system,
which provides flexible, fast, scalable geo services for multi-dimensional spatio-temporal
sensor, image, simulation, and statistics data of unlimited volume. ... data with all geo data in
the PostgreSQL database, support for the raster-relevant OGC standards, Reference Implementation
for WCS Core and WCPS.",
   "dcat:contactPoint": {
      "@type": "vcard:Organization",
      "vcard:hasName": {
         "@value": "rasdaman GmbH",
         "@language": "en"
      },
      "vcard:hasURL": {
         "@id": "http://rasdaman.org"
      }
   },
   "dcat:keyword": [
      "Big Data",
      "arrays",
      "raster data",
      "OGC",
      "WMS",
      "WCS",
      "WCS-T",
      "WCPS",
      "fast",
      "scalable",
      "flexible",
      "open standards",
      "free",
      "cost-efficient",
      "sensor",
      "image",
```

```
      "simulation",
      "statistics data"
   ],
   "foaf:isPrimaryTopicOf": {
      "dct:modified": "2021-10-20T16:12:55.511Z",
      "dct:identifier": "https://cat.ceos.org/collections/services/items/rasdaman",
      "dct:source": {
         "@id": "
https://cat.ceos.org/collections/services/items/rasdaman?httpAccept=application/vnd.iso.19139-
2%2Bxml",
         "type": "dcat:CatalogRecord",
         "dct:conformsTo": {
            "@type": "dct:Standard",
            "dct:title": "ISO19139"
         }
      },
      "type": "dcat:CatalogRecord",
      "dct:conformsTo": {
         "@id": "https://joinup.ec.europa.eu/release/geodcat-ap/20"
      },
      "dct:language": {
         "@id": "http://publications.europa.eu/resource/authority/language/EN"
      },
      "dcat:contactPoint": [
         {
            "@type": "vcard:Organization",
            "vcard:organization-name": "Committee on Earth Observation Satellites"
         }
      ]
   },
   "foaf:page": [
      {
         "@type": "foaf:Document",
         "@id": "http://www.rasdaman.org/",
         "dct:title": {
            "@value": "Welcome to rasdaman — the world's most flexible and scalable Array /
Datacube Engine",
            "@language": "en"
         }
      }
   ],
   "dct:language": {
      "@id": "http://publications.europa.eu/resource/authority/language/EN"
   },
   "dct:bibliographicCitation": "Peter Baumann, email: p.baumann@jacobs-university.de, & website:
rasdaman.org. (2018, January 31). rasdaman - raster data manager (Version 9.5.0). Zenodo.
http://doi.org/10.5281/zenodo.1163021",
   "dcat:theme": [
      {
         "skos:inscheme":
"https://gcmd.earthdata.nasa.gov/kms/concepts/concept_scheme/sciencekeywords",
         "skos:preflabel": "EARTH SCIENCE SERVICES > DATA MANAGEMENT/DATA HANDLING > DATA
ACCESS/RETRIEVAL",
         "@id": "https://gcmd.earthdata.nasa.gov/kms/concept/86cbb2d3-6783-4d9b-9dc1-
b0aea78f98ea"
      },
      {
         "skos:inscheme": "https://inspire.ec.europa.eu/metadata-codelist/ProtocolValue",
         "skos:preflabel": "OGC Web Coverage Service 2.0",
         "@id": "http://www.opengis.net/def/serviceType/ogc/wcs/2.0"
      },
      {
         "skos:inscheme": "http://inspire.ec.europa.eu/metadata-
codelist/SpatialDataServiceCategory",
         "skos:preflabel": "Coverage access service",
         "@id": "https://inspire.ec.europa.eu/metadata-
codelist/SpatialDataServiceCategory/infoCoverageAccessService"
      }
   ]
}
```

C.5 Schema.org

Example 94: Complete example (Schema.org)


```
{
   "@context": {
      "@vocab": "https://schema.org/"
   },
   "@type": "CreativeWork",
   "name": "Coastline Classifier",
   "@id": "https://cat.ceos.org/collections/services/items/coastline-classifier",
   "additionalType": [
      "http://purl.org/dc/dcmitype/Service"
   ],
   "description": "A coastal boundary algorithm is used to classify a given pixel as either
coastline or not coastline using a simple binary format. The algorithm makes a classification by
examining surrounding pixels and making a determination based on how many pixels around it are
water",
   "alternateName": "coastline-classifier",
   "dateModified": "2021-03-17T11:41:21Z",
   "identifier": [
      "coastline-classifier"
   ],
   "license": [
      "https://spdx.org/licenses/Apache-2.0"
   ],
   "keywords": [
      {
         "@type": "DefinedTerm",
         "name": "EARTH SCIENCE > TERRESTRIAL HYDROSPHERE > GLACIERS/ICE SHEETS > COASTLINE",
         "@id": "https://gcmd.earthdata.nasa.gov/kms/concept/18d136b8-728f-438b-90cb-
3c82956e1c2c",
         "inDefinedTermSet":
"https://gcmd.earthdata.nasa.gov/kms/concepts/concept_scheme/sciencekeywords"
      },
      {
         "@type": "DefinedTerm",
         "name": "Landsat-8",
         "@id": "https://earth.esa.int/concept/landsat-8",
         "inDefinedTermSet": "https://earth.esa.int/concepts/concept_scheme/platforms"
      },
      {
         "@type": "DefinedTerm",
         "name": "LANDSAT-8",
         "@id": "https://gcmd.earthdata.nasa.gov/kms/concept/13e3a08a-0d28-4e3f-a306-
a20d9fb4fff8",
         "inDefinedTermSet":
"https://gcmd.earthdata.nasa.gov/kms/concepts/concept_scheme/platforms"
      }
   ],
   "subjectOf": [
      {
         "@type": "DataDownload",
         "contentUrl": "https://raw.githubusercontent.com/ceos-
seo/data_cube_notebooks/master/notebooks/water/coastline/Coastline_Classifier.ipynb",
         "name": "Download the Notebook",
         "encodingFormat": "application/x-ipynb+json"
      },
      {
         "@type": [
            "ListItem",
            "CreativeWork"
         ],
         "inLanguage": {
            "@type": "Language",
            "name": "en",
            "@id": "http://id.loc.gov/vocabulary/iso639-1/en"
         },
         "publisher": [
```

```
            {
               "@type": "Organization",
               "name": "Committee on Earth Observation Satellites",
               "contactPoint": {
                  "@type": "ContactPoint"
               }
            }
         ],
         "encodingFormat": "application/vnd.iso.19139+xml",
         "dateCreated": "2020-12-04T12:00:00.000Z",
         "dateModified": "2021-03-17T11:41:21Z"
      },
      {
         "contentUrl": "https://cat.ceos.org/collections/services/items/coastline-
classifier?httpAccept=application/atom%2Bxml",
         "additionalType": "http://www.iana.org/assignments/relation/alternate",
         "@type": "MediaObject",
         "name": "Atom format",
         "encodingFormat": "application/atom+xml"
      },
      {
         "contentUrl": "https://cat.ceos.org/collections/services/items/coastline-classifier",
         "additionalType": "http://www.iana.org/assignments/relation/alternate",
         "@type": "MediaObject",
         "name": "OGC 17-069r3 metadata",
         "encodingFormat": "application/geo+json;profile=\"http://www.opengis.net/spec/ogcapi-
features-1/1.0\""
      },
      {
         "contentUrl": "https://cat.ceos.org/collections/services/items/coastline-
classifier?httpAccept=application/vnd.iso.19139%2Bxml",
         "@type": "MediaObject",
         "name": "ISO 19139 metadata",
         "encodingFormat": "application/vnd.iso.19139+xml"
      },
      {
         "contentUrl": "https://cat.ceos.org/collections/services/items/coastline-
classifier?httpAccept=text/html",
         "@type": "MediaObject",
         "name": "HTML",
         "encodingFormat": "text/html"
      },
      {
         "contentUrl": "https://github.com/ceos-
seo/data_cube_notebooks/blob/master/notebooks/water/coastline/Coastline_Classifier.ipynb",
         "@type": "MediaObject",
         "name": "View the Notebook",
         "encodingFormat": "text/html"
      }
   ],
   "spatialCoverage": {
      "geo": {
         "@type": "GeoShape"
      },
      "@type": "Place"
   },
   "temporalCoverage": "1999-01-01T12:00:00.000Z/2003-12-31T11:59:59.000Z",
   "provider": [
      {
         "@type": "Organization",
         "name": "CEOS",
         "url": "https://ceos.org"
      }
   ]
}
```

C.6 ISO19115-3

Example 95: Complete example (ISO19115-3)

```
<?xml version="1.0" encoding="UTF-8"?>
<mdb:MD_Metadata xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:mdb="http://standards.iso.org/iso/19115/-3/mdb/1.0"
xmlns:mac="http://standards.iso.org/iso/19115/-3/mac/1.0"
xmlns:mcc="http://standards.iso.org/iso/19115/-3/mcc/1.0"
xmlns:gco="http://standards.iso.org/iso/19115/-3/gco/1.0"
xmlns:gcx="http://standards.iso.org/iso/19115/-3/gcx/1.0"
xmlns:gex="http://standards.iso.org/iso/19115/-3/gex/1.0"
xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:mco="http://standards.iso.org/iso/19115/-
3/mco/1.0" xmlns:mdq="http://standards.iso.org/iso/19157/-2/mdq/1.0"
xmlns:mri="http://standards.iso.org/iso/19115/-3/mri/1.0"
xmlns:srv="http://standards.iso.org/iso/19115/-3/srv/2.0"
xmlns:mrd="http://standards.iso.org/iso/19115/-3/mrd/1.0"
xmlns:lan="http://standards.iso.org/iso/19115/-3/lan/1.0"
xmlns:cit="http://standards.iso.org/iso/19115/-3/cit/1.0"
xmlns:xlink="http://www.w3.org/1999/xlink"
xsi:schemaLocation="http://standards.iso.org/iso/19115/-3/mds/1.0 ./standards.iso.org/19115/-
3/mds/1.0/mds.xsd">
   <mdb:metadataIdentifier>
      <mcc:MD_Identifier>
         <mcc:code>
            <gco:CharacterString>eo-pdgs-landsat-datacube</gco:CharacterString>
         </mcc:code>
      </mcc:MD_Identifier>
   </mdb:metadataIdentifier>
   <mdb:defaultLocale>
      <lan:PT_Locale>
         <lan:language>
            <lan:LanguageCode
codeList="http://standards.iso.org/iso/19115/resources/Codelist/lan/LanguageCode.xml#LanguageCode
" codeListValue="eng"/>
         </lan:language>
         <lan:characterEncoding/>
      </lan:PT_Locale>
   </mdb:defaultLocale>
   <mdb:metadataScope>
      <mdb:MD_MetadataScope>
         <mdb:resourceScope>
            <mcc:MD_ScopeCode
codeList="http://standards.iso.org/iso/19115/resources/Codelist/cat/codeLists.xml#MD_ScopeCode"
codeListValue="service"/>
         </mdb:resourceScope>
      </mdb:MD_MetadataScope>
   </mdb:metadataScope>
   <mdb:contact>
      <cit:CI_Responsibility>
         <cit:role>
            <cit:CI_RoleCode
codeList="http://standards.iso.org/iso/19115/resources/Codelist/cat/codeLists.xml#CI_RoleCode"
codeListValue="pointOfContact"/>
         </cit:role>
         <cit:party>
            <cit:CI_Organisation>
               <cit:name>
                  <gco:CharacterString>ESA/ESRIN</gco:CharacterString>
               </cit:name>
               <cit:contactInfo>
                  <cit:CI_Contact>
                     <cit:phone>
                        <cit:CI_Telephone>
                           <cit:number>
                              <gco:CharacterString>+3906941801</gco:CharacterString>
                           </cit:number>
                           <cit:numberType>
```

```
                              <cit:CI_TelephoneTypeCode
codeList="http://standards.iso.org/iso/19115/resources/Codelist/cat/codeLists.xml#CI_TelephoneTyp
eCode" codeListValue="voice"/>
                           </cit:numberType>
                        </cit:CI_Telephone>
                     </cit:phone>
                     <cit:phone>
                        <cit:CI_Telephone>
                           <cit:number>
                              <gco:CharacterString>+390694180280</gco:CharacterString>
                           </cit:number>
                           <cit:numberType>
                              <cit:CI_TelephoneTypeCode
codeList="http://standards.iso.org/iso/19115/resources/Codelist/cat/codeLists.xml#CI_TelephoneTyp
eCode" codeListValue="facsimile"/>
                           </cit:numberType>
                        </cit:CI_Telephone>
                     </cit:phone>
                     <cit:address>
                        <cit:CI_Address>
                           <cit:deliveryPoint>
                              <gco:CharacterString>Largo Galileo Galilei 1</gco:CharacterString>
                           </cit:deliveryPoint>
                           <cit:city>
                              <gco:CharacterString>Frascati (Roma)</gco:CharacterString>
                           </cit:city>
                           <cit:postalCode>
                              <gco:CharacterString>00044</gco:CharacterString>
                           </cit:postalCode>
                           <cit:country>
                              <gco:CharacterString>Italy</gco:CharacterString>
                           </cit:country>
                           <cit:electronicMailAddress>
                              <gco:CharacterString>eohelp@esa.int</gco:CharacterString>
                           </cit:electronicMailAddress>
                        </cit:CI_Address>
                     </cit:address>
                     <cit:onlineResource>
                        <cit:CI_OnlineResource>
                           <cit:linkage>
                              <gco:CharacterString>https://earth.esa.int</gco:CharacterString>
                           </cit:linkage>
                        </cit:CI_OnlineResource>
                     </cit:onlineResource>
                  </cit:CI_Contact>
               </cit:contactInfo>
               <cit:individual>
                  <cit:CI_Individual>
                     <cit:positionName>
                        <gco:CharacterString>ESRIN Earth Observation Help
Desk</gco:CharacterString>
                     </cit:positionName>
                  </cit:CI_Individual>
               </cit:individual>
            </cit:CI_Organisation>
         </cit:party>
      </cit:CI_Responsibility>
   </mdb:contact>
   <mdb:dateInfo>
      <cit:CI_Date>
         <cit:date>
            <gco:DateTime>2019-05-15T09:00:00</gco:DateTime>
         </cit:date>
         <cit:dateType>
            <cit:CI_DateTypeCode codeList="
http://standards.iso.org/iso/19115/resources/Codelist/cat/codeLists.xml#CI_DateTypeCode"
codeListValue="revision">revision</cit:CI_DateTypeCode>
         </cit:dateType>
      </cit:CI_Date>
   </mdb:dateInfo>
   <mdb:metadataStandard>
```

```
      <cit:CI_Citation>
         <cit:title>
            <gco:CharacterString>ISO 19115-3</gco:CharacterString>
         </cit:title>
         <cit:edition>
            <gco:CharacterString>2016-08-15</gco:CharacterString>
         </cit:edition>
      </cit:CI_Citation>
   </mdb:metadataStandard>
   <mdb:identificationInfo>
      <srv:SV_ServiceIdentification>
         <mri:citation>
            <cit:CI_Citation>
               <cit:title>
                  <gco:CharacterString>rasdaman - raster data manager</gco:CharacterString>
               </cit:title>
               <cit:date>
                  <cit:CI_Date>
                     <cit:date>
                        <gco:DateTime>2020-12-04T00:00:00</gco:DateTime>
                     </cit:date>
                     <cit:dateType>
                        <cit:CI_DateTypeCode codeList="
http://standards.iso.org/iso/19115/resources/Codelist/cat/codeLists.xml#CI_DateTypeCode"
codeListValue="revision">revision</cit:CI_DateTypeCode>
                     </cit:dateType>
                  </cit:CI_Date>
               </cit:date>
               <cit:edition>
                  <gco:CharacterString>9.5</gco:CharacterString>
               </cit:edition>
               <cit:identifier>
                  <mcc:MD_Identifier>
                     <mcc:code>
                        <gco:CharacterString>eo-pdgs-landsat-datacube</gco:CharacterString>
                     </mcc:code>
                  </mcc:MD_Identifier>
               </cit:identifier>

            </cit:CI_Citation>
         </mri:citation>
         <mri:abstract>
            <gco:CharacterString>ESA PDGS-DataCube enables multi-temporal and pixel-based access
to a subset of the data available in the European Space Agency dissemination services, including
Heritage Missions (HM), Third-Party Missions (TPM) and Earth Explorer (EE)
data.</gco:CharacterString>
         </mri:abstract>
         <mri:pointOfContact>
            <cit:CI_Responsibility>
               <cit:role>
                  <cit:CI_RoleCode codeList="
http://standards.iso.org/iso/19115/resources/Codelist/cat/codeLists.xml#CI_RoleCode"
codeListValue="pointOfContact">pointOfContact</cit:CI_RoleCode>
               </cit:role>
               <cit:party>
                  <cit:CI_Organisation>
                     <cit:name>
                        <gco:CharacterString>ESA/ESRIN</gco:CharacterString>
                     </cit:name>
                     <cit:contactInfo>
                        <cit:CI_Contact>
                           <cit:phone>
                              <cit:CI_Telephone>
                                 <cit:number>
                                    <gco:CharacterString>+3906941801</gco:CharacterString>
                                 </cit:number>
                                 <cit:numberType>
                                    <cit:CI_TelephoneTypeCode
codeList="codeListLocation#CI_TelephoneTypeCode"
codeListValue="voice">voice</cit:CI_TelephoneTypeCode>
                                 </cit:numberType>
```

```
                              </cit:CI_Telephone>
                           </cit:phone>
                           <cit:phone>
                              <cit:CI_Telephone>
                                 <cit:number>
                                    <gco:CharacterString>+390694180280</gco:CharacterString>
                                 </cit:number>
                                 <cit:numberType>
                                    <cit:CI_TelephoneTypeCode
codeList="codeListLocation#CI_TelephoneTypeCode"
codeListValue="facsimile">facsimile</cit:CI_TelephoneTypeCode>
                                 </cit:numberType>
                              </cit:CI_Telephone>
                           </cit:phone>
                           <cit:address>
                              <cit:CI_Address>
                                 <cit:deliveryPoint>
                                    <gco:CharacterString>Largo Galileo Galilei
1</gco:CharacterString>
                                 </cit:deliveryPoint>
                                 <cit:city>
                                    <gco:CharacterString>Frascati (Roma)</gco:CharacterString>
                                 </cit:city>
                                 <cit:postalCode>
                                    <gco:CharacterString>00044</gco:CharacterString>
                                 </cit:postalCode>
                                 <cit:country>
                                    <gco:CharacterString>Italy</gco:CharacterString>
                                 </cit:country>
                                 <cit:electronicMailAddress>
                                    <gco:CharacterString>eohelp@esa.int</gco:CharacterString>
                                 </cit:electronicMailAddress>
                              </cit:CI_Address>
                           </cit:address>
                           <cit:onlineResource>
                              <cit:CI_OnlineResource>
                                 <cit:linkage>
                                    <gco:CharacterString>https://www.esa.int</gco:CharacterString>
                                 </cit:linkage>
                              </cit:CI_OnlineResource>
                           </cit:onlineResource>
                        </cit:CI_Contact>
                     </cit:contactInfo>
                     <cit:individual>
                        <cit:CI_Individual>
                           <cit:positionName>
                              <gco:CharacterString>ESRIN Earth Observation Help
Desk</gco:CharacterString>
                           </cit:positionName>
                        </cit:CI_Individual>
                     </cit:individual>
                  </cit:CI_Organisation>
               </cit:party>
            </cit:CI_Responsibility>
         </mri:pointOfContact>
         <mri:extent>
            <gex:EX_Extent>
               <gex:geographicElement>
                  <gex:EX_GeographicBoundingBox>
                     <gex:westBoundLongitude>
                        <gco:Decimal>-180</gco:Decimal>
                     </gex:westBoundLongitude>
                     <gex:eastBoundLongitude>
                        <gco:Decimal>180</gco:Decimal>
                     </gex:eastBoundLongitude>
                     <gex:southBoundLatitude>
                        <gco:Decimal>-90</gco:Decimal>
                     </gex:southBoundLatitude>
                     <gex:northBoundLatitude>
                        <gco:Decimal>90</gco:Decimal>
                     </gex:northBoundLatitude>
```

```
                  </gex:EX_GeographicBoundingBox>
               </gex:geographicElement>
            </gex:EX_Extent>
         </mri:extent>
         <mri:descriptiveKeywords>
            <mri:MD_Keywords>
               <mri:keyword>
                  <gcx:Anchor xlink:href="https://earth.esa.int/concept/landsat-7">Landsat-
7</gcx:Anchor>
               </mri:keyword>
                  <mri:keyword>
                  <gcx:Anchor xlink:href="https://earth.esa.int/concept/landsat-8">Landsat-
8</gcx:Anchor>
               </mri:keyword>
               <mri:type>
                  <mri:MD_KeywordTypeCode codeListValue="platform"
codeList="https://schemas.isotc211.org/19115/resources/Codelists/cat/codelists.xml#MD_KeywordType
Code"/>
               </mri:type>
               <mri:thesaurusName>
                  <cit:CI_Citation>
                     <cit:title>
                        <gcx:Anchor
xlink:href="https://earth.esa.int/concepts/concept_scheme/platforms">EO Parameter Code List -
Platforms</gcx:Anchor>
                     </cit:title>
                     <cit:date>
                        <cit:CI_Date>
                           <cit:date>
                              <gco:DateTime>2019-07-24T00:00:00</gco:DateTime>
                           </cit:date>
                           <cit:dateType>
                              <cit:CI_DateTypeCode
codeList="https://schemas.isotc211.org/19115/resources/Codelists/cat/codelists.xml#CI_DateTypeCod
e" codeListValue="publication">publication</cit:CI_DateTypeCode>
                           </cit:dateType>
                        </cit:CI_Date>
                     </cit:date>
                  </cit:CI_Citation>
               </mri:thesaurusName>
            </mri:MD_Keywords>
         </mri:descriptiveKeywords>
         <mri:resourceConstraints>
            <mco:MD_LegalConstraints>
               <mco:useConstraints>
                  <mco:MD_RestrictionCode
codeList="https://schemas.isotc211.org/19115/resources/Codelist/cat/codeLists.xml#MD_RestrictionC
ode" codeListValue="otherRestrictions"/>
               </mco:useConstraints>
               <mco:otherConstraints>
                  <gcx:Anchor xlink:href="http://inspire.ec.europa.eu/metadata-
codelist/ConditionsApplyingToAccessAndUse/noConditionsApply">No conditions apply to access and
use.</gcx:Anchor>
               </mco:otherConstraints>
            </mco:MD_LegalConstraints>
         </mri:resourceConstraints>
         <mri:resourceConstraints>
            <mco:MD_LegalConstraints>
               <mco:accessConstraints>
                  <mco:MD_RestrictionCode
codeList="https://schemas.isotc211.org/19115/resources/Codelist/cat/codeLists.xml#MD_RestrictionC
ode" codeListValue="otherRestrictions"/>
               </mco:accessConstraints>
               <mco:otherConstraints>
                  <gcx:Anchor xlink:href="http://inspire.ec.europa.eu/metadata-
codelist/LimitationsOnPublicAccess/noLimitations">no limitations to public access.</gcx:Anchor>
               </mco:otherConstraints>
            </mco:MD_LegalConstraints>
         </mri:resourceConstraints>
         <mri:associatedResource>
            <mri:MD_AssociatedResource>
```

```
               <mri:associationType>
                  <mri:DS_AssociationTypeCode
codeList="http://standards.iso.org/iso/19115/resources/Codelist/cat/codelists.xml#DS_AssociationT
ypeCode" codeListValue="dependency"/>
               </mri:associationType>
               <mri:metadataReference>
                  <cit:CI_Citation>
                     <cit:title>
                        <gco:CharacterString>Landsat 7 ETM+ (Enhanced Thematic Mapper Plus)
Geolocated Terrain Corrected Systematic processing</gco:CharacterString>
                     </cit:title>
                     <cit:identifier>
                        <mcc:MD_Identifier>
                           <mcc:code>
                              <gco:CharacterString>C1532648148-ESA</gco:CharacterString>
                           </mcc:code>
                           <mcc:codeSpace>
                              <gco:CharacterString>https://idn.ceos.org</gco:CharacterString>
                           </mcc:codeSpace>
                        </mcc:MD_Identifier>
                     </cit:identifier>
                     <cit:onlineResource>
                        <cit:CI_OnlineResource>
                           <cit:linkage>

   <gco:CharacterString>https://eovoc.spacebel.be/collections/series/items/LANDSAT.ETM.GTC</gco:C
haracterString>
                           </cit:linkage>
                        </cit:CI_OnlineResource>
                     </cit:onlineResource>
                  </cit:CI_Citation>
               </mri:metadataReference>
            </mri:MD_AssociatedResource>
         </mri:associatedResource>
         <srv:serviceType>
            <gco:ScopedName codeSpace="http://inspire.ec.europa.eu/metadata-
codelist/SpatialDataServiceType">transformation</gco:ScopedName>
         </srv:serviceType>
      </srv:SV_ServiceIdentification>
   </mdb:identificationInfo>
   <mdb:distributionInfo>
      <mrd:MD_Distribution>
         <mrd:transferOptions>
            <mrd:MD_DigitalTransferOptions>
               <mrd:onLine>
                  <cit:CI_OnlineResource>
                     <cit:linkage>

   <gco:CharacterString>https://datacube.pdgs.eo.esa.int/wcs?service=WCS&amp;Request=DescribeCove
rage&amp;version=2.0.0&amp;CoverageId=LE7_RGB</gco:CharacterString>
                     </cit:linkage>
                     <cit:protocol>
                        <gco:CharacterString>OGC:WCS:DescribeCoverage</gco:CharacterString>
                     </cit:protocol>
                     <cit:name>
                        <gco:CharacterString>DescribeCoverage</gco:CharacterString>
                     </cit:name>
                     <cit:description>
                        <gcx:Anchor xlink:href="http://inspire.ec.europa.eu/metadata-
codelist/OnLineDescriptionCode/accessPoint">accessPoint</gcx:Anchor>
                     </cit:description>
                     <cit:function>
                        <cit:CI_OnLineFunctionCode
codeList="https://schemas.isotc211.org/19115/resources/Codelist/cat/codeLists.xml#CI_OnLineFuncti
onCode" codeListValue="information"/>
                     </cit:function>
                  </cit:CI_OnlineResource>
               </mrd:onLine>
               <mrd:onLine>
                  <cit:CI_OnlineResource>
                     <cit:linkage>
```

```
   <gco:CharacterString>https://datacube.pdgs.eo.esa.int/wcs?service=WCS&amp;Request=GetCapabilit
ies&amp;version=2.0.0</gco:CharacterString>
                     </cit:linkage>
                     <cit:protocol>
                        <gcx:Anchor
xlink:href="http://www.opengis.net/def/serviceType/ogc/wcs/2.0">
          OGC:WCS:GetCapabilities</gcx:Anchor>
                     </cit:protocol>
                     <cit:name>
                        <gco:CharacterString>GetCapabilities</gco:CharacterString>
                     </cit:name>
                     <cit:description>
                        <gcx:Anchor xlink:href="http://inspire.ec.europa.eu/metadata-
codelist/OnLineDescriptionCode/accessPoint">accessPoint</gcx:Anchor>
                     </cit:description>
                     <cit:function>
                        <cit:CI_OnLineFunctionCode
codeList="https://schemas.isotc211.org/19115/resources/Codelist/cat/codeLists.xml#CI_OnLineFuncti
onCode" codeListValue="information"/>
                     </cit:function>
                  </cit:CI_OnlineResource>
               </mrd:onLine>
            </mrd:MD_DigitalTransferOptions>
         </mrd:transferOptions>
      </mrd:MD_Distribution>
   </mdb:distributionInfo>
   <mdb:dataQualityInfo>
      <mdq:DQ_DataQuality>
         <mdq:scope>
            <mcc:MD_Scope>
               <mcc:level>
                  <mcc:MD_ScopeCode
codeList="http://standards.iso.org/iso/19115/resources/Codelist/cat/CodeLists.xml#MD_ScopeCode"
codeListValue="service"/>
               </mcc:level>
               <mcc:levelDescription/>
            </mcc:MD_Scope>
         </mdq:scope>
         <mdq:report>
            <mdq:DQ_DomainConsistency>
               <mdq:result>
                  <mdq:DQ_ConformanceResult>
                     <mdq:specification>
                        <cit:CI_Citation>
                           <cit:title>
                              <gcx:Anchor xlink:href="http://docs.opengeospatial.org/is/17-
089r1/17-089r1.html">OGC Web Coverage Service 2.0</gcx:Anchor>
                           </cit:title>
                           <cit:date>
                              <cit:CI_Date>
                                 <cit:date>
                                    <gco:Date>2010-10-27</gco:Date>
                                 </cit:date>
                                 <cit:dateType>
                                    <cit:CI_DateTypeCode
codeList="http://standards.iso.org/iso/19115/resources/Codelist/cat/codeLists.xml#CI_DateTypeCode
" codeListValue="publication"/>
                                 </cit:dateType>
                              </cit:CI_Date>
                           </cit:date>
                        </cit:CI_Citation>
                     </mdq:specification>
                     <mdq:explanation>
                        <gco:CharacterString>This Spatial Data Service is conformant with the OGC
Web Coverage Service 2.0 specification</gco:CharacterString>
                     </mdq:explanation>
                     <mdq:pass gco:nilReason="unknown"/>
                  </mdq:DQ_ConformanceResult>
               </mdq:result>
            </mdq:DQ_DomainConsistency>
```

```
         </mdq:report>
      </mdq:DQ_DataQuality>
   </mdb:dataQualityInfo>
   <mdb:acquisitionInformation>
      <mac:MI_AcquisitionInformation>
         <mac:platform>
            <mac:MI_Platform>
               <mac:citation>
                  <cit:CI_Citation>
                     <cit:title>
                        <gcx:Anchor xlink:href="https://earth.esa.int/concept/landsat-7">Landsat-
7</gcx:Anchor>
                     </cit:title>
                     <cit:alternateTitle>
                        <gcx:Anchor
xlink:href="https://gcmd.earthdata.nasa.gov/kms/concept/c7a09e9f-3c99-4b31-a521-
313c379ba2b4">LANDSAT-7</gcx:Anchor>
                     </cit:alternateTitle>
                  </cit:CI_Citation>
               </mac:citation>
               <mac:identifier>
                  <mcc:MD_Identifier>
                     <mcc:code>
                        <gcx:Anchor xlink:href="https://earth.esa.int/concept/landsat-7">Landsat-
7</gcx:Anchor>
                     </mcc:code>
                  </mcc:MD_Identifier>
               </mac:identifier>
               <mac:description>
                  <gco:CharacterString/>
               </mac:description>
               <mac:instrument>
                  <mac:MI_Instrument>
                     <mac:citation>
                        <cit:CI_Citation>
                           <cit:title>
                              <gcx:Anchor
xlink:href="https://earth.esa.int/concept/etm">ETM</gcx:Anchor>
                           </cit:title>
                           <cit:alternateTitle>
                              <gcx:Anchor
xlink:href="https://gcmd.earthdata.nasa.gov/kms/concept/4dbe7764-a2ea-4a19-b754-
696c35ac3205">ETM+</gcx:Anchor>
                           </cit:alternateTitle>
                           <cit:identifier>
                              <mcc:MD_Identifier>
                                 <mcc:code>
                                    <gcx:Anchor
xlink:href="https://earth.esa.int/concept/etm">ETM</gcx:Anchor>
                                 </mcc:code>
                              </mcc:MD_Identifier>
                           </cit:identifier>
                        </cit:CI_Citation>
                     </mac:citation>
                     <mac:identifier/>
                     <mac:type/>
                  </mac:MI_Instrument>
               </mac:instrument>
            </mac:MI_Platform>
         </mac:platform>
      </mac:MI_AcquisitionInformation>
   </mdb:acquisitionInformation>
</mdb:MD_Metadata>
```

C.7 UMM-JSON

C.7.1 UMM-S

Note: example was retrieved from https://cmr.earthdata.nasa.gov/search/services.umm_json?name=PO.DAAC%20harmony-netcdf-to-zarr&pretty=true.


```
{
   "meta": {
      "native-id": "mmt_service_14322",
      "provider-id": "POCLOUD",
      "concept-type": "service",
      "concept-id": "S2009180097-POCLOUD",
      "revision-date": "2021-02-23T03:34:10.803Z",
      "user-id": "mgangl",
      "deleted": false,
      "revision-id": 2,
      "format": "application/vnd.nasa.cmr.umm+json"
   },
   "umm": {
      "URL": {
         "Description": "This is the harmony root endpoint.",
         "URLValue": "https://harmony.earthdata.nasa.gov"
      },
      "Type": "Harmony",
      "ServiceKeywords": [
         {
            "ServiceCategory": "EARTH SCIENCE SERVICES",
            "ServiceTopic": "DATA MANAGEMENT/DATA HANDLING",
            "ServiceTerm": "DATA ACCESS/RETRIEVAL"
         },
         {
            "ServiceCategory": "EARTH SCIENCE SERVICES",
            "ServiceTopic": "DATA MANAGEMENT/DATA HANDLING",
            "ServiceTerm": "DATA INTEROPERABILITY",
            "ServiceSpecificTerm": "DATA REFORMATTING"
         }
      ],
      "ServiceOrganizations": [
         {
            "Roles": [
               "PUBLISHER",
               "SERVICE PROVIDER"
            ],
            "ShortName": "NASA/GSFC/EOS/EOSDIS/EMD",
            "LongName": "Maintenance and Development, Earth Observing System Data and Information
System, Earth Observing System,Goddard Space Flight Center, NASA"
         }
      ],
      "Description": "Backend NetCDF to Zarr service option description for Harmony data
transformations. Cannot be chained with other operations from this record.",
      "VersionDescription": "Data operation version\r\n\r\n",
      "Version": "0.9.0",
      "Name": "PO.DAAC harmony-netcdf-to-zarr",
      "ServiceOptions": {
         "SupportedReformattings": [
            {
               "SupportedInputFormat": "NETCDF-4",
               "SupportedOutputFormats": [
                  "ZARR"
               ]
            }
         ]
      },
```

```
      "MetadataSpecification": {
         "URL": "https://cdn.earthdata.nasa.gov/umm/service/v1.4",
         "Name": "UMM-S",
         "Version": "1.4"
      },
      "LongName": "PO.DAAC harmony-netcdf-to-zarr Service Options"
   }
}
```


C.7.2 UMM-T

Note: example was retrieved from https://cmr.earthdata.nasa.gov/search/tools.umm_json?name=Proba-V%20MEP&pretty=true.


```
{
   "meta": {
      "native-id": "Proba-V_MEP",
      "provider-id": "ESA",
      "concept-type": "tool",
      "concept-id": "TL2093861884-ESA",
      "revision-date": "2021-10-04T20:04:50.558Z",
      "user-id": "mmorahan",
      "deleted": false,
      "revision-id": 2,
      "format": "application/vnd.nasa.cmr.umm+json"
   },
   "umm": {
      "URL": {
         "Description": "Access the Proba-V MEP.",
         "URLValue": "https://proba-v-mep.esa.int/",
         "URLContentType": "DistributionURL",
         "Type": "GOTO WEB TOOL",
         "Subtype": "MAP VIEWER"
      },
      "AncillaryKeywords": [
         "Sentinel satellites",
         "ESA",
         "Imagery",
         "Urban development",
         "Natural disaster management",
         "Satellite data",
         "CEOS"
      ],
      "Type": "Web User Interface",
      "AccessConstraints": "Viewing is anonymous. On-demand processing, notebook, Virtual
Machines are free, but require registration.",
      "Description": "Exploitation Platform for Proba-V, Spot-Vegetation and selected parameters
from Copernicus Global Land. Several components are provided: full-resolution viewing, Time
series viewing, Notebooks, VMs on private cloud, Hadooop/Spark cluster for large-scale parallel
on-demand processing. Operations Start Date: 01/2016 Targeted Users: Scientific, Education,
Public Authority. Data (Type, Mission, Time Series): Sentinel-2A, Sentinel-2B, Proba-V full
archive, Spot-Vegetation full archive: Global from 1998. Copernicus global land service
vegetation products. Meteo data from Chirps.",
      "Version": "NOT PROVIDED",
      "ToolKeywords": [
         {
            "ToolCategory": "EARTH SCIENCE SERVICES",
            "ToolTopic": "DATA MANAGEMENT/DATA HANDLING",
            "ToolTerm": "CATALOGING"
         }
      ],
      "Name": "Proba-V MEP",
      "ContactPersons": [
         {
            "Roles": [
               "SERVICE PROVIDER"
            ],
```

```
            "LastName": "VITO Helpdesk/Operations",
            "ContactInformation": {
               "ContactMechanisms": [
                  {
                     "Type": "Email",
                     "Value": "remotesensing@vito.be"
                  },
                  {
                     "Type": "Telephone",
                     "Value": "+32 14 33 68 55"
                  }
               ]
            }
         }
      ],
      "Organizations": [
         {
            "Roles": [
               "SERVICE PROVIDER"
            ],
            "ShortName": "VITO",
            "LongName": "Flemish Institute for Technological Research",
            "URLValue": "https://www.vito.be/"
         },
         {
            "Roles": [
               "SERVICE PROVIDER"
            ],
            "ShortName": "ESA/EO",
            "LongName": "Observing the Earth, European Space Agency",
            "URLValue": "http://www.esa.int/esaEO/"
         }
      ],
      "MetadataSpecification": {
         "URL": "https://cdn.earthdata.nasa.gov/umm/tool/v1.1",
         "Name": "UMM-T",
         "Version": "1.1"
      },
      "LongName": "Proba-V Mission Exploitation Platform (MEP)"
   }
}
```