

WIGOS Core Metadata. Draft specification.

WIGOS Core Metadata – Semantic Standard

ICG-WIGOS TT-WMD

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Purpose and Scope of WIGOS metadata

An important aspect of WIGOS (WMO Integrated Global Observing System) implementation is ensuring maximum usefulness of WIGOS observations and measurement data. Data on its own is of very limited use: it is only when accompanied by adequate metadata (data describing the data) that the full potential of the data can be utilized. Metadata of two complementary types are required. The first of these is **discovery metadata** – information that facilitates data discovery, access and retrieval. **These metadata are WIS (WMO Information System) metadata** and are specified and handled as part of WIS. The second type is **interpretation or description metadata** – information that enables data values to be interpreted in context. **These latter metadata are WIGOS metadata** and are the subject of this specification, which provides a WIGOS-wide standard for the minimum interpretation metadata set (the ‘core’ metadata set) required for the effective interpretation of data from all WIGOS observing sub-systems by all data users.

WIGOS metadata should describe the observed quantity, the conditions under which it was observed, how it was measured, and how the data has been processed, in order to provide data users with confidence that the use of the data is appropriate for their application. GCOS Climate Monitoring Principle #3 describes the relevance of metadata as:

“The details and history of local conditions, instruments, operating procedures, data processing algorithms and other factors pertinent to interpreting data (i.e., metadata) should be documented and treated with the same care as the data themselves.”

WIGOS Observations consist of an exceedingly wide range of data from the manual observations to complex combinations of satellite hyper-spectral frequency bands, measured *in situ* or remotely, from single dimension to multiple dimensions, and those involving post observation analysis. A comprehensive metadata specification to cover all types of data is by nature complex to define. A user should be able to use the WIGOS metadata to identify the conditions under which the observations or measurement was made, and any aspects which may affect the use or understanding of the data; i.e. to determine whether the data are fit for purpose.

WIGOS 'Core' Metadata Categories

Ten categories of metadata have been identified. These are listed in Table 1 below. They define the 'core' of the WIGOS metadata standard. All of the elements listed are considered to be important for the documentation and interpretation of observations made even in the distant future. Hence, the standard currently declares many elements as mandatory that are clearly not needed for applications focusing on more immediate use of observations. For these applications, such as numerical weather prediction, aeronautical or other transport sector applications, advisories, etc., profiles of the standard would have to be developed. The categories are in no particular order but reflect the need to specify the observed quantity; to answer why, where, and how an observation was made; how the raw data were processed; and what the quality of the data is.

Each of these categories contains a number of individual elements as shown in Figure 1. Note that some of these elements will most likely be implemented using several individual entities (e.g., geolocation will consist of the atomic elements latitude, longitude, elevation or a set of polar coordinates.)

Table 1. WIGOS core metadata categories

#	Category	Description
1	observed quantity	The specification of a measurand requires knowledge of the kind of quantity, description of the state of the phenomenon, body, or substance carrying the quantity, including any relevant component, and the chemical entities involved. [VIM3, 2.3].
2	purpose of observation	Specifies the main application area(s) of an observation and the observation program an observation is affiliated to.
3	data quality	Specifies the data quality and traceability of an observation or dataset.
4	environment	Specifies the geographical setting within which an observation was made.
5	data processing	Specifies how raw data are transferred into the reported physical quantities.
6	sampling and analysis	Specifies how the observation was made or a specimen collected.
7	station/platform	Specifies the environmental monitoring facility, including fixed station, moving equipment or remote sensing platform, at which an observed quantity is measured using an instrument.
8	instrument	Specifies characteristics of the instrument(s) used to make the observation.
9	ownership and data policy	Specifies who is responsible for the observation and owns it.
10	contact	Specifies where information about an observation or dataset can be obtained.

For example, an observation / dataset will have the following metadata categories associated with it

- One or several purpose(s) of observation (e.g. upper air observations and surface synoptic observations)
- Data processing procedures associated with the instruments
- Instruments which have been used to make the observation
- A station/platform to which the instrument(s) belong(s)
- Ownership and data policy restriction
- Contact

An instrument can observe/measure one or more quantities. For example:

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- a resistance temperature device can report temperature;
- a humidity probe can report temperature and humidity;
- a sonic anemometer can report wind speed, wind direction and air temperature

An instrument can be associated with:

- sampling and analysis (e.g. 10 Hz samples of air temperature)
- data processing (e.g. ceilometer reporting of 10 min statistics of cloud height following processing through sky condition algorithm);

An observed quantity can be influenced or characterized by the environment, for example:

- wind speed (observed quantity) on top of a hill (environment);
- river yield (observed quantity) characterized by the upstream catchment and land use

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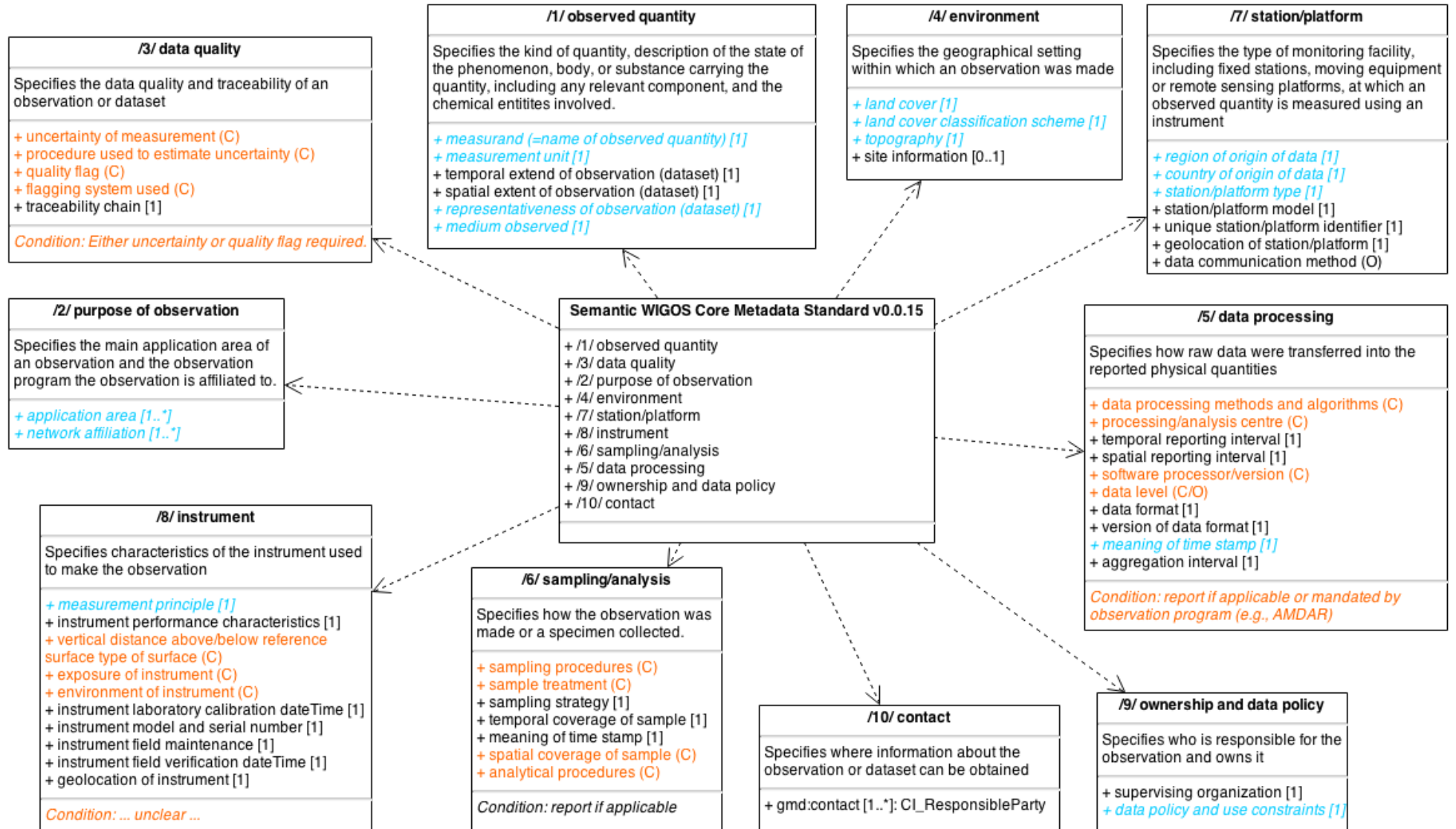


Figure 1. UML diagram specifying the WIGOS Metadata Standard (blue italic: code tables expected; orange: conditional (C) or optional (O) elements)

A Note on Space and Time

It is important to understand that WIGOS metadata are intended to describe a dataset, i.e. one or several observations, including the where, when, how, and even why the observations were made. As a consequence, reference to space and time is made in several places throughout the standard.

Figure 2 illustrates the concepts and terms used to describe the **temporal aspects** of an observation or dataset, sampling strategy, analysis and data processing.

The concepts and terms used to describe **spatial aspects** (i.e., geolocation) of observations are perhaps even more complex. For example, for ground-based in-situ observations, the spatial extent of the observation coincides with the geolocation of the sensor, which in most cases will be time-invariant and is normally close to the geolocation of the station/platform where the observation was made. For a satellite-based lidar system, the situation is quite different. Depending on the granularity of metadata desired, the spatial extent of the individual observation may be an individual pixel in space, the straight line probed during an individual laser pulse, or perhaps an entire swath. In any case, the spatial extent of the observation will not coincide with the location of the sensor. The WIGOS metadata standard therefore needs to take into account such quantities as

1. the spatial extent of the observed quantity (e.g. atmospheric column above a Dobson Spectrophotometer) (cf. 1-04)
2. the location of the station/platform (e.g. radar transmitter/receiver or aircraft position/route) (cf. 7-06)
3. the location of the instrument (e.g. the anemometer is located adjacent to Runway 23) (cf. 8-03, 8-10)
4. the spatial representativeness of the observation (cf. 1-05)

All these are expressed in terms of geolocations, specifying either a zero-dimensional geographic extent (a point), a one-dimensional geographic extent (a line, either straight or curved), a two-dimensional geographic extent (a plane or other surface), or a three-dimensional geographic extent (a volume).

By way of example, a station/platform can be:

1. collocated with the observed quantity as for in situ surface observations station (e.g. AWS)
2. collocated with the instrument but remote to the observed quantity (e.g. Radar)
3. remote from where the instrument may transmit data to the station (e.g. Airport surface station where instruments are located across the airport, or a balloon atmosphere profiling station)
4. in motion and travelling through the observed medium (e.g. Aircraft AMDAR equipped aircraft)
5. in motion and remote to the observed medium (e.g. satellite platform)

An Instrument can be:

1. collocated with the observed quantity (e.g. surface observations temperature sensor);
2. remote to the observed quantity (e.g. radar transmitter/receiver);
3. in motion but located in the observed medium (e.g. radiosonde)
4. in motion and remote from the observed quantity (e.g. satellite based radiometer)
5. located within a standardized enclosure (e.g. a temperature sensor within a Stevenson screen)

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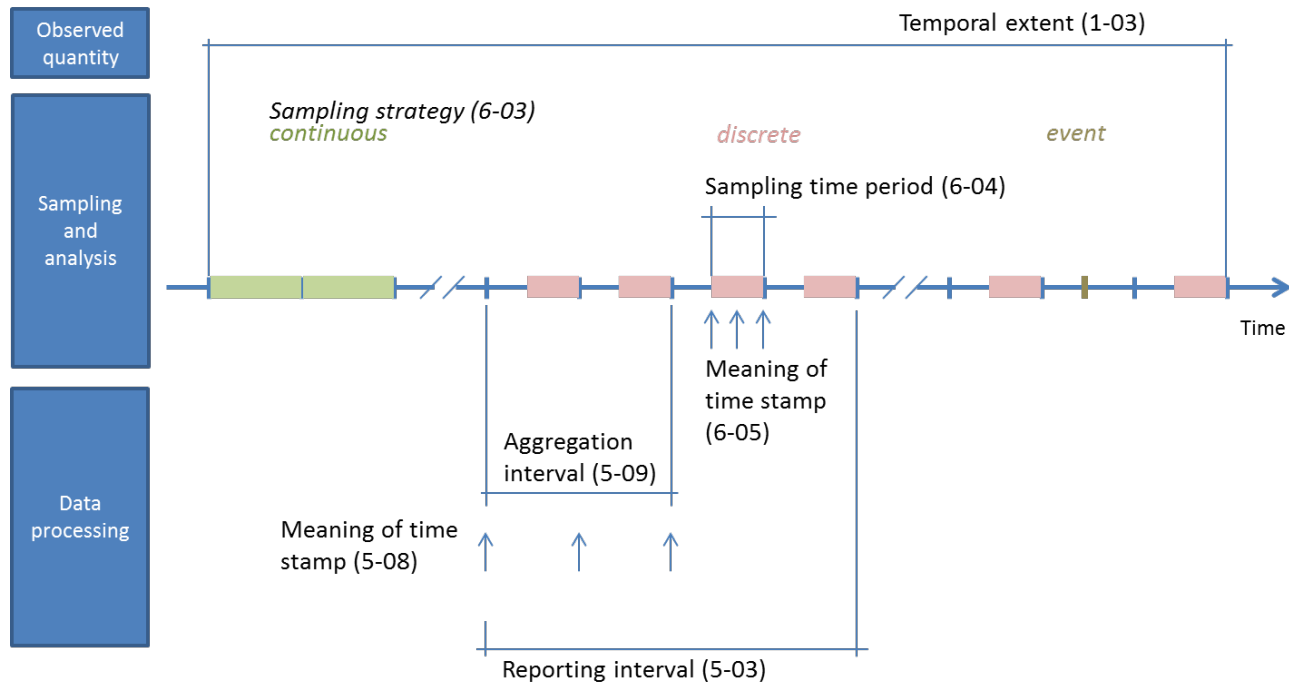


Figure 2. Graphical representation of temporal elements referenced in WIGOS Metadata categories

Reporting Obligations for WIGOS Metadata

In keeping with ISO, the elements are classified as either mandatory (M), conditional (C), or optional (O).

Most of the elements in this standard are considered **mandatory** and presumed to be of importance for all WMO Technical Commissions in view of enabling adequate future use of (archived) data. Metadata providers are expected to report mandatory metadata elements, and a formal validation of a metadata record will fail if mandatory elements are not reported. The TT-WMD recognizes however that not all Members may be in a position to provide all these elements at present, and that a small fraction of these mandatory elements may not even be applicable for a specific type of observation. Under such circumstances, the reason for not providing information on mandatory elements shall be reported as “not applicable” or “unknown”. The motivation for this is that knowledge of the reason why a mandatory metadata element is not available provides more information than not reporting a mandatory element at all.

Optional elements provide useful information that can help to better understand an observation. As is to be expected for a ‘core’ metadata standard, very few elements are considered optional. Optional elements are likely to be important for a particular community, but less so for others.

Conditional elements must be reported under certain conditions. For example, the category <environment> is classified as conditional, because for the most part, it really only applies to land stations/platforms (a land cover type ‘water’ is allowed, though). Therefore, the elements in this category should be considered mandatory for land stations/platforms, but not so for e.g., satellites, aircraft. Within this category, there are mandatory elements and one optional element.

The Appendix details the independent assessment of elements in terms of mandatory, conditional or optional, and shows that there was considerable consistency among representatives of various Technical Commissions. The indication of obligation in the tables below reflects a consensus of TT-WMD with a view to specifying the metadata needed for adequate use of observations in future analysis.

Implementation and Use of Standard

This document is a semantic standard, not an implementation guideline. A semantic standard specifies the elements that exist and that can be reported. It does not specify how the information shall be encoded or exchanged. However, the following are likely scenarios and important aspects that may help the reader appreciate what lies ahead.

1. The most likely implementation will be in XML, in line with the specifications for WIS metadata and common interoperability standards. Regardless of the final implementation, the full metadata record describing a dataset can be envisioned as a tree with the category as branches off the stem, and the individual elements as leaves on these branches. Some branches may occur more than once, e.g., a dataset may have been generated using more than one instrument at once, in which case two branches for 'instrument' may be required.
2. Not all of the elements specified in this document need to be updated at the same frequency. Some elements, such as position of a land-based station are more or less time-invariant, while others, such as a specific sensor, may change regularly every year. Still other elements, such as environment, may change gradually or rarely, but perhaps abruptly. Finally, elements restricting the application of an observation, e.g., to road condition forecasting, may have to be transmitted with every observation. The implementation of the WIGOS metadata needs to be able to deal with this.
3. Not all applications of observations require the full suite of metadata as specified in this standard at any given time. The amount of metadata that needs to be provided to be able to make adequate use of an observation, for example for the purpose of issuing a heavy precipitation warning, is much less than for the adequate use of even the same observation for a climatological analysis. On the other hand, the metadata needed for near-real-time applications also need to be provided in near-real-time. This is important to realize, as it makes the task of providing WIGOS metadata much more tractable. The implementation of WIGOS metadata needs to be able to cope with vastly different update intervals, and incremental submission of additional metadata to allow the creation of 'complete' metadata records.
4. User will want to obtain and filter datasets according to certain criteria / properties as described within each WIGOS metadata record. This functionality requires either a central repository for WIGOS metadata or full interoperability of the archives collecting WIGOS metadata.

How, then can these requirements be met? In the case where observations are clearly only used for some near-real-time application and there is clearly no long-term use or re-analysis application to be expected, a profile of the WIGOS metadata standard may be specified that declares a specific subset of metadata elements as mandatory. This is depicted schematically in Figure 3.

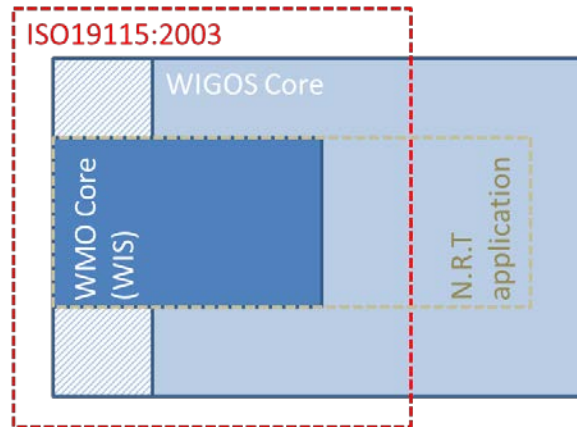


Figure 3. Schematic of the relationship of WIS and WIGOS metadata and the scope of the ISO19115 standard. The WMO Core is a profile of ISO19115. There is clearly an overlap between WIS and WIGOS metadata, but it is undecided if WIS metadata should be viewed as a subset of WIGOS metadata or if certain WIS metadata elements will not be included in WIGOS. WIGOS metadata exceed the scope of the ISO19115 standard. Also shown is a possible profile (subset) of WIGOS metadata elements for some specific near-real-time application.

Importantly, all WIGOS metadata elements (or group of elements) will have to be time-stamped with the time of validity and associated to a unique identifier for a dataset during transmission and for archiving. Using this approach, increments of a 'full' WIGOS metadata record can be transmitted anytime changes occur and updates are deemed necessary. At the archive, the increments can be added to the existing metadata record for that dataset, in time establishing the full history of a particular observation.

Category 1: Observed Quantity (lead: J. Klausen)

This category groups elements that specify the observed quantity and the data sets generated. It includes an element describing the spatial representativeness of the observations as well as the biogeophysical compartment the observations describe.					
Id	Name	Definition	Note or Example	Code Table	ItemMC O
1-01	Name of observed quantity measurand	quantity intended to be measured [VIM3, 2.3] or observed or derived	<p><i>[VIM3, 2.3] NOTE 1</i> The specification of a measurand requires knowledge of the kind of quantity, description of the state of the phenomenon, body, or substance carrying the quantity, including any relevant component, and the chemical entities involved.</p> <p><i>[VIM3, 2.3] NOTE 2</i> In the second edition of the VIM and in IEC 60050-300:2001, the measurand is defined as the “particular quantity subject to measurement”.</p> <p><i>[VIM3, 2.3] NOTE 3</i> The measurement, including the measuring system and the conditions under which the measurement is carried out, might change the phenomenon, body, or substance such that the quantity being measured may differ from the measurand as defined. In this case, adequate correction is necessary.</p> <p><i>[VIM3, 2.3] NOTE 4</i> In chemistry, “analyte”, or the name of a substance or compound, are terms sometimes used for ‘measurand’. This usage is erroneous because these terms do not refer to quantities.</p> <p><i>[ISO19156] NOTE 5</i> In conventional measurement theory the term “measurement” is used. However, a distinction between measurement and category-observation has been adopted in more recent work so the term “observation” is used for the general concept. “Measurement” may be reserved for cases where the result is a numeric quantity.</p> <p><i>EXAMPLE</i> In hydrology, this would typically be stage or discharge.</p>	1-01	M
1-02	measurement unit unit of measurement	real scalar quantity, defined and adopted by convention, with which any other quantity of the same kind can be compared to express the ratio of the two quantities as	<p><i>[VIM3, 1.9] NOTE 1.</i> Measurement units are designated by conventionally assigned names and symbols.</p> <p><i>[VIM3, 1.9] NOTE 2</i> Measurement units of quantities of the same quantity dimension may be designated by the same name and symbol even when the</p>	1-02	M

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Id	Name	Definition	Note or Example	Code Table	ItemMC O
		a number [VIM3, 1.9]	<p>quantities are not of the same kind. For example, joule per kelvin and J/K are respectively the name and symbol of both a measurement unit of heat capacity and a measurement unit of entropy, which are generally not considered to be quantities of the same kind. However, in some cases special measurement unit names are restricted to be used with quantities of a specific kind only. For example, the measurement unit 'second to the power minus one' (1/s) is called hertz (Hz) when used for frequencies and becquerel (Bq) when used for activities of radionuclides.</p> <p><i>[VIM3, 1.9] NOTE 3</i> Measurement units of quantities of dimension one are numbers. In some cases these measurement units are given special names, e.g. radian, steradian, and decibel, or are expressed by quotients such as millimole per mole equal to 10⁻³ and microgram per kilogram equal to 10⁻⁹.</p> <p><i>NOTE 4</i> For a given quantity, the short term "unit" is often combined with the quantity name, such as "mass unit" or "unit of mass".</p> <p><i>EXAMPLE</i> In hydrology, this would typically be m for stage or m³/s for discharge.</p>		
1-03	temporal extent of observed quantity	period covered by a series of observations inclusive of the specified dateTime indications (measurement history).	<p>The Temporal Extent is specified as either or both of two date Time indications, Begin and End. If the earliest temporal reference in the data is not known, omit the Begin date (but specify an End date). If the data are still being added to, omit the End date (but specify a Begin date). If there are gaps in the data collection (e.g. 1950-1955 then collection resumes 1960-present) then the first date recorded should be the earliest date and the last the most recent, ignoring the gap. The gap can however be mentioned in the notes field. [modified from: http://new.freshwaterlife.org/web/fwl/wiki/-/wiki/FreshwaterLife+Help/Dataset+Metadata+Field+Temporal+Extent]</p> <p><i>Examples:</i> Surface temperature at the station Säntis has been observed since 1 September 1882. The CO2 record at Mauna Loa extends from 1958 to today. Continuous, 1-hourly aggregates are available from the World Data Centre for Greenhouse Gases for the period 1974-01-01</p>		M

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Id	Name	Definition	Note or Example	Code Table	ItemMC O
			to 2011-12-31		
1-04	spatial extent of observed quantity	Location information specifying the spatial extent of the feature of interest	<p>The spatial extent of an observed quantity can be a zero-, one-, two-, or three-dimensional feature and will be expressed in terms of a series of geolocations.</p> <p>A zero-dimensional geolocation of an observation implies either an in-situ (point) observation or, by convention, a column-averaged quantity above the specified geolocation in nadir. One-dimensional geolocation of an observation implies a distribution / profile of a quantity along a trajectory (e.g., a straight line from the ground up with a given zenith angle). A two-dimensional geolocation of an observation implies an area or hyper-surface (e.g., a radar image, or a satellite pixel of a property near the surface). A three-dimensional geolocation of an observation implies a volume-averaged quantity (e.g., a radar pixel in 3D-space).</p> <p><i>Examples</i></p> <p>i) Air temperature by surface observing site: Sydney Airport NSW - 33.9465 N; 151.1731 E, Alt: 6.0 m asl.</p> <p>ii) Radar reflectivity and Doppler wind by weather watch radar, Warruwi NT -11.6485° N, 133.3800 E, Height 43.46 m asl. Max range 370 km; Doppler 150 km.</p> <p>iii) Infrared and visible imagery by meteorological satellite (sunsynchronous): VIRR (FY-3), Global coverage twice/day (IR) or once/day (VIS)</p> <p>iv) River discharge by gauge: Warrego River at Cunnamulla Weir 28.1000 S, 145.6833 E, Height: 180 m. Warrego River Catchment 48,690 km².</p>		M
1-05	Volume/Area/catchment represented by observation	spatial extent of the region around the observation for which an observed quantity value is representative	<p>The representativeness of an observation is the degree to which it describes the value of the variable needed for a specific purpose. Therefore, it is not a fixed quality of any observation, but results from joint appraisal of instrumentation, measurement interval and exposure against the requirements of some particular application (CIMO Guide, 2008). Representativeness of an observed value describes the concept that the result of an observation made at a given geolocation would be compatible with the result of other observations of the same quantity at other geolocations. In statistics, the term describes the notion that a sample of a population allows an</p>	1-05	M

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Id	Name	Definition	Note or Example	Code Table	ItemMC O
			adequate description of the whole population. Assessing representativeness can only be accomplished in the context of the question the data [or observations] are supposed to address. In the simplest terms, if the data [or observations] can answer the question, it is representative (Ramsey and Hewitt, 2005). The representativeness of an environmental observation depends on the spatio-temporal dynamics of the observed quantity (Henne et al., 2010). Representativeness of an observation can sometimes be specified quantitatively, in most cases qualitatively, based on experience or heuristic arguments.		
1-06	observed medium	Specification of the environment or matrix of which the observation was made.	<p><u>Examples:</u> Relevant environments or matrices include air, aerosol, water, ocean, soil, cloud water, aerosol particulate phase, troposphere, upper troposphere/lower stratosphere, etc. Following are examples of observations of temperature in different media:</p> <ul style="list-style-type: none"> i) Temperature – in situ soil ii) Temperature – atmosphere iii) Temperature – sea water 	1-06	M

Code list definitions

Code table: 1-01

Note: A code table will have to be developed in conjunction with other applications / stakeholders to provide a fixed vocabulary with a clearly defined governance. To provide this code table here is premature.

Code table: 1-02

Note: Make reference to http://www.bipm.org/en/si/si_brochure/, mention units such as °C, mbar, hPa

Code table: 1-05

Code table title: Representativeness [CIMO Guide, 7th edition]

#	Name	Definition
1-05-0	Not applicable	None of the codes in the table are applicable in the context of this particular observation (nilReason)
1-05-1	microscale	An area or volume less than 100 m horizontal extent
1-05-2	toposcale, local scale	An area or volume of 100 m to 33 km horizontal extent

#	Name	Definition
1-05-3	mesoscale	An area or volume of 33 km to 100 km horizontal extent
1-05-4	large scale	An area or volume 100 km to 3000 km horizontal extent
1-05-5	planetary scale	An area or volume of more than 3000 km horizontal extent
1-05-6	drainage area	An area (also known as 'catchment') having a common outlet for its surface runoff, in km ²

Code table: 1-06

Code table title: Observed medium

#	Name	Definition
1-06-0	air	Mixture of gases which compose the Earth's atmosphere. (source: WMO No.182)
1-06-1	water	The liquid state of water between the gaseous and the solid phases or roughly between 100 and 0°C (373 and 273 K). (source: WMO No. 182)
1-06-2	ocean surface	The top boundary of the ocean, the interface between ocean and atmosphere
1-06-3	land surface	The top boundary of the land mass, the interface between land and atmosphere
1-06-4	soil	mixture of minerals, organic matter, gases, liquids and a myriad of micro- and macro- organisms that can support plant life
1-06-5	aerosol	colloid of fine solid particles or liquid droplets, in air or another gas
1-06-6	aerosol particulate phase	The solid part of an aerosol
1-06-7	Wet precipitation	The liquid phase of precipitation ("rain")
1-06-8	atmospheric boundary layer	
1-06-9	lake	A water body confined by land masses
1-06-10	cloud	
1-06-11	lower troposphere	
1-06-12	upper troposphere / lower stratosphere	
1-06-12	upper stratosphere	
1-06-13 More terms needed

Category 2: Purpose of Observation (lead: B. Howe)

This category specifies the main application area(s) of an observation and the observation program an observation is affiliated to.					
Id	Name	Definition	Note or Example	Code Table	ItemMCO

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Id	Name	Definition	Note or Example	Code Table	ItemMCO
2-01	Application area(s)	Context within, or intended application for which the observation is primarily made or which has the most stringent requirements.	<i>Note</i> Many observations serve more than one purpose, meeting the requirements of various applications areas. In such cases, the application area for which the station was originally established should be listed first.	2-01	O
2-02	Network affiliation	For a station, the affiliation enumerates the network(s) that the station is associated with.	GUAN, AMDAR, GAW, RBSN, WHOS, etc. (full names to be referenced in code table)	2-02	M

Code list definitions

Code table: 2-01

Code table title: Application Area

#	Name	Definition
2-01-1	Global numerical weather prediction (GNWP)	Source: http://www.wmo.int/pages/prog/www/wigos/wir/application-areas.html , and http://www.wmo.int/pages/prog/www/wigos/documents/WIGOS-RM/New-Dev/Section_2.1_Ver2_18-06-13.doc
2-01-2	High-resolution numerical weather prediction (HRNWP)	Ibid
2-01-2	Nowcasting and very short range forecasting (NVSRF)	Ibid
2-01-3	Seasonal and inter-annual forecasting (SIAF)	Ibid
2-01-4	Aeronautical meteorology	Ibid
2-01-5	Atmospheric chemistry	Ibid
2-01-6	Ocean applications	Ibid
2-01-7	Agricultural meteorology	Ibid
2-01-8	Hydrology	Ibid
2-01-9	Climate monitoring (as undertaken through the Global Climate Observing System, GCOS)	Ibid
2-01-10	Climate applications	Ibid
2-01-11	Space weather	Ibid
2-01-12	Cryosphere applications	Source: EGOS-IP
2-01-13	Energy sector	

#	Name	Definition
2-01-14	Transportation sector	
2-01-15	Health sector	
2-01-16	Terrestrial ecology	

Code table: 2-02

Code table title: Network Affiliation

#	Name	Definition
2-02-1	RBSN	Regional baseline surface network
2-02-2	GAW	Global Atmosphere Watch
2-02-2	GUAN	GCOS upper air network
2-02-3	AMDAR	...
...

Category 3: Data Quality (lead: J. Swaykos)

This category specifies the data quality and traceability of an observation or dataset.					
Id	Name	Definition	Note or Example	Code Table	ItemMCO
3-01	uncertainty of measurement	parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand [GUM 2.2.3]	<p><i>NOTE 1</i> The parameter may be, for example, a standard deviation (or a given multiple of it), or the half-width of an interval having a stated level of confidence.</p> <p><i>NOTE 2</i> Uncertainty of measurement comprises, in general, many components. Some of these components may be evaluated from the statistical distribution of the results of series of measurements and can be characterized by experimental standard deviations. The other components, which also can be characterized by standard deviations, are evaluated from assumed probability distributions based on experience or other information.</p> <p><i>NOTE 3</i> It is understood that the result of the measurement is the best estimate of the value of the measurand, and that all components of uncertainty, including those arising from systematic effects, such as components associated with corrections and reference standards, contribute to the dispersion.</p> <p><i>Example</i> Thermometer reading has an uncertainty of +/- 0.1 deg C (k=2)</p>		C
3-02	Reference to procedures used	A reference or link pointing to a			C

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Id	Name	Definition	Note or Example	Code Table	ItemMCO
		document describing the procedures / algorithms used to derive the uncertainty statement			
3-03	quality flags	An ordered list of qualifiers indicating the quality of an observation according to a predefined set of criteria	“L Flag” Failed range of limits test (measurement is less than lower limit or higher than upper limit).		C
3-04	quality flagging system	System used to flag data quality			C
3-05	traceability chain	sequence of measurement standards and calibrations that is used to relate a measurement result to a reference [VIM v3]	<p><i>Notes</i></p> <p>A metrological traceability chain is defined through a calibration hierarchy, whereby a measurement result can be related to a reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty [VIM3, 2.41]. A metrological traceability chain is used to establish metrological traceability of a measurement result.</p>		M

Condition

One of {3-01 and 3-02} or {3-03 and 3-04} must be reported. If unknown, a nilReason="unknown" must be reported.

Code list definitions

-- none --

Category 4: environment (lead: J. Klausen)

This category describes the geographical environment within which the observations are made. It also provides an unstructured element for additional meta-information that is considered relevant for adequate use of the data and that is not captured anywhere else in the standard.

Id	Name	Definition	Note or Example	Code table	ItemMCO
4-01	land cover	the observed (bio)physical cover on the earth's surface (FAO, 2005) in the vicinity of the measurand	<p><u>Note 1</u> Land cover is distinct from land use despite the two terms often being used interchangeably. Land use is a description of how people utilize the land and socio-economic activity - urban and agricultural land uses are two of the most commonly known land use classes. At any one point or place, there may be multiple and alternate land uses, the specification of which may have a political dimension (Wikipedia, 2013).</p> <p><u>Note 2</u> There are various classification methods for 'land cover'. The MODIS product MCD12Q1 provides 5 different classifications on 500 m resolution grid (https://lpdaac.usgs.gov/products/modis_products_table/mcd12q1). These include the IGBP, UMD, LAI/fPAR, NPP and PFT classifications.</p> <p><u>Note 3</u> An alternative approach is the 'Land Cover Classification System' (LCCS) adopted by the Food and Agriculture Organization of the United Nations. Translation of other systems to LCCS has been explored by Herold et al. (2009). Eight major land cover types are identified during the first, dichotomous classification phase. These are refined in a subsequent so-called Modular-Hierarchical Phase, in which land cover classes are created by the combination of sets of pre-defined classifiers. These classifiers are tailored to each of the eight major land cover types. This process can be supported by software (http://www.glcnet.org/sof_7_en.jsp) or manually using a field log sheet (http://commons.wikimedia.org/wiki/File:LCCS_field_protokoll.png)</p>	4-01	C
4-02	land cover classification scheme	Name and reference or link to document	IGBP, UMD, LAI/fPAR, NPP and PFT, LCCS		C

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Id	Name	Definition	Note or Example	Code table	ItemMCO
		describing the classification scheme			
4-03	topography	the shape or configuration of a geographical feature, represented on a map by contour lines, hypsometric tints, and relief shading,	Topography shall be formally expressed with the four elements 'local topography', 'relative elevation', 'topographic context', and 'altitude' <i>Examples</i> "a hilltop at low relative elevation within valleys of middle altitude" "a depression within plains of very low altitude"	4-03	C
4-04	Site information	Non-formalized information about the location and its surroundings at which an observed quantity is measured or that have an influence on the observation.	e.g., maps, plans, photographs, descriptions and other unique site information that is difficult to express in words or that cannot easily be quantified. In hydrology, description and dating of activities occurring in the basin that can affect the observed discharge, e.g., construction of a regulation structure upstream of the gauging location that significantly affects the hydrological regime, inter-basin diversion of water into or from the basin upstream of the gauging location, significant change in consumptive use, land cover or land use.		O

Condition

Either {4-01 and 4-02 and 4-03} or a nilReason="not applicable" must be reported. For hydrology and satellite observations, specifying nilReason is appropriate.

Code list definitions

Code table: 4-01-01

Code table title: Land cover types (IGBP)

#	Name	Definition
4-01-01-0	Not applicable	None of the codes in the table are applicable in the context of this particular observation (nilReason)
4-01-01-1	Water	Cf. https://lpdaac.usgs.gov/products/modis_products_table/mcd12q1
4-01-01-2	Evergreen Needleleaf forest	
4-01-01-3	Evergreen Broadleaf forest	
4-01-01-4	Deciduous Needleleaf forest	
4-01-01-5	Deciduous Broadleaf forest	
4-01-01-6	Mixed forest	

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#	Name	Definition
4-01-01-7	Closed shrublands	
4-01-01-8	Open shrublands	
4-01-01-9	Woody savannas	
4-01-01-10	Savannas	
4-01-01-11	Grasslands	
4-01-01-12	Permanent wetlands	
4-01-01-13	Croplands	
4-01-01-14	Urban and built-up	
4-01-01-15	Cropland/Natural vegetation mosaic	
4-01-01-16	Snow and ice	
4-01-01-17	Barren or sparsely vegetated	
4-01-01-99	Unclassified	

Code table: 4-01-02

Code table title: Land cover types (LCCS)

#	Name	Definition
4-01-02-1	Not applicable	None of the codes in the table are applicable in the context of this particular observation (nilReason)
4-01-02-1	Cultivated and Managed Terrestrial Areas	cf. Antonio Di Gregorio (2005)
4-01-02-2	Natural and Semi-Natural Terrestrial Vegetation	
4-01-02-3	Cultivated Aquatic or Regularly Flooded Areas	
4-01-02-4	Natural and Semi-Natural Aquatic or Regularly Flooded Vegetation	
4-01-02-5	Artificial Surfaces and Associated Areas	
4-01-02-6	Bare Areas	
4-01-02-7	Artificial Waterbodies, Snow and Ice	
4-01-02-8	Natural Waterbodies, Snow and Ice	
4-01-02-99	Unclassified	

Code table: 4-03-01

Code table title: Local topography (based on Speight 2009)

#	Name	Definition
4-03-01-0	Not applicable	None of the codes in the table are applicable in the context of this particular observation (nilReason)
4-03-01-1	Hilltop	Higher than all or nearly all of the surrounding land. Use for mountaintops.
4-03-01-2	Ridge	Higher than all or nearly all of the surrounding land, but elongated and extending beyond a 50 m radius.
4-03-01-3	Slope	Neither crest nor depression or valley bottom, and with a slope more than 3%.

#	Name	Definition
4-03-01-4	Flat	Slope less than 3% and not a hilltop, ridge, valley bottom or depression. Use for plains.
4-03-01-5	Valley bottom	Lower than nearly all of surrounding land, but water can flow out.
4-03-01-6	Depression	Lower than surrounding land, with no surface outlet for water.

Code table: 4-03-02

Code table title: Relative elevation

#	Name	Definition
4-03-02-0	Not applicable	None of the codes in the table are applicable in the context of this particular observation (nilReason)
4-03-02-1	Lowest	In the bottom 5% of the elevation range
4-03-02-2	Low	Between 5% and 25% of the elevation range
4-03-02-3	Middle	Between 25% and 75% of the elevation range
4-03-02-4	High	Between 75% and 95% of the elevation range
4-03-02-5	Highest	In the highest 5% of the elevation range

Code table: 4-03-03

Code table title: Topographic context (based on Hammond 1954)

#	Name	Definition
4-03-03-0	Not applicable	None of the codes in the table are applicable in the context of this particular observation (nilReason)
4-03-03-1	Plains	Very low relief
4-03-03-2	Hollows	Low relief, tending to convergent form
4-03-03-3	Rises	Low relief, tending to divergent form
4-03-03-4	Valleys	Medium relief, tending to convergent form
4-03-03-5	Hills	Medium relief, tending to divergent form
4-03-03-6	Mountains	High relief

Code table: 4-03-04

Code table title: Altitude

#	Name	Definition
4-03-04-0	Not applicable	None of the codes in the table are applicable in the context of this particular observation (nilReason)
4-03-04-1	Very low	Below 100 m
4-03-04-2	Low	Between 100 and 300 m
4-03-04-3	Middle	Between 300 and 1000 m
4-03-04-4	High	Between 1000 and 3000 m
4-03-04-5	Very high	Above 3000 m

Category 5: Data Processing (lead: B. Howe)

Specifies how raw data are transferred into the reported physical quantities.					
Id	Name	Definition	Example	Code table	ItemMCO
5-01	data processing methods and algorithms	A description of the processing applied to the observed quantity and list of algorithms utilized to derive the resultant value.	In hydrology, this would be the equation(s) defining the rating curve and any shifts or corrections applied to the data or the curve.		C
5-02	Processing/analysis centre (eg chemical analysis, transform to physical variables)	location/center at which the observed quantity is transformed from input to end result.	chemical analysis, AMDAR processing centre, National Hydrological Service office		C
5-03	Reporting interval (time/space)	Interval at which the observed quantity is reported (this may not be applicable for event based observations)	Hourly, daily, monthly, seasonal, event-based.	5-03	M
5-04	software/processor and version	Name and version of the software or processor utilized to derive the element value.	Avionics version, retrieval algorithm version; MCH Database Management System version 25/10/2013.		C
5-05	level of data	Level of data processing	Pre or Post processing.		C/O
5-06	data format ¹	Description of the format in which the observed quantity is being provided.	ASCII, BUFR, NASA AMES, HDF, XML, FM 42-XI EXT AMDAR Aircraft report, TDCF FM 94-XIV BUFR, comma-separated (CSV), tab-separated (.txt), MCH (for interchange)		M
5-07	version of data format ²	Version of the data format in which the observed quantity is being provided.	E.g. FM 12–XIV SYNOP FM 94 Version 20.0.0 Radar : ODIM_H5		M
5-08	Aggregation interval	Time period over which	5 minute mean, daily maximum,		M

¹ Provided as part of the WIS metadata records

² Provided as part of the WIS metadata records

Id	Name	Definition	Example	Code table	ItemMCO
		statistical data is collected	seasonal, event based		
5-09	Definition of time stamp	The time period reflected by the time stamp.	Beginning, middle, end of period.	5-08	M

Code list definitions

Code table: 5-03

Code table title: Reporting Interval

#	Name	Definition
5-03-01	Seconds	One observation per second period
5-03-02	Minutes	One observation per 1-minute period
5-03-03	Hourly	One observed value per 60 minute period
5-03-03	Daily	One observed value per 24hour period
5-03-04	Annually	One observation per year
5-03-05	Monthly	One observed value per month
5-03-06	Seasonal	An observed value per season i.e. Spring, Summer, Fall, Winter
5-03-07	Event Based	An observed value representative of a specific requirement.

Code table: 5-08

Code table title: Definition of time stamp

#	Name	Definition
5-09-1	Beginning	Time stamps indicate the beginning of a period covering the range up to but excluding the following time stamp
5-09-2	End	Time stamps indicate the end of a period covering the range up to but excluding the preceding time stamp
5-09-3	Middle	Time stamps indicate the middle of a period beginning at the middle of the range described by this and the preceding time stamp and ending right before the middle of the range described by this and the following time stamp.

Category 6: Sampling and Analysis (lead: Joe Swaykos)

Specifies how the observation was made or a specimen collected.					
Id	Name	Definition	Example	CodeTable	ItemMCO
6-01	Sampling procedures	Procedures involved in obtaining a sample	<p>Temperature measurements are made using a XYZ thermometer and reported results are an average of 10 measurements made in a given hour.</p> <p>Aerosols may be sampled with an inlet with size-cutoff at 2.5 µm and be deposited on a teflon filter.</p>		O
6-02	Sample treatment	Chemical or physical treatment of sample prior to analysis	Homogenization, milling, mixing, drying, sieving, heating, melting, freezing, evaporation, sanity check (range, jumps)...		O
6-03	Sampling strategy	The method by which a measurement or observation is made to produce the most representative value.	eg discrete/continuous. Integral over period, or aggregation over discrete intervals within period, or whether instantaneous. Grab, flask spot times, discrete water level reading taken every 5 minutes..	6-03	M
6-04	Sampling time period	The period of time over which a measurement is taken	surface winds measured once every 4 Hz (CIMO); surface winds measured once per hour; Barometric pressure measured once every 6 minutes; water column height measured every 15 seconds; water column height reporting 15 minute averages of the 15 second measurements; water temperature measured once per hour; water temperature measured once per hour reporting a 24 hour average of the hourly measurements. (Ref: National Data Buoy Center Technical Document 09-02 "Handbook of Automated Data Quality Control Checks and Procedures")		M
6-05	Meaning of the time stamp	The time period reflected by the	Wind measurement is reported at 10Z (an	6-05 (5-08)	M

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Id	Name	Definition	Example	CodeTable	ItemMCO
		time stamp. (cf. 5-08)	average of measurements made at 6 minute intervals form 0906Z – 1000Z). Beginning, middle, end of period. 5 minute mean, daily maximum, seasonal.		
6-06	Spatial sampling resolution	Spatial resolution refers to the size of the smallest observable object. The intrinsic resolution of an imaging system is determined primarily by the instantaneous field of view of the sensor, which is a measure of the ground area viewed by a single detector element in a given instance in time.	AVHRR: 1.1 km IFOV s.s.p.		C
6-07	Analytical procedures	how specimen is analyzed	Water sample - physical or chemical analyses for excess minerals, toxins, turbidity, color - accomplished in a laboratory or by conducting a field test. Water sample - bacteriological analyses - coliform bacteria using a) Standard Plate Count or b) Multiple Tube Method using one of three tests (1) Presumptive Test (2) Confirmed Test (3) Complete Test (Ref: Water for the World Technical Note "Water Sample Analysis" No. RWS.3.P.3) Gas chromatography, ion chromatography, photometry		O

Code list definitions

Code table: 6-03

Code table title: Sampling strategy

#	Name	Definition
6-03-1	Continuous	Sampling is done continuously, but not necessarily at regular time intervals. Sampling is integrating, i.e., none of the medium escapes observations. Examples include global radiation, pressure, or continuous ozone monitoring with a UV monitor.
6-03-2	Discrete	Sampling is done at regular time intervals for certain sampling periods that are smaller than the time interval. Sampling is not integrating, i.e., parts of the medium escape observation. Examples include gas chromatographic analysis of carbon monoxide, etc.
6-03-3	Event	Sampling is done at irregular time intervals in a quasi-instantaneous manner. Examples include grab water samples, flask

#	Name	Definition
		sampling of air, etc.

Code table: 6-06

Code table title: SpatialSampling Resolution

#	Name	Definition
6-06-1	Point	The sample is a point in space or a very small volume resembling a point, e.g., a temperature sampled by a thermocouple element
6-06-2	Line	The sample is a line, either straight (e.g., a line of sight of a DOAS instrument) or curved (e.g., the humidity sampled by an aircraft in flight). The spatial extent should be given with canonical unit 'length'.
6-06-3	Area	The sample is an area, either rectangular or of any other shape, e.g., the pixel of a satellite or the reach of a radar image. The spatial extent should be given with canonical unit 'length x length'.
6-06-4	Volume	The sample is a volume, e.g. a water sample or a well-mixed volume of air sampled by flask. The spatial extent should be given with canonical unit 'length x length x length'.

Category 7: Station/Platform (lead: Tony Boston)

Specifies the environmental monitoring facility, including fixed station, moving equipment or remote sensing platform, at which an observed quantity is measured using an instrument.

Id	Name	Definition	Example	Code Table	ItemMCO
7-01	Region of origin of data	WMO region. WMO divides member countries into six regional associations responsible for coordination of meteorological, hydrological and related activities within their respective Regions.	Region I (Africa), Region II (Asia), Region III (South America), Region IV (North America, Central America and the Caribbean), Region V (South-West Pacific) and Region VI (Europe), plus Antarctica	7-01	C
7-02	Country of origin of data	Country name	E.g. Australia. Mandatory for fixed stations, optional for mobile stations Refer to the relevant WMO list / code table	7-02	C
7-03	Platform/station type	A categorization of the type of environmental monitoring facility at which an observed quantity is measured [INSPIRE].	refer to code list	7-03	M
7-04	Platform/station model	The version of the environmental monitoring facility at which an observed quantity is measured.	Environmental monitoring facilities include fixed stations, moving equipment or remote sensing platforms, This element is used to record the model of the platform/station. For example 'Landsat 8' is a platform/station model and 'satellite' would be the platform/station type; an 'Almos Automatic Weather Station (AWS)' is a platform/station model and 'land station' would be the platform/station type; 'Airbus A340-600' is a platform/station model and 'aircraft' would be the platform type.		O
7-05	Station unique identifier	A unique and persistent identifier for an environmental monitoring facility, which may be used as an external point of reference.	A globally unique identifier assigned by WMO for a station. Where a station has multiple identifiers, there must be a way of recording that they are synonyms. To be defined according to WMO guidelines. Ship: Call sign.		M

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Id	Name	Definition	Example	Code Table	ItemMCO
7-06	geolocation	Position in space defining the location of the environmental monitoring station/ platform/ facility at the time of observation.	<p>The geolocation of the platform/station at the time of observation. Required for fixed stations; for stations following pre-determined trajectory (e.g. satellites); optional for other mobile stations. The elevation of a fixed terrestrial station is defined as the height above sea level of the ground on which the station stands.</p> <p>The geolocation can be a zero-, one-, two-, or three-dimensional feature.</p> <p>Geographical coordinates can be specified in decimal degrees or in degrees, minutes and decimal seconds. Latitudes are specified with reference to the equator, with positive sign or the letter 'N' for latitudes north of the equator, and negative sign or the letter 'S' for latitudes south of the equator. Longitudes are specified with reference to the Greenwich meridian, with positive sign or the letter 'E' for longitudes east of Greenwich, and negative sign or the letter 'W' for meridians west of Greenwich. Elevation is a signed number specified in some distance measure (e.g., meters) relative to a reference elevation.</p> <p>The latitudinal and longitudinal positions of a station referred to in the World Geodetic System 1984 (WGS-84) Earth Geodetic Model 1996 (EGM96) must be recorded to a resolution of at least 0.001 decimal degrees (CIMO Guide).</p> <p><u>Examples</u></p> <p>(i) The station Jungfrauoch is located at 46.54749°N 7.98509°E (3580 m a.m.s.l.). The reference system is WGS-84.</p> <p>(ii) Voluntary Observing Ship Route: WMO Regional Association 5, Sub Area 6 (R56)</p> <p>(iii) [geostationary satellite] Meteosat-8 (MSG-1) 3.6°E</p> <p>(iv) [sunsynchronous satellite] NOAA-19 Height 870 km; Local Solar Time (LST) 13:39</p> <p>ii) Weather Watch Radar: Warruwi NT -11.6485° N,</p>		C

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Id	Name	Definition	Example	Code Table	ItemMCO
			133.3800 E, Height 19.1 m amsl. iv) River discharge gauge: Warrego River at Cunnamulla Weir 28.1000 S, 145.6833 E, Height: 180 m amsl.		
7-07	Data Communication Method	Data communication method for the station/platform	Inmarsat-C, ARGOS, Cellular, Globalstar, GMS(DCP), Iridium, Orbcomm, VSat, landline telephone, mail		O

Condition on 7-01 and 7-02: Mandatory for fixed land-based stations, optional for mobile stations

Code list definitions

Code table: 7-01

Code table title: WMO Regional Associations

#	Name	Definition
7-01-1	I	Africa
7-01-2	II	Asia
7-01-3	III	South America
7-01-4	IV	North America, Central America and the Caribbean
7-01-5	V	South-West Pacific
7-01-6	VI	Europe
7-01-7	VII	Antarctica

Code table: 7-02

Code table title:

#	Name	Definition
7-02-1	WMO territory names	Include international operators (e.g., ESA) as separate entities.

Code table: 7-03

Code table title: Platform/station type (simplified) [WMO No 306]

#	Name	Definition
7-03-1	land station	An observing station or field site situated on land, either fixed or mobile.
7-03-2	sea station	An observing station situated at sea. Sea stations include ships, ocean weather stations and stations on fixed or drifting platforms (rigs, platforms, lightships and buoys).

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#	Name	Definition
7-03-3	aircraft	An airplane, helicopter or airship used to make environmental observations.
7-03-4	satellite	A platform placed in orbit around the earth to make environmental observations.
7-03-5	underwater platform	A platform under a lake or sea surface, including autonomous underwater vehicles .

Category 8: Instrument (lead: Karl Monnik)

Specifies characteristics of the instrument(s) used to make the observation.					
Id	Name	Definition	Note or Example	Code Table	ItemMCO
8-01	Measurement principle	The principle of measurement used.	Temperature can be determined using different principles: liquid in glass; mechanical; electrical resistance; thermistor; thermocouple. Likewise, humidity is determined in AMDAR as a mass mixing ratio. Several chemical variables can be determined using infrared absorption spectroscopy. In hydrology, stage would be observed using a staff gauge, electric tape, pressure transducer, gas bubbler, or acoustics.		M
8-02	Instrument performance characteristics	Intrinsic capability of the instrument to measure the designated element	record "not available" Upper limit of operational range Lower limit of operational range Uncertainty specified by manufacturer <i>Example</i> Barometer measurement range 800-1100 hPa (i.e. unsuitable for some mountain ranges, Mt Everest ~300hPa)		M
8-03	Vertical distance of instrument above/below reference surface and type of surface	Vertical Distance of in situ instrument from reference level (ground surface, water surface, lowest astronomical tide, station, platform) to instrument. Reference level is generally a surface which will strongly influence the observation. Away from centre of earth positive.	eg height of the temperature sensor above ground; depth of buoy, height relative to lowest astronomical tide Distance (m) <i>Example:</i> i) Air temperature: 1.4 m above ground surface (station level). ii) Surface wind: 10.0 m above ground surface (station level) iii) Soil temperature: 0.50 m below soil surface; iv) Ship: Visual Obs Height: 22.0 m a.s.l.		C

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Id	Name	Definition	Note or Example	Code Table	ItemMCO
			v) Weather Watch Radar: Warruwi AU 24.3 m above ground surface (see 7-06) vi) Transmissometer 2.5 above runway surface vii) Refer to 7-06 <i>Note:</i> Not meaningful for hydrology, i.e., measurement of stage.		
8-04	Exposure of instruments.	The exposure of an instrument is the degree to which it is unaffected by external influences and reflects the value of the variable under observation needed for a specific purpose. It results from joint appraisal of the environment, measurement interval and exposure against the requirements of some particular application	Site enclosure, CIMO sensor classification, site classification index etc. Will consist of many elements, that could include photographs; this may be frequently changing (for example ocean debris impacting buoys) A summary classification in terms of its primary purpose may be as follows ³ : <i>Note:</i> Not meaningful for hydrology, i.e., measurement of stage.	8-04	C
8-05	Description of instrument and setup	The instrument housing or enclosure	shelter, temperature control, etc. Internal volume: [m ³] External colour: Internal colour: Aspirated: [Natural/forced/na] Aspiration rate: m ³ s ⁻¹ Shielding: [radiation] <i>Note:</i> Not meaningful for hydrology, i.e., measurement of stage.		C
8-06	Instrument lab calibration date and time	Date/time of most recent calibration [CIMO Guide, 7 th ed, 1.5.1]	Even if record "not available" YYYYMMDD HH:MM UTC		M

³ CIMO-XV 1064 Annex IV pg. 47.

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Id	Name	Definition	Note or Example	Code Table	ItemMCO
			<p>Standard type: [International, Primary, Secondary, Reference, Working, Transfer, collective] [CIMO Guide, 7th ed, 1.5.1] Standard name: [free text] Standard reference: [serial number or equivalent]</p> <p><i>Note:</i> In hydrology, for example, this could be the last calibration date of a pressure transducer. A comparison between two measurement standards may be viewed as a calibration if the comparison is used to check and, if necessary, correct the quantity value and measurement uncertainty attributed to one of the measurement standards [VIM3, 2.41].</p>		
8-07	instrument model and serial number	Details of manufacturer, model number, serial number and firmware version if applicable.	<p>Record "not available" Vaisala PTB330B G2120006 Instrument manufacturer: [free text] Instrument model: [free text] Instrument serial number: [free text] Firmware version: [free text]</p>		M
8-08	instrument field maintenance including interval	A description of maintenance that is routinely performed on an instrument.	<p>Daily cleaning of a radiation sensor. Daily, weekly.</p>		M
8-09	instrument field verification with date/time	Date/time of most recent field verification with travelling standard	<p>Even if installation date YYYYMMDD HH:MM UTC Standard type: [International, Primary, Secondary, Reference, Working, Transfer, Travelling, collective] Standard name: [free text] Standard reference: [serial number or equivalent] Within verification limit [Y/N]</p>		M
8-10	geospatial location of instrument/sensor if	Location of instrument/sensor if	Absolute geographic location of		C

Id	Name	Definition	Note or Example	Code Table	ItemMCO
	different from the station/platform	different from station/platform	instrument such as airfield anemometer or transmissometer. e.g. Melbourne Airport AU (East anemometer) -37.6602 N, 144.8443 E, 122.0 m amsl.		

Condition

8-03:value or a nilReason="not applicable" must be reported.

8-04:value or a nilReason="not applicable" must be reported.

8-05:value or a nilReason="not applicable" must be reported.

8-10:value or a nilReason="not applicable" must be reported.

Code list definitions

Code table: 8-04

Code table title:Exposure of Instrument

#	Name	Definition
8-04-1	Class 1	instrument exposure allows reference level measurements
8-04-2	Class 2	instrument exposure has small or infrequency influence on measurement
8-04-3	Class 3	instrument exposure leads to increased uncertainty or occasional invalid measurements
8-04-4	Class 4	instrument exposure leads to high uncertainty or regular invalid measurements
8-04-5	Class 5	External influences of the instrument exposure lead to invalid measurements

Category 9: Ownership & Data Policy (lead: B. Howe)

Specifies who is responsible for the observation and owns it.					
Id	Name	Definition	Example	Code Table	ItemMC O
9-01	supervising organization	Name of organization who owns the resource	<p><i>Notes</i> To be modelled as <i>gmd:CI_ResponsibleParty</i>, cf. https://geo-ide.noaa.gov/wiki/index.php?title=File:CI_ResponsibleParty.png. Here, this will be <i>/gmd:MD_Metadata/gmd:contact</i> <i>/gmd:MD_Metadata/gmd:contact/gmd:role = "pointOfContact"</i></p> <p>It is recommended that <i>/gmd:MD_Metadata/gmd:identificationInfo/gmd:pointOfContact</i> should provide a minimum of a name and an e-mail address. [see http://wis.wmo.int/2012/metadata/WMO_Core_Metadata_Profile_v1.3_Specification_Part_1_v1.0FINALcorrected.pdf]</p>		M
9-02	data policy/use constraints	Provide details relating to the use and limitations surrounding the imposed by the supervising organization or governing body.	<p><i>Notes</i> Shall be modeled as <i>/gmd:MD_Metadata/gmd:identificationInfo/gmd:resourceConstraints/gmd:otherConstraints</i> Only one single use constraint with a value taken from <i>WMO_DataLicenseCode</i> is allowed to ensure unambiguity. [see http://wis.wmo.int/2012/metadata/WMO_Core_Metadata_Profile_v1.3_Specification_Part_1_v1.0FINALcorrected.pdf p15]</p>	9-02	M

Code list definitions

Code table: 9-02

Code table

title: *WMO_DataLicenseCode* (http://wis.wmo.int/2012/metadata/WMO_Core_Metadata_Profile_v1.3_Specification_Part_2_v1.0FINAL.pdf, Table 14)

#	Name	Definition
9-02-1	WMOEssential	WMO Essential Data: free and unrestricted international exchange of basic meteorological data and products.
9-02-2	WMOAdditional	WMO Additional Data: free and unrestricted access to data and products exchanged under the auspices of WMO to the

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#	Name	Definition
		research and education communities for non-commercial activities. A more precise definition of the data policy may be additionally supplied within the metadata. In all cases it shall be the responsibility of the data consumer to ensure that they understand the data policy specified by the data provider – which may necessitate dialogue with the data publisher for confirmation of terms and conditions.
9-02-3	WMOOther	Data identified for global distribution via WMO infrastructure (GTS / WIS) that is not covered by WMO Resolution 25 or WMO Resolution 40; e.g. aviation OPMET data. Data marked with "WMOOther" data policy shall be treated like "WMOAdditional" where a more precise definition of the data policy may be additionally supplied within the metadata. In all cases it shall be the responsibility of the data consumer to ensure that they understand the data policy specified by the data provider – which may necessitate dialogue with the data publisher for confirmation of terms and conditions.

Category 10: Contact (lead: S Taylor)

Specifies where information about an observation or dataset can be obtained.					
Id	Name	Definition	Example	Code Table	ItemMCO
10-01	Contact (Nominated Focal Point)	Principal contact (Nominated Focal Point, FP) for resource	<p><u>Notes</u> To be modeled as <i>gmd:CI_ResponsibleParty</i>, cf. https://geo-ide.noaa.gov/wiki/index.php?title=File:CI_ResponsibleParty.png. Here, this will be <i>/gmd:MD_Metadata/gmd:contact</i> <i>/gmd:MD_Metadata/gmd:contact/gmd:role = "pointOfContact"</i></p> <p>It is recommended that <i>/gmd:MD_Metadata/gmd:identificationInfo/gmd:pointOfContact</i> should provide a minimum of a name and an e-mail address.</p> <p><u>Examples</u> Programme or Network Manager, e.g. E-AMDAR Technical Co-ordinator (TC) has responsibility for data quality of several airlines' fleets, has information on aircraft type/software/known errors etc.</p> <p>The FP would be able to provide data users with information regarding individual observing platforms.</p>		M

Code list definitions

-- none --

Appendix. Preliminary 'MCO' classification of elements

After completing the definition of this draft version of the standard, representatives of TCs each reviewed independently the classification of each element in terms of 'mandatory', 'conditional' or 'optional' from the point of view of the Technical Commission or WMO Programme they represent in TT-WMD. The result is shown in the following tables. It underlines the broad consensus in the team and highlights the notion that, even if rather comprehensive, the semantic standard presented here can still be considered the 'Core' of WIGOS metadata. Only very few elements were considered 'optional'.

Perspective		WMD	GAW	CIMO	CHy	JCOMM	CBS			
1	Observed Quantity The specification of a measurand requires knowledge of the kind of quantity, description of the state of the phenomenon, body, or substance carrying the quantity, including any relevant component, and the chemical entities involved. [VIM3, 2.3].									
1-01	Name of observed quantity, measurand	M	M	M	M	M	M			
1-02	measurement unit , unit of measurement	M	M	M	M	M	M			
1-03	temporal extent of observed quantity	M	M	M?	M	M	M			
1-04	spatial extent of observed quantity	M	M	M	M	M	M			
1-05	Volume/Area/catchment represented by observed value	M	M	M	M	M	M			
1-06	observed medium	M	M	M	M	M	M			
2	Purpose of observation Specifies the main application area of an observation and the observation program an observation is affiliated to.									
2-01	Application area(s)	M	M	M	M	M	M			
2-02	Network affiliation	M	M	M	M	M	M			
3	Data quality Specifies the data quality and traceability of an observation or dataset									
3-01	uncertainty of measurement	C	C	O	C	C	C			
3-02	Reference to procedures used	C	C	O	C	C	C			
3-03	quality flags	C	C	O	C	M	C			
3-04	quality flagging system	C	C	O	C	M	C			
3-05	traceability chain	M	M	O	O	M	O			

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Perspective		WMD	GAW	CIMO	CHy	JCOMM	CBS			
4	Environment - Specifies the geographical setting within which an observation was made									
4-01	land cover	C	M	M	O	C	O			
4-02	land cover classification scheme	C	M	C	O	C	O			
4-03	topography	C	M	O	O	C	C			
4-04	Site information	O	O	O	O	O	O			

5	Data processing Specifies how raw data are transferred into the reported physical quantities									
5-01	data processing methods and algorithms	C	M	C	C	C	C			
5-02	Processing/analysis centre (eg chemical analysis, transform to physical variables)	C	M	C	C	C	C			
5-03	Reporting interval (time/space)	M	M	M	M	M	M			
5-04	software/processor and version	C	O	C	C	C/O	O			
5-05	level of data	C/O	O	O	O	C/O	O			
5-06	data format	M	M	M	M	M	M			
5-07	version of data format	M	M	M	M	M	M			
5-09	Definition of time stamp	M	M	M	M	M	C			
5-08	Aggregation interval	M	M	M	M	M	C			

6	Sampling and analysis Specifies how the observation was made or a specimen collected									
6-01	Sampling procedures	O	O	O	O	O	O			
6-02	Sample treatment	O	O	O	O	O	O			
6-03	Sampling strategy	M	M	O	M	M	O			
6-04	Sampling time period	M	M	O	M	M	M			
6-05	Meaning of the time stamp	M	M	O	M	M	O			
6-06	Spatial sampling resolution	C	C	C	O	C	C			
6-07	Analytical procedures	O	O	O	O	O	O			

7	station/platform Environmental monitoring facilities, including fixed stations, moving equipment or remote sensing platforms, at which an observed quantity is measured using an instrument.									
7-01	Region of origin of data	C	M	C	C	C	M			
7-02	Country of origin of data	C	M	C	C	C	M			
7-03	Platform/station type	M	M	M	M	M	M			

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Perspective		WMD	GAW	CIMO	CHy	JCOMM	CBS			
7-04	Platform/station model	O	O	O	O	O	O			
7-05	Station unique identifier	M	M	M	M	M	M			
7-06	geolocation (cf. 1-04)	C	M	O	C	C	M			
7-07	Data Communication Method	O	O	O	O	O	O			

8	Instrument Specifies characteristics of the instrument used to make the observation									
8-01	Measurement principle	M	M	M	M	M	C			
8-02	Instrument performance characteristics	M	M	M	O	M	C			
8-03	Vertical distance of instrument above/below reference surface and type of surface	C	C	M	O	C	C			
8-04	Exposure of instruments	C	M	C	O	C	M			
8-05	environment of instrument	C	M	C	O	C	C			
8-06	Instrument lab calibration date and time	M	M	C	M	M	O			
8-07	instrument model and serial number	M	M	M	M	M	O			
8-08	instrument field maintenance	M	M	C	M	M	O			
8-09	instrument field verification with date/time	M	M	O	M	M	O			
8-10	geolocation of instrument/sensor when different to the station/platform	C	C	C	C	C	C			

	Ownership and data policy Specifies who is responsible for the observation and owns it									
9-01	supervising organization	M	M	M	M	M	M			
9-02	data policy/use constraints	M	M	M	M	M	M			

10	Contact Specifies where information about an observation or dataset can be obtained									
10-01	Contact (Nominated Focal Point)	M	M	M	M	M	M			

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CIMO guide 7th Ed. Par 1.5.1 Calibration: The set of operations which establish, under specified conditions, the relationship between values indicated by a measuring instrument or measuring system, or values represented by a material measure, and the corresponding known values of a measurand (the physical quantity being measured).

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