GNSS-DCAT–AP: an extension of the DCAT Application Profile for GNSS observation data

Version 0.4

Basic document metadata

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Document history

Version	Date	Description
0.1	March 2022	First draft version
0.2	May 2022	Including additional optional properties for Dataset
0.3	April 2024	Additional recommended properties for Dataset and Distribution and updated gnss namespace
0.4	July 2025	Alignment with DCAT-AP 3.0.0, use of registered PIDs (w3id), information on schema and API versions, fixes and updates in the documentation

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Glossary

DCAT	The Data Catalogue Vocabulary (DCAT) is an RDF v*ocabulary* designed to facilitate interoperability between data catalogues published on the web. Developed by W3C.
AP	An *application profile (AP)* re-uses terms from one or more *metadata standard elements*, but adds more specificity by identifying mandatory, recommended, and optional elements to be used for a particular application.
DCAT-AP	DCAT-AP provides a common specification for describing datasets in Europe and enables the exchange of dataset descriptions among data portals.
GeoDCAT-AP	GeoDCAT-AP is an extension of DCAT-AP for representing geographic metadata.

For a complete glossary of the terms used in this document the online version.

1 Introduction

1.1 Scope of this *metadata application profile* proposal

The proposal for the *application profile* GNSS-DCAT-AP specified in this document concerns the metadata that will accompany the exchange of GNSS RINEX observation data in order to increase their Findability, Accessibility, Interoperability, and Re-usability (FAIR). GNSS-DCAT-AP is based on the specifications of the DCAT application profile (DCAT-AP).
The Data Catalog Vocabulary (DCAT) is an RDF[1] *vocabulary* and therefore, by design, it facilitates the interoperability between data portals (supporting DCAT-based RDF documents) and enables publishing *metadata* directly on the web by using different formats e.g., JSON-LD.

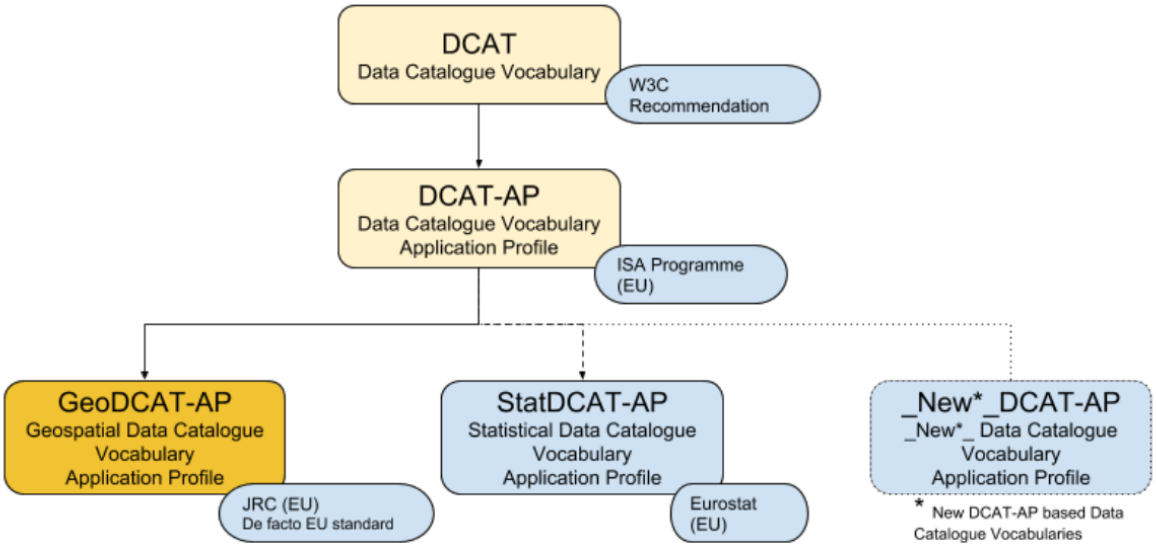


Figure 1:Overview of DCAT and related initiatives (picture from GeoDCAT-AP documentation).

In particular, DCAT-AP has been developed as a generic core set of *metadata* that can be extended to more specific uses (see Fig. 1) and is in practice the EU standard metadata interchange format.
The building blocks of DCAT-AP are DCAT classes: Catalogue, Data Service, Dataset and Distribution where the catalogue consists of one or more data services and datasets, and one or more distributions

[1] Resource Description Framework (RDF) http://www.w3.org/RDF/

for each dataset, see Fig. 2. A data service is essentially and endpoint (API), which provides access to that dataset (see https://github.com/SEMICeu/DCAT-AP/blob/master/releases/2.1.0/usageguide-dataset-distribution-dataservice.md).

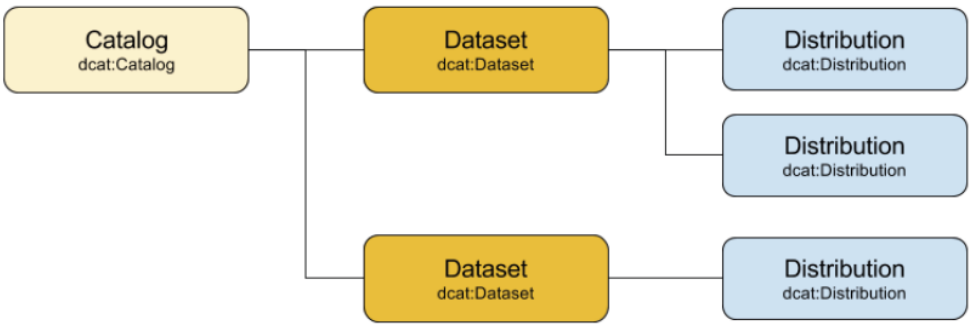


Figure 2: DCAT data structure (picture from GeoDCAT-AP documentation)

This document conforms to the specifications in Section 6 of DCAT-AP v2.1.0 on how to extend the DCAT *application profile*, and follows in broad terms the structure of the DCAT-AP v2.1.0 document. Additional classes and properties from other *vocabularies* are re-used or created (domain specific vocabulary) where necessary. There are no requirements for communication systems except for being able to export/import data in RDF in compliance with this DCAT-AP extension.

The scope of this *application profile* (here indicated as GNSS-DCAT-AP) is to facilitate GNSS RINEX observation data exchange and therefore the classes and properties relevant for the data to be exchanged are defined in this document.
The GNSS-DCAT-AP schema describes in a standardized and structured way the daily RINEX files, the GNSS stations' datasets and the GNSS data repositories. Each of these digital objects corresponds to a DCAT-AP class:

GNSS-DCAT-AP hierarchical levels	
DCAT-AP class	**Corresponding digital object**
Catalog	GNSS data repository
Dataset	GNSS station dataset
Distribution	Daily RINEX file

As illustrated in Section 1.3, together with DCAT-AP classes such as the Dataset (to describe the GNSS station dataset), new recommended *metadata* classes are proposed to describe the specific characteristics of GNSS RINEX observation files (i.e. the Distribution): the type of RINEX file (e.g., compression format, frequency, etc.); the RINEX file header and the information regarding the GNSS station, the GNSS antenna and receiver associated with the station; the software used to generate the RINEX observation file. Three additional optional classes allow the inclusion of information regarding the GNSS antenna, receiver and monument associated with the GNSS station and extracted from the IGS site log or GeodesyML files.

1.2 Terminology

In the following sections, metadata classes and properties are grouped as “Mandatory”, “Recommended” and “Optional” (red indicates classes and/properties set to a higher priority with respect to DCAT-AP v3.0 in order to be in line with FAIR principles and/or GNSS user needs e.g., DCAT-AP v3.0 recommended properties that we promoted to be mandatory).
“Mandatory”, “Recommended” and “Optional” are defined in Section 2 of DCAT-AP v2.1.0.

The proposed application profile (GNSS-DCAT-AP) introduces new classes and properties and reuses terms from various existing specifications.
Classes and properties specified in the next sections have been taken from the following *namespaces*:

- adms: http://www.w3.org/ns/adms#
- dcat: http://www.w3.org/ns/dcat#
- dcatap: http://data.europa.eu/r5r/
- dct: http://purl.org/dc/terms/
- dctype: http://purl.org/dc/dcmitype/
- dqv: http://www.w3.org/ns/dqv#
- foaf: http://xmlns.com/foaf/0.1/
- geo: https://www.fair-gnss.oma.be/gnss-dcat-ap/vocabulary/geo#[2] - to be defined
- gml: http://www.opengis.net/gml/3.2
- gnss: https://w3id.org/gnss-dcat-ap/gnss#
- locn: http://www.w3.org/ns/locn#
- odrl: http://www.w3.org/ns/odrl/2/
- owl: http://www.w3.org/2002/07/owl#
- prov: http://www.w3.org/ns/prov
- rdf: http://www.w3.org/1999/02/22-rdf-syntax-ns#
- rdfs: http://www.w3.org/2000/01/rdf-schema#
- schema: https://schema.org/
- skos: http://www.w3.org/2004/02/skos/core#
- spdx: http://spdx.org/rdf/terms#
- time: http://www.w3.org/2006/time#
- vann: http://purl.org/vocab/vann/
- vcard: http://www.w3.org/2006/vcard/ns#
- voaf: http://purl.org/vocommons/voaf#
- xsd: http://www.w3.org/2001/XMLSchema#

[2] Use of the ”geo” prefix as in geo:urn:xml-gov-au:icsm:egeodesy:0.5, mainly to name the three optional classes (and their properties) related to station information encoded in GeodesyML i.e., geo:GNSSAntenna, geo:Monument, geo:GNSSReceiver (Section 3.3)

1.3 Revision history

1.3.1 Alignment with DCAT-AP 3.0.0

GNSS-DCAT-AP is an extension of DCAT-AP and therefore inherits the changes introduced in DCAT-AP Version 3.0 (due to the aligment with DCAT Version 3).

Class name	Property	DCAT-AP v3.0	GNSS-DCAT-AP v0.4
Dataset	Deprecated properties: dct:hasVersion, dct:isVersionOf , owl:isVersionOf.	Replaced the URI with: dcat:hasVersion, dcat:isVersionOf, dcat:version.	Aligned
Distribution	dcat:bytesize	The range is now fixed by xsd:nonNegativeInteger	Aligned
DataService	dct:publisher	Added	Aligned
Dataset	dct:accessRights	New definition, more generic	Aligned
DatasetSeries	dct:title dct:description dcat:contactPoint dct:publisher dct:spatial dct:temporal dct:accrualPeriodicity dct:issued dct:modified	Added new class and its properties	Aligned

1.3.2 Additional properties

The following new properties were added in this version of the schema:

- the Distribution class has now the properties:
  - dct:temporal to account for the temporal period covered by the (daily RINEX) file,
  - dct:temporalResolution to represent its temporal resolution e.g. 30s
  - dcat:mediaType to describe the format, as defined by IANA
  - dqv:hasQualityMeasurement to represent a quality measurement such, for example, the ratio of the number of GPS observations, on at least two frequencies, in the daily RINEX file with respect to the number of expected observations
  - dcat:version to identify the version of both the metadata schema and the API used to output the Distribution metadata
- the DataService class has now the properties:
  - dct:publisher to store information on the entity (organisation) responsible for making the Data Service available
  - dcat:version to identify the version of the API
- the Catalogue and the Dataset have now the properties:
  - owl:versionIRI to inform on the metadata schema (latest version) used
  - dcat:version to identify the version of both the metadata schema and the API used to output the Catalogue and Dataset metadata

1.3.3 Additional changes

The property dqv:hasQualityMeasurement of class Dataset now stores quality information regarding the GNSS station's coordinates i.e. the repeatability of the estimated station coordinates (measure of how stable are the station coordinates in time).
The links to the GeodesyML files and site log of a given GNSS station (stored in the class gnss:Station) are now expressed using as value schema:DataDownload instead of dcat:Distribution.

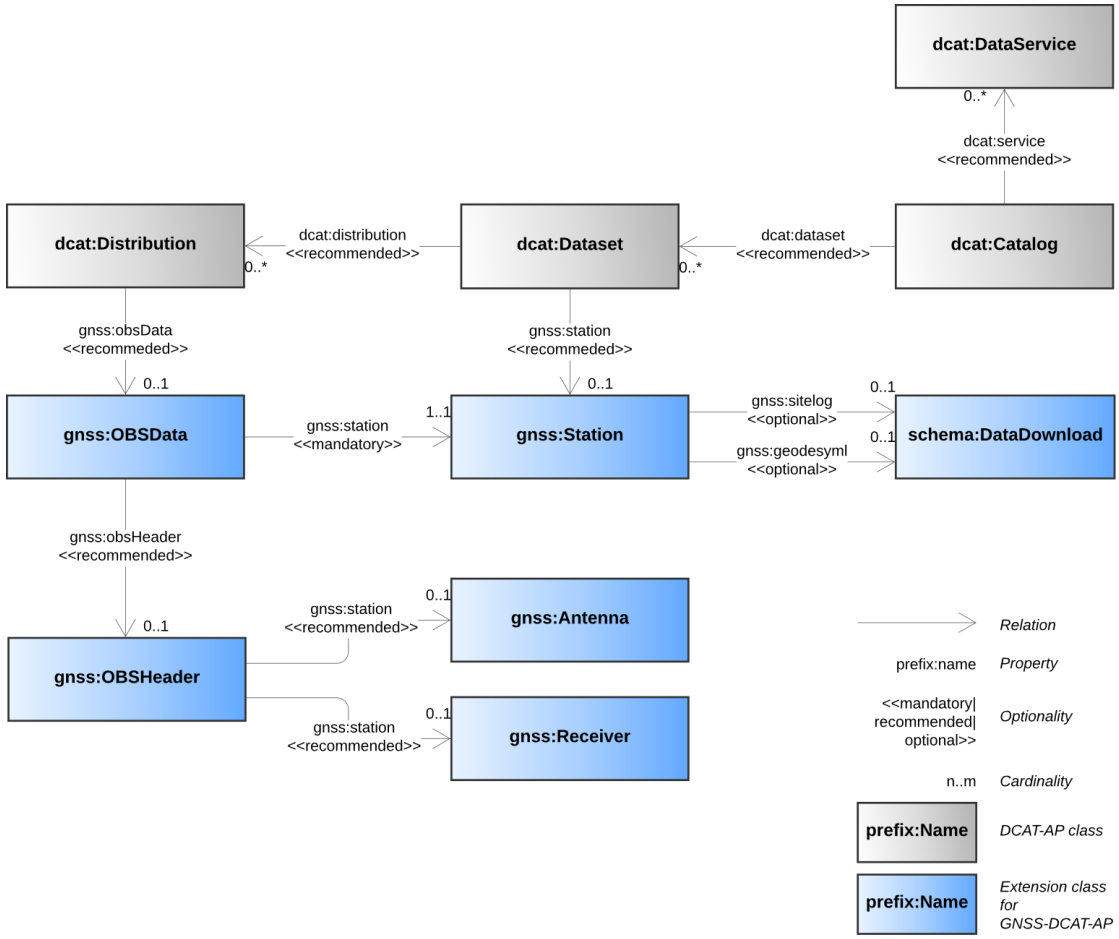
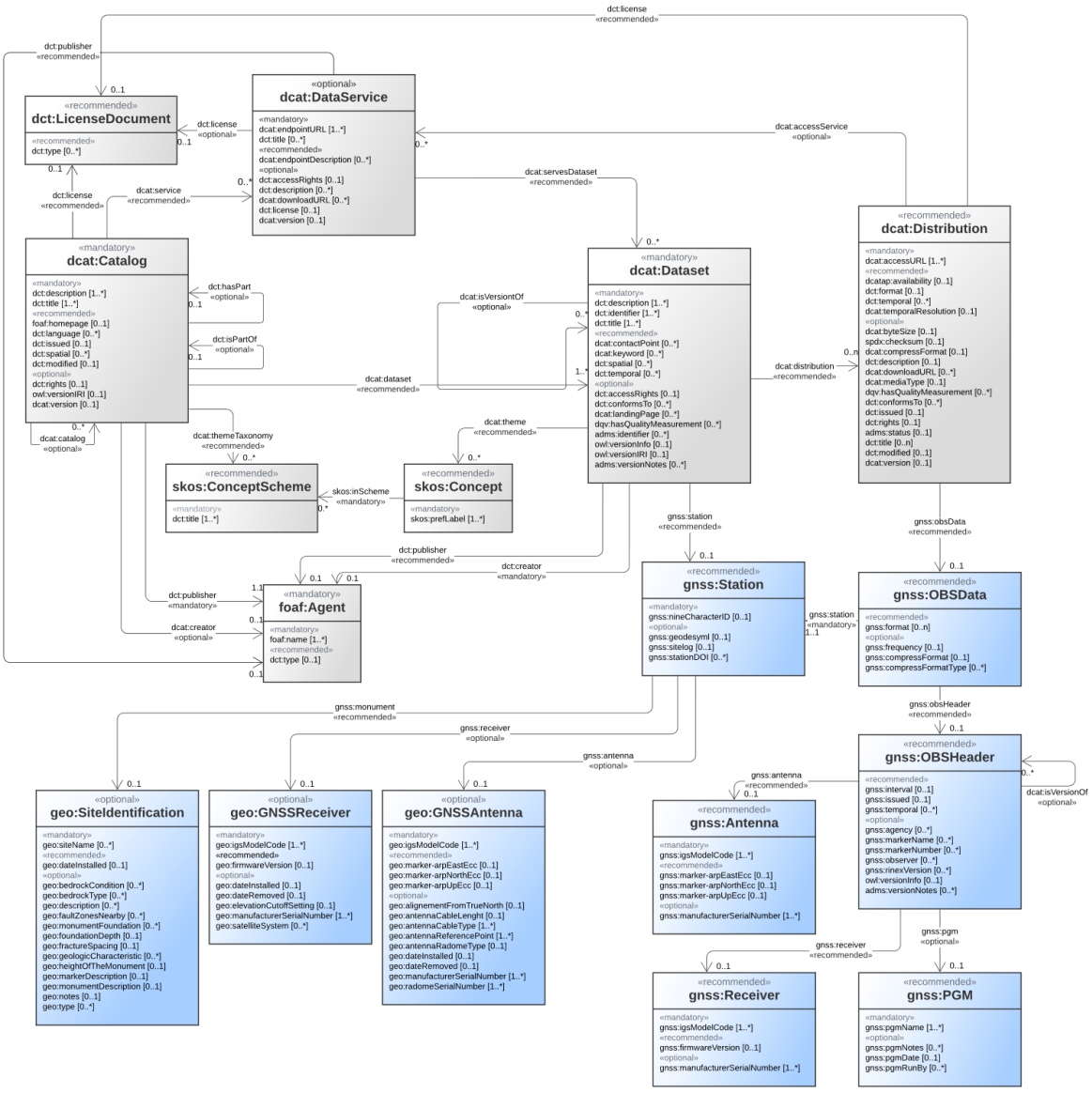


Figure 3: Simplified ULM class diagram providing a partial view of GNSS-DCAT-AP, which extends DCAT-AP 2.1.0 by adding new classes (in blue) and properties. For example, *dcat:Dataset* can be linked to one *gnss:Station* instance via the *gnss:station* property. Only the GNSS-DCAT-AP classes populated so far are shown.

1.4 Class Diagram

Below, a UML diagram of all relevant classes and properties for the proposed GNSS-DCAT application profile (additional classes in blue).



2 Classes

2.1 Mandatory classes

2.1.1 DCAT-AP mandatory classes

Class name	URI	Mandatory/ Recommended/ Optional	Description
Agent	foaf:Agent	Mandatory	An agent/organization/entity associated with Catalogues and or with Datasets.
Catalogue	dcat:Catalog	Mandatory	Repository that hosts the Datasets.
Dataset	dcat:Dataset	Mandatory	A conceptual entity that represents the data itself.
Literal	rdfs:Literal	Mandatory	A literal value such as a string or integer; literals may be typed, e.g. as a date according to xsd:date.

2.2 Recommended classes

2.2.1 DCAT-AP recommended classes

Class name	URI	Mandatory/ Recommended/ Optional	Description
Category	skos:Concept	Recommended	Internal subject/vocabulary
Category scheme	skos:ConceptScheme	Recommended	A concept collection (e.g. controlled vocabulary) in which the Category is defined.
Data service	dcat:DataService	Recommended	A collection of operations that provides access to one or more datasets or data processing functions.
Distribution	dcat:Distribution	Recommended	A physical embodiment of the Dataset in a particular format.
License document	dct:LicenseDocument	Recommended	A legal document giving official permission to use the dataset.

2.2.2 GNSS-DCAT-AP recommended classes

Class name	URI	Mandatory/ Recommended/ Optional	Description
GNSS station antenna	gnss:Antenna	Recommended	Domain specific vocabulary for the antenna associated with gnss:Station

GNSS observation data	gnss:OBSData	Recommended	Domain specific vocabulary for RINEX observation files
GNSS observation data header	gnss:OBSHeader	Recommended	Domain specific vocabulary for the information in the RINEX observation file header associated with gnss:OBSData
GNSS observation data generating software	gnss:PGM	Recommended	Domain specific vocabulary for software used to generate the RINEX file associated with gnss:OBSData
GNSS station receiver	gnss:Receiver	Recommended	Domain specific vocabulary for the receiver associated with gnss:Station
GNSS station	gnss:Station	Recommended	Domain specific vocabulary for station information

2.3 Optional classes

2.3.1 GNSS-DCAT-AP optional classes

Class name	URI	Mandatory/ Recommended/ Optional	Description
GNSS station antenna from GeodesyML	geo:GNSSAntenna	Optional	Antenna info from GeodesyML installed on gnss:temporal (associated with gnss:Station)
GNSS station monument from GeodesyML	geo:Monument	Optional	Monument info from GeodesyML (associated with gnss:Station)
GNSS station receiver from GeodesyML	geo:GNSSReceiver	Optional	Receiver info from GeodesyML installed on gnss:temporal (associated with gnss:Station)

3 Properties per class

The following list of included properties contains a selection of the properties from DCAT-AP as well as new recommended or optional additional properties. DCAT-AP properties that are not mentioned are considered out of scope for GNSS-DCAT-AP. For a quick reference table of properties per class, see Section 4.

3.1 Mandatory classes

3.1.1 DCAT-AP mandatory classes

Agent

foaf:Agent

Property	URI	Range & Cardinality	Mandatory/ Recommended /Optional	Description
name	foaf:name	rdfs:Literal [1..n]	Mandatory	Name of the agent. It can be repeated for different versions of the name (e.g. in different languages)
type	dc:type	skos:Concept [0..1]	Recommended	Type of the agent that makes the Catalogue or Dataset available

Catalogue

dcat:Catalog

Property	URI	Range & Cardinality	Mandatory/ Recommended/ Optional	Description
description	dct:description	rdfs:Literal [1..n]	Mandatory	Free-text account of the Catalogue.
publisher	dct:publisher	foaf:Agent [1..1]	Mandatory	Entity (organisation) responsible for making the Catalogue available.
title	dct:title	rdfs:Literal [1..n]	Mandatory	Name given to the Catalogue.
dataset	dcat:dataset	dcat:Dataset [1..n]	Recommended	Link to the Dataset that is part of the Catalogue.
homepage	foaf:homepage	foaf:Document [0..1]	Recommended	Web page that acts as the main page for the Catalogue.
language	dct:language	dct:LinguisticSystem [0..n]	Recommended	Language used in the textual metadata describing titles
licence	dct:license	dct:LicenseDocument[0..1]	Recommended	Licence under which the Catalogue can be used or reused

release date	dct:issued	xsd:date or xsd:dateTime [0..1]	Recommended	Publication date of the Catalogue
service	dcat:service	dcat:DataService [0..n]	Recommended	A site or end-point that is listed in the catalog.
spatial/geographic	dct:spatial	dct:Location [0..n]	Recommended	Geographical area covered by the Catalogue
themes	dcat:themeTaxonomy	skos:ConceptScheme [0..n]	Recommended	Knowledge organization system used to classify the Catalogue's Datasets
update/modification date	dct:modified	xsd:date or xsd:dateTime [0..1]	Recommended	Most recent date on which the Catalogue was modified.
catalogue	dcat:catalog	dcat:catalog [0..n]	Optional	Catalog whose contents are of interest in the context of this catalog (e.g. GNSS metadata catalogue)
creator	dct:creator	foaf:Agent [0..1]	Optional	Entity primarily responsible for producing the Catalogue
has part	dct:hasPart	dcat:Catalog [0..1]	Optional	Related Catalogue that is part of the described Catalogue
is part of	dct:isPartOf	dcat:Catalog [0..1]	Optional	Related Catalogue in which the described Catalogue is physically or logically included
ontology version	owl:versionIRI	xsd:anyURI [0..1]	Optional	IRI which resolves to a source file corresponding to the ontology version
rights	dct:rights	dct:RightsStatement [0..1]	Optional	Statement that specifies rights associated with the Catalogue.
version	dcat:version	rdfs:Literal [0..1]	Optional	Version number or other version designation of the Catalogue e.g. information on the version of the metadata schema and the API used to output the Catalogue metadata

Dataset

dcat:Dataset

Property	URI	Range & Cardinality	Mandatory/ Recommended/ Optional	Description
creator	dct:creator	foaf:Agent [0..1]	Mandatory	Entity primarily responsible for producing the Dataset
description	dct:description	rdfs:Literal [1..n]	Mandatory	Free-text account of the Dataset.
title	dct:title	rdfs:Literal [1..n]	Mandatory	Name given to the Dataset.

contact point	dcat:contactPoint	vcard:Kind [0..n]	Recommended	Contact information that can be used for sending comments about the Dataset.
dataset distribution	dcat:distribution	dcat:Distribution [0..n]	Recommended	Link to an available Distribution.
identifier	dct:identifier	rdfs:Literal [0..n]	Recommended	Identifier for the Dataset, e.g. the URI or other unique identifier in the context of the Catalogue.
keyword/ tag	dcat:keyword	rdfs:Literal [0..n]	Recommended	Keyword or tag describing the Dataset.
publisher	dct:publisher	foaf:Agent [0..1]	Recommended	Entity (organisation) responsible for making the Dataset available.
station description	gnss:station	gnss:Station	Recommended	Description of the station.
spatial/geographic	dct:spatial	dct:Location [0..n]	Recommended	Geographic region that is covered by the Dataset.
temporal coverage	dct:temporal	dct:PeriodOfTime [0..n]	Recommended	Temporal period that the Dataset covers.
theme/ category	dcat:theme, subproperty of dct:subject	skos:Concept[0..n]	Recommended	Category of the Dataset. A Dataset may be associated with multiple themes.
access rights	dct:accessRights	dct:RightsStatement [0..1]	Optional	Information that indicates whether the Dataset is publicly accessible, has access restrictions or is not public.
conforms to	dct:conformsTo	dct:Standard [0..n]	Optional	Implementation rule or other specification. (e.g. RINEX 2/ RINEX 3 standards)
has quality measurement	dqv:hasQualityMeasurement	dqv:QualityMeasurement [0..n]	Optional	Repeatability of the estimated station coordinates (measure of how stable are the station coordinates in time)
is version of	dcat:isVersionOf	dcat:Dataset [0..n]	Optional	Related Dataset of which the described Dataset is a version, edition, or adaptation.
landing page	dcat:landingPage	foaf:Document[0..n]	Optional	Web page that provides access to the Dataset
other identifier	adms:identifier	adms:Identifier [0..n]	Optional	Secondary identifier of the Dataset, such as MAST/ADS, DataCite, DOI, EZID or W3ID.
ontology version	owl:versionIRI	xsd:anyURI [0..1]	Optional	IRI which resolves to a source file corresponding to the ontology version
version	dcat:version	rdfs:Literal [0..1]	Optional	Version number or other version designation of the Dataset e.g. information on the version of the

				metadata schema and the API used to output the Dataset metadata
version note	adms:versionNotes	rdfs:Literal [0..n]	Optional	Description of the differences between this version and a previous version of the Dataset.

Literal

rdfs:Literal

Property	URI	Range & Cardinality	Mandatory/ Recommended/ Optional	Description
dataset	dcat:dataset	dcat:Dataset [1..n]	Mandatory	Link to the Dataset that is part of the Catalogue.
description	dct:description	rdfs:Literal [1..n]	Recommended	Free-text account of the Catalogue.

3.2 Recommended classes

3.2.1 DCAT-AP recommended classes

Category

skos:Concept

Property	URI	Range & Cardinality	Mandatory/ Recommended/ Optional	Description
Preferred label	skos:prefLabel	rdfs:Literal [1..n]	Mandatory	Preferred label of the Category. It can be repeated for parallel language versions of the label.

Category scheme

skos:ConceptScheme

Property	URI	Range & Cardinality	Mandatory/ Recommended/ Optional	Description
Title	dc:title	rdfs:Literal [1..n]	Mandatory	Name of the Category scheme. May be repeated for different versions of the name

Data service

dcat:DataService

Property	URI	Range & Cardinality	Mandatory/ Recommended/	Description

			Optional	
endpoint URL	dcat:endpointURL	rdfs:Resource [1..n]	Mandatory	The root location or primary endpoint of the service (an IRI).
title	dct:title	rdfs:Literal [0..n]	Mandatory	Name of the Data Service.
endpoint description	dcat:endpointDescription	rdfs:Resource [0..n]	Recommended	Description of the services available via the end-points, including their operations, parameters etc.The property gives specific details of the actual endpoint instances, while dct:conformsTo is used to indicate the general standard or specification that the endpoints implement.
serves dataset	dcat:servesDataset	dcat:Dataset [0..n]	Recommended	Collection of data that this data service can distribute
publisher	dct:publisher	foaf:Agent [0..1]	Recommended	An entity (organisation) responsible for making the Data Service available.
access rights	dct:accessRights	dct:RightsStatement[0..1]	Optional	Information regarding access or restrictions based on privacy, security, or other policies..
description	dct:description	dfs:Literal [0..n]	Optional	Free-text account of the Data Service
download URL	dcat:downloadURL	rdfs:Resource [0..n]	Optional	URL that is a direct link to a downloadable file in a given format.
licence	dct:license	dct:LicenseDocument [0..1]	Optional	Licence under which the Data service is made available.
version	dcat:version	rdfs:Literal [0..1]	Optional	Version number or other version designation of the Data service

Distribution

dcat:Distribution

Property	URI	Range & Cardinality	Mandatory/ Recommended/ Optional	Description
access URL	dcat:accessURL	rdfs:Resource [1..n]	Mandatory	URL that gives access to a Distribution of the Dataset.
availability	dcatap:availability	skos:Concept [0..1]	Recommended	Planned availability of the Distribution of the Dataset
description	dct:description	rdfs:Literal [1..n]	Recommended	Free-text account of the Distribution
format	dct:format	dct:MediaTypeOrExtent [0..1]	Recommended	File format of the Distribution.

licence	dct:license	dct:LicenseDocument [0..1]	Recommended	Licence under which the Distribution is made available.
GNSS observation data	gnss:obsData	gnss:OBSData [0..1]	Recommended	GNSS observation data
temporal coverage	dct:temporal	dct:PeriodOfTime [0..n]	Recommended	Temporal period covered by the Distribution.
temporal resolution	dcat:temporalResolution	xsd:duration [0.1]	Recommended	Temporal resolution of the Distribution e.g. 30 sec
access service	dcat:accessService	dcat:DataService [0..n]	Optional	A data service that gives access to the distribution of the dataset
byte size	dcat:byteSize	xsd:nonNegativeInteger [0..1]	Optional	Size of a Distribution in bytes.
checksum	spdx:checksum	spdx:Checksum [0..1]	Optional	Mechanism that can be used to verify that the contents of a Distribution have not changed.
compression format	dcat:compressFormat	dct:MediaType[0..1]	Optional	Format of the file in which the data is contained in a compressed form.
download URL	dcat:downloadURL	rdfs:Resource [0..n]	Optional	URL that is a direct link to a downloadable file in a given format.
format	dcat:mediaType	dct:MediaType[0..1]	Optional	Media type of the Distribution as defined by IANA
has quality measurement	dqv:hasQualityMeasurement	dqv:QualityMeasurement [0..n]	Optional	A quality measurement performed on the Distribution (e.g. ratio of the number of GPS observations, on at least two frequencies, in the daily RINEX file with respect to the number of expected observations)"
linked schemas	dct:conformsTo	dct:Standard [0..n]	Optional	Established schema to which the described Distribution conforms. (RNX2/RNX3 documentation)
release date	dct:issued	rdfs:Literal typed as xsd:date or xsd:dateTime[0..1]	Optional	Date of formal issuance (e.g., publication) of the Distribution.
rights	dct:rights	dct:RightsStatement[0..1]	Optional	Statement that specifies rights associated with the Distribution.
status	adms:status	skos:Concept [0..1]	Optional	Status of the Distribution in the context of the publication process e.g. RINEX file no longer meant to be published
title	dct:title	rdfs:Literal [0..n]	Optional	Name given to the Distribution.
update/modification date	dct:modified	rdfs:Literal typed as xsd:date or	Optional	Most recent date on which the Distribution was

		xsd:dateTime [0..1]		changed or modified.
version	dcat:version	rdfs:Literal [0..1]	Optional	Version number or other version designation of the Distribution e.g. information on the version of the metadata schema and the API used to output the Distribution metadata

License document

dct:LicenseDocument

Property	URI	Range & Cardinality	Mandatory/ Recommended/ Optional	Description
License type	dct:type	skos:Concept [0..n]	Recommended	Type of licence, e.g. indicating 'public domain' or 'royalties required'.

3.2.2 GNSS-DCAT-AP recommended classes

GNSS station antenna

gnss:Antenna

Property	URI	Range & Cardinality	Mandatory/ Recommended/ Optional	Description
IGS model code	gnss:igsModelCode	rdfs:Literal[1..n]	Mandatory	Antenna and radome name (e.g. TRM57971.00 NONE)
distance ARP-marker (east)	gnss:marker-arpEastEcc	xsd:float[0..1]	Recommended	Distance from the ARP[3] to the marker - East component
distance ARP-marker (north)	gnss:marker-arpNorthEcc	xsd:float[0..1]	Recommended	Distance from the ARP to the marker - North component
distance ARP-marker (up)	gnss:marker-arpUpEcc	xsd:float [0..1]	Recommended	Distance from the ARP to the marker - Up component
manufacturer serial number	gnss:manufacturerSerialNumber	rdfs:Literal[1..n]	Optional	Serial number of the antenna

GNSS observation data

gnss:OBSData

Property	URI	Range & Cardinality	Mandatory/ Recommended/ Optional	Description
station	gnss:station	gnss:Station[1..1]	Mandatory	Station description
file format	gnss:format	rdfs:Literal [0..n]	Recommended	RINEX 2 / RINEX 3/ RINEX 4

[3] ARP: Antenna Reference Point

header	gnss:obsHeader	gnss:OBSHeader[0..1]	Recommended	Metadata for the RINEX header
frequency	gnss:frequency	dct:Frequency[0..1]	Optional	Daily/hourly RINEX files
CRX compression	gnss:compressFormat	dct:Standard[0..1]	Optional	Compression Format (e.g. Hatanaka)
CRX version	gnss:compressFormatType	rdfs:Literal [0..n]	Optional	Crinex Version (e.g. 3.0)

GNSS observation data header

gnss:OBSHeader

Property	URI	Range & Cardinality	Mandatory/ Recommended/ Optional	Description
antenna	gnss:antenna	gnss:Antenna [0..1]	Recommended	Antenna information from the RINEX header
interval	gnss:interval	xsd:nonNegativeInteger [0..1]	Recommended	30 sec / 15 sec/1 sec
receiver	gnss:receiver	gnss:Receiver [0..1]	Recommended	Receiver information from RINEX header
release date	gnss:issued	xsd:date or xsd:dateTime [0..1]	Recommended	Publication date of the header
temporal coverage	gnss:temporal	dct:PeriodOfTime [0..n]	Recommended	Temporal coverage from the RINEX header (start time/date-end time/date).
agency	gnss:agency	rdfs:Literal[0..n]	Optional	Agency as in the RINEX header (e.g., ROB)
is version of	gnss:isVersionOf	gnss:OBSHeader [0..n]	Optional	Related gnss:OBSHeader of which the described header is a version, edition or adaptation.
marker name	gnss:markerName	rdfs:Literal [0..n]	Optional	Marker name in the RINEX header (4-char/9-char id)
marker number	gnss:markerNumber	rdfs:Literal[0..n]	Optional	DOMES number
observer	gnss:observer	rdfs:Literal[0..n]	Optional	Observer as in the RINEX header (e.g., John Smith)
pgm	gnss:pgm	gnss:PGM [0..1]	Optional	Info regarding the software used to generate the file as from the RINEX header
rinex version	gnss:rinexVersion	rdfs:Literal[0..n]	Optional	RINEX sub-version (text e.g 3.04)
version	owl:versionInfo	rdfs:Literal [0..1]	Optional	Version number or other version designation of the RINEX Header.
version note	adms:versionNotes	rdfs:Literal [0..n]	Optional	Description of the differences between current and a previous version of the RINEX

				header.

GNSS observation data generating software

gnss:PGM

Property	URI	Range & Cardinality	Mandatory/ Recommended/ Optional	Description
name	gnss:pgmName	rdfs:Literal[1..n]	Mandatory	Name of the software used to generate the RINEX file (e.g. Spider V7.1.1.7438)
comment	gnss:pgmNotes	rdfs:Literal[0..n]	Optional	Comment (e.g. THIS RINEX FILE IS CREATED FROM LB2 DATA)
date	gnss:pgmDate	as xsd:date or xsd:dateTime[0..1]	Optional	PGM generation date as from the RINEX header
run by	gnss:pgmRunBy	rdfs:Literal[0..n]	Optional	Name of the agency operating the software generating the RINEX file

GNSS station receiver

gnss:Receiver

Property	URI	Range & Cardinality	Mandatory/ Recommended/ Optional	Description
IGS model code	gnss:igsModelCode	rdfs:Literal[1..n]	Mandatory	Receiver name (e.g. TRIMBLE NETR9)
firmware version	gnss:firmwareVersion	rdfs:Literal[0..1]	Recommended	Firmware version (e.g. 5.37)
manufacturer serial number	gnss:manufacturerSerialNumber	rdfs:Literal[1..n]	Optional	Serial number for the receiver (e.g. 5608R50231)

GNSS station

gnss:Station

Property	URI	Range & Cardinality	Mandatory/ Recommended/ Optional	Description
station long marker name	gnss:nineCharacterID	rdfs:Literal[0..1]	Mandatory	9-char id of the station
Station monument	gnss:monument	geo:Monument[0..1]	Recommended	Station monument
antenna	gnss:antenna	geo:GNSSAntenna[0..1]	Optional	Station antenna from GeodesyML
GeodesyML link	gnss:geodesyml	schema:DataDownload[0..1]	Optional	URL Resource for the GeodesyML file
receiver	gnss:receiver	geo:GNSSReceiver[0..1]	Optional	Station receiver from GeodesyML

station identifier	gnss:stationDOI	adms:Identifier [0..n]	Optional	Identifier of the station (e.g. MAST/ADS, DataCite, DOI, EZID or W3ID.
site log	gnss:sitelog	schema:DataDownload[0..1]	Optional	URL resource for the sitelog file

3.3 Optional classes

3.3.1 GNSS-DCAT-AP optional classes

GNSS station antenna from GeodesyML

geo:GNSSAntenna

Property	URI	Range & Cardinality	Mandatory/ Recommended/ Optional	Description
IGS model code	geo:igsModelCode	rdfs:Literal[1..n]	Mandatory	Antenna name (e.g. TRM57971.00 NONE)
distance ARP-marker (east)	geo:marker-arpEastEcc	xsd:float[0..1]	Recommended	Distance from the ARP to the marker - East component
distance ARP-marker (north)	geo:marker-arpNorthEcc	xsd:float[0..1]	Recommended	Distance from the ARP to the marker - North component
distance ARP-marker (up)	geo:marker-arpUpEcc	xsd:float[1]	Recommended	Distance from the ARP to the marker - Up component
alignment from true north	geo:alignmentFromTrueNorth	xsd:double[0..1]	Optional	Alignment from true north
antenna cable length	geo:antennaCableLength	xsd:double[0..1]	Optional	Length of the antenna cable (e.g. 70.0)
antenna cable type	geo:antennaCableType	rdfs:Literal[1..n]	Optional	Type of cable of the antenna (e.g. CNT-400 50 Ohm)
antenna reference point	geo:antennaReferencePoint	gml:CodeType[1..n]	Optional	ARP type (e.g. BPA)
antenna radome type	geo:antennaRadomeType	geo:igsRadomeModelCodeType[0..1]	Optional	Radome Type (e.g. : NONE)
date installed	geo:dateInstalled	gml:TimePositionType[0..1]	Optional	Installation date (e.g. 2009-08-05T02:00:00Z)
date removed	geo:dateRemoved	gml:TimePositionType[0..1]	Optional	Removal date (e.g. 2010-05-03T01:30:00Z)
manufacturer serial number	geo:manufacturerSerialNumber	rdfs:Literal[1..n]	Optional	Serial number for the antenna (e.g. 103320)
radome serial number	geo:radomeSerialNumber	rdfs:Literal[1..n]	Optional	Serial number of the radome (e.g. N/A)

GNSS station monument from GeodesyML

geo:Monument

Property	URI	Range & Cardinality	Mandatory/ Recommended / Optional	Description
site names/identifiers	geo:name	gml:CodeType[0..n]	Mandatory	GNSS site names, (e.g. 4-char id, site-name, iers-DOMES, cdp-number)
installed Date	geo:installedDate	gml:TimePositionType[0..1]	Recommended	Station installation date (e.g. 2002-09-15Z)
bedrock condition	geo:bedrockCondition	rdfs:Literal[0..n]	Optional	Bedrock conditions (e.g., FRESH)
bedrock type	geo:bedrockType	rdfs:Literal[0..n]	Optional	Bedrock Type (e.g. SEDIMENTARY)
site description	geo:description	rdfs:Literal[0..n]	Optional	Site Description
fault zones nearby	geo:faultZonesNearby	rdfs:Literal[0..n]	Optional	Fault zones nearby (e.g. NO)
monument foundation	geo:foundation	gml:CodeType[0..n]	Optional	Monument foundation (e.g. CONCRETE BLOCK)
foundation depth	geo:foundationDepth	xsd:double[0..1]	Optional	Depth of monument foundation (e.g. : 3 m)
fracture spacing	geo:fractureSpacing	xsd:double[0..1]	Optional	Fracture spacing (e.g. 0 cm)
geologic characteristic	geo:geologicCharacteristic	rdfs:Literal[0..n]	Optional	Geologic characteristic (e.g. SAND)
height of the Monument	geo:height	xsd:double[0..1]	Optional	Height of the monument (e.g. 8 m)
marker description	geo:markerDescription	gml:TimePositionType[0..1]	Optional	Marker description (e.g. CENTER OF HOLE IN STEEL PLATE)
monument Description	geo:monumentDescription	rdfs:Literal[0..1]	Optional	Monument description (e.g. STEEL MAST)
notes	geo:notes	rdfs:Literal[0..1]	Optional	Additional information
type	geo:type	rdfs:Literal[0..n]	Optional	Monument-type (e.g. CORS)

GNSS station receiver from GeodesyML

geo:GNSSReceiver

Property	URI	Range & Cardinality	Mandatory/ Recommended /Optional	Description

igs Model Code	geo:igsModelCode	rdfs:Literal[1..n]	Mandatory	Receiver name (e.g.TRIMBLE NETR9)
firmware version	geo:firmwareVersion	rdfs:Literal[0..1]	Recommended	Firmware version (e.g. 5.37)
date installed	geo:dateInstalled	gml:TimePosition Type[0..1]	Optional	Receiver installation date e.g. 2020-05-01T00:00Z
date removed	geo:dateRemoved	gml:TimePosition Type[0..1]	Optional	Receiver removal date e.g.2021-04-11T12:00Z
elevation cutoff setting	geo:elevationCutoffSetting	xsd:double[0..1]	Optional	Elevation cut off settings (e.g. 0)
manufacturer serial number	geo:manufacturerSerialNumber	rdfs:Literal[1..n]	Optional	Serial number for the receiver (e.g. 5608R50231)
satellite system	geo:satelliteSystem	gml:CodeType[0..n]	Optional	Satellite system (e.g GPS+GLO+GAL)

4 Quick reference of classes and properties

Class	URI	Mandatory properties	Recommended properties	Optional properties
Mandatory classes				
Agent	foaf:Agent	foaf:name	dct:type	
Catalogue	dcat:Catalog	dct:description dct:publisher dct:title	dcat:dataset foaf:homepage dct:language dct:license dct:issued dcat:service dct:spatial dcat:themeTaxonomy dct:modified	dcat:catalog dct:creator dct:rights dcat:version owl:versionIRI
Dataset	dcat:Dataset	dct:creator dct:description dct:title	gnss:Station dcat:contactPoint dcat:distribution dct:identifier dcat:keyword dct:publisher dct:spatial dct:temporal dcat:theme, subproperty of dct:subject	dct:accessRights dct:conformsTo dcat:isVersionOf dcat:landingPage dqv:hasQualityMeasurement dcat:version adms:identifier owl:versionInfo owl:versionIRI adms:versionNotes
Literal	rdfs:Literal			
Recommended classes				
Category	skos:Concept	skos:prefLabel		
Category scheme	skos:ConceptScheme	dct:title		
Data service	dcat:DataService	dcat:endpointURL dct:title dct:publisher	dcat:endpointDescription dcat:servesDataset	dct:accessRights dct:description dcat:downloadURL dct:license

				dcat:version
Distribution	dcat:Distribution	dcat:accessURL	gnss:obsData dcatap:availability dct:format dct:license dct:temporal dcat:temporalResolution	dcat:accessService dcat:byteSize spdx:checksum dcat:compressFormat dcat:downloadURL dcat:mediaType dqv:hasQualityMeasurement dct:conformsTo dct:issued dct:rights adms:status dct:title dct:modified dcat:version
GNSS station antenna	gnss:Antenna	gnss:igsModelCode	gnss:marker-arpEastEcc gnss:marker-arpNorthEcc gnss:marker-arpUpEcc	gnss:manufacturerSerialNumber
GNSS observation data	gnss:OBSData	gnss:station	gnss:format gnss:obsHeader	gnss:frequency gnss:compressFormat gnss:compressFormatType
GNSS observation data header	gnss:OBSHeader		gnss:antenna gnss:interval gnss:issued gnss:receiver gnss:temporal	gnss:agency gnss:isVersionOf gnss:markerName gnss:markerNumber gnss:observer gnss:pgm gnss:rinexVersion owl:versionInfo adms:versionNotes
GNSS observation data processing	gnss:PGM	gnss:pgmName		gnss:pgmNotes gnss:pgmDate gnss:pgmRunBy
GNSS station receiver	gnss:Receiver	gnss:igsModelCode	gnss:firmwareVersion	gnss:manufacturerSerialNumber
License document	dct:LicenseDocument		dct:type	
GNSS station	gnss:Station	gnss:nineCharacterID	gnss:monument	gnss:geodesyml gnss:stationDOI gnss:sitelog
Optional classes				
GNSS station antenna from GeodesyML	geo:GNSSAntenna	geo:igsModelCode	geo:marker-arpEastEcc geo:marker-arpNorthEcc geo:marker-arpUpEcc	geo:alignmentFromTrueNorth geo:antennaCableLength geo:antennaCableType geo:antennaReferencePoint geo:antennaRadomeType geo:dateInstalled geo:dateRemoved geo:manufacturerSerialNumber geo:radomeSerialNumber
GNSS station monument from GeodesyML	geo:Monument	geo:name	geo:installedDate	geo:bedrockCondition geo:bedrockType geo:description geo:faultZonesNearby geo:foundation geo:foundationDepth geo:fractureSpacing geo:geologicCharacteristic geo:height geo:markerDescription geo:monumentDescription geo:notes

				geo:type
GNSS station receiver from GeodesyML	geo:GNSSReceiver	geo:igsModelCode	geo:firmwareVersion	geo:dateInstalled geo:dateRemoved geo:elevationCutoffSetting geo:manufacturerSerialNumber geo:satelliteSystem