

Extract from

Seventeenth World Meteorological Congress

Geneva

25 May–12 June 2015

Abridged final report with resolutions



**World
Meteorological
Organization**

Weather · Climate · Water

WMO-No. 1157

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Attachment to Appendix 2.4

WIGOS Metadata Standard

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27 January 2015

VERSION CONTROL

Version	Date	Who	What
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0.0.1	10-06-2013	J. Klausen	Included content for category 4 (environment)
0.0.2	30-06-2013	S Taylor	Included content for category 10 (contact)
0.0.3	01-07-2013	T Boston	Edits to category 7 (station/platform)
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0.0.6	18-07-2013	T. Boston	Edits to category 4 (environment), category 7 (station/platform); code tables 4-02; 7-03
0.0.7	06-08-2013	J. Klausen	After Telecon-4
0.0.8	02-09-2013	T. Boston, B. Howe	Edits to topography category 5 and platform/station model corresponding code table.
0.0.9	03-09-2013	J. Klausen	After Telecon-5
0.0.10	??	??	Intermediate version of uncertain origin
0.0.11	03-10-2013	J.,Klausen	After Telecon-6, with expansions not discussed during telecom
0.0.12	03-10-2013	B. Howe	After Telecon-6 with changes accepted.
0.0.13	24-10-2013	B. Howe	After Telecon-7
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0.0.19			
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	18-03-2014	J. Klausen	Comments by ET-SUP carried over.
0.0.21	27-03-2014	J. Klausen	Element 5-04 (Reporting interval (space)) explicitly listed; code table 5-05 included; element 5-11 (reference time) defined and explained; numbering in list of category 5 corrected; Figures 1 and 2 updated
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0.1	15-05-2014	J. Klausen	Version after TT-WMD-2; dropped notion of "Core" in favor of a phased implementation; added element 8-00; dropped 4-04; moved element 8-05 to become 4-04; editorial improvements
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0.1.02	03-07-2014	WIGOS PO	Review with comments and proposed changes
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0.1.04	25-11-2014	J. Klausen	Includes several corrections and changes as they accumulated.
0.1.05	04-12-2014	TT-WMD-3	As of the end of TT-WMD 3 rd session
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0.1.06b	20-01-2015	L. Nunes	Second intermediate editing version
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0.2	27-01-2015	TT-WMD	WebEx, plus co-chairs and Secretariat edits on 20150128

Table of Contents

I	– Purpose and Scope of WIGOS Metadata
II	– WIGOS Metadata Categories
III	– A Note on Space and Time
IV	– Reporting Obligations for WIGOS Metadata
V	– Technical Implementation and Use of Standard
VI	– Adoption through a Phased Approach
VII	– Detailed specification of WIGOS metadata elements
	Category 1: Observed variable
	Category 2: Purpose of Observation
	Category 3: Station/Platform
	Category 4: Environment
	Category 5: Instruments and Methods of Observation
	Category 6: Sampling
	Category 7: Data Processing and Reporting
	Category 8: Data Quality
	Category 9: Ownership & Data Policy
	Category 10: Contact
VIII	– References
ANNEX	– Code Tables

I – Purpose and Scope of WIGOS Metadata

An important aspect of WIGOS (WMO Integrated Global Observing System) implementation is ensuring maximum usefulness of WIGOS observations. Observations without metadata are of very limited use: it is only when accompanied by adequate metadata (data describing the data) that the full potential of the observations 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/description or observational metadata** – information that enables data values to be interpreted in context. **These latter metadata are WIGOS metadata** and are the subject of this standard, which provides a WIGOS standard for the interpretation metadata required for the effective utilization of observations from all WIGOS component observing systems by all users.

WIGOS metadata should describe the observed variable, 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 (Global Climate Observing System) 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 processing. A comprehensive metadata standard to cover all types of observations is by nature complex to define. A user should be able to use the WIGOS metadata to identify the conditions under which the observation (or measurement) was made, and any aspects which may affect its use or understanding, i.e. to determine whether the observations are fit for the purpose.

II – WIGOS Metadata Categories

Ten categories of WIGOS metadata have been identified. These are listed in Table 1 below. They define the WIGOS metadata standard, each category consisting of one or more metadata elements. All of the categories listed are considered to be important for the documentation and interpretation of observations made, and even for their use in the distant future. Hence, the standard currently declares many elements 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 may be developed. The categories are in no particular order but reflect the need to specify the observed variable; to answer why, where and how the observation was made; how the raw data were processed; and what the quality of the observation is.

A schematic composition of all categories, containing the individual elements is shown in Figure 1. Note that some of these elements will most likely be implemented using several individual entities (e.g., geospatial location will consist of the a combination of elements, such as latitude, longitude, elevation or a set of polar coordinates, as well as a reference to the geo-positioning methods used). Chapter VII contains a set of tables detailing all the elements, including definition, notes/examples, and obligations/implementation phase. Code tables enabling users to select from pre-defined vocabularies to facilitate the application of the WIGOS metadata standard and the exchange of metadata are presented in Annex I.

Table 1: WIGOS Metadata Categories

#	Category	Description
1	Observed variable	Specifies the basic characteristics of the observed variable and the resulting datasets.
2	Purpose of observation	Specifies the main application area(s) of the observation and the observing programme(s) and networks the observation is affiliated to.
3	Station/platform	Specifies the environmental monitoring facility, including fixed station, moving equipment or remote sensing platform, at which the observation is made.
4	Environment	Describes the geographical environment within which the observation is 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 this standard.
5	Instruments and methods of observation	Specifies the method of observation and describes characteristics of the instrument(s) used to make the observation. If multiple instruments are used to generate the observation, then this category should be repeated.
6	Sampling	Specifies how sampling and/or analysis are used to derive the reported observation or how a specimen is collected.
7	Data processing and reporting	Specifies how raw data are transferred into the observed variable and reported to the users.
8	Data quality	Specifies the data quality and traceability of the observation.
9	Ownership and data policy	Specifies who is responsible for the observation and owns it.
10	Contact	Specifies where information about the observation or dataset can be obtained.

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

- One or several purpose(s) of observation;
- 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 output may contribute to observations of one or more variables. For example:

- A four wire humidity probe can produce temperature and humidity, as well as dew point;
- A sonic anemometer does report wind speed, wind direction and can report air temperature;
- A spectrometer can report absorption due to many different chemical species.

An instrument typically will be associated with the categories:

- Instruments and methods of observation;
- Sampling (e.g. 10 Hz samples of air temperature);
- Data processing and reporting (e.g. ceilometer reporting of 10 min statistics of cloud height following processing through sky condition algorithm).

An observed variable may be influenced or characterized by the environment, for example:

- Wind speed (observed variable) on top of a hill (environment);
- River yield (observed variable) characterized by the upstream catchment and land use.

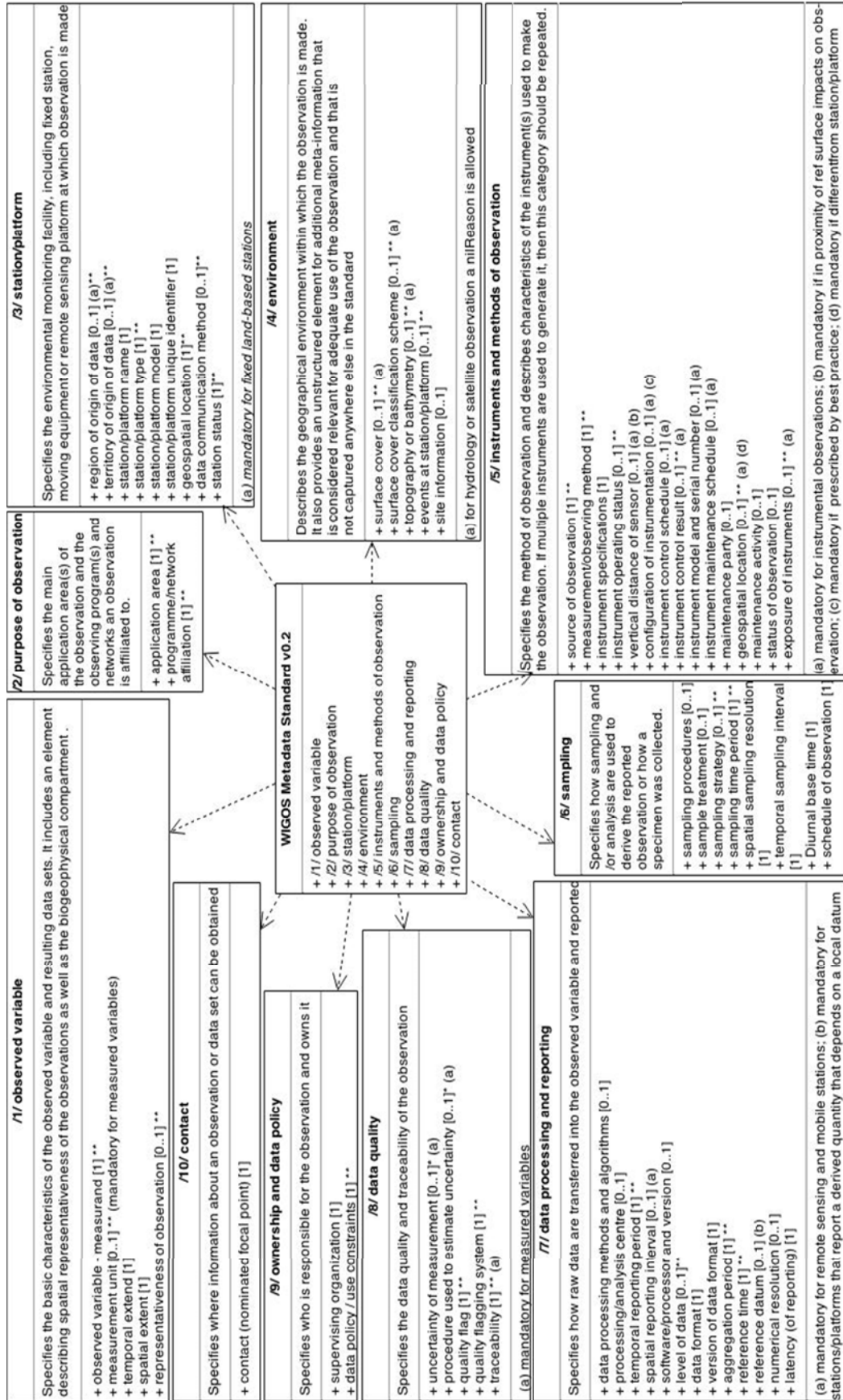


Figure 1. UML diagram specifying the WIGOS Metadata Standard (**: code tables expected; [0..1*]: optional or conditional elements. Conditional elements become mandatory if a given condition is met. Conditions are referenced in parentheses. Optional elements may be declared mandatory as part of profiling the standard for specific application areas; [1..*]: mandatory elements. These elements must be reported, and if no value is available, a nilReason must be reported, which indicates that the metadata is “unknown”, or “not available”)

Table 2. Names and Definition of Elements

An asterisk (*) denotes the element is required for the WIGOS Rolling Review of Requirements (RRR) process. A hash sign (#) denotes that it is acceptable to record a "mandatory" element with a value of nilReason (that indicates that the metadata is either "unknown", or "not applicable", or "not available").

Category	Id	Name	Definition	MCO	Phase
Observed variable	1-01	Observed variable – measurand	Variable intended to be measured or observed or derived, including the biogeophysical context	M*	1
	1-02	Measurement unit	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 a number [VIM3, 1.9]	C*	1
	1-03	Temporal extent	Time period covered by a series of observations inclusive of the specified date-time indications (measurement history)	M*	1
	1-04	Spatial extent	Typical georeferenced volume covered by the observations	M*	1
	1-05	Representativeness	Spatial extent of the region around the observation for which it is representative	O	2
Purpose of observ.	2-01	Application area(s)	Context within, or intended application(s) for which the observation is primarily made or which has/have the most stringent requirements	M*	1
	2-02	Programme/Network affiliation	The global, regional or national Programmes/network(s) that the station/platform is associated with	M	1
Station/platform	3-01	Region of origin of data	WMO Region	C*	1
	3-02	Territory of origin of data	Country or territory name of the location of the observation	C*	1
	3-03	Station/platform name	Official name of the station/platform	M	1
	3-04	Station/platform type	A categorization of the type of environmental monitoring facility at which an observed variable is measured	M*	2
	3-05	Station/platform model	The model of the monitoring equipment used at the station/platform	M##	3
	3-06	Station/platform unique identifier	A unique and persistent identifier for an environmental monitoring facility (station/platform), which may be used as an external point of reference	M*	1
	3-07	Geospatial location	Position in space defining the location of the environmental monitoring station/platform at the time of observation	M*	1
Environment	3-08	Data communication method	Data communication method between the station/platform and some central facility	O	2
	3-09	Station Status	Declared reporting status of the station	M	1
	4-01	Surface cover	The observed (bio)physical cover on the earth's surface in the vicinity of the observation	C	3
	4-02	Surface cover classification scheme	Name and reference or link to document describing the classification scheme	C	3
	4-03	Topography or bathymetry	The shape or configuration of a geographical feature, represented on a map by contour lines	C	3
4-04	Events at station/platform	Description of human action or natural event at the station or at the vicinity that may influence the observation	O	2	
4-05	Site information	Non-formalized information about the location and its surroundings at which an observation is made and that may influence it	O	2	

Category	Id	Name	Definition	MCO	Phase
Instruments and methods of observation	5-01	Source of observation	The source of the dataset described by the metadata	M	1
	5-02	Measurement/observing method	The method of measurement/observation used	M*	1
	5-03	Instrument specifications	Intrinsic capability of the measurement/observing method to measure the designated element, including range, stability, precision, etc	M**	1
	5-04	Instrument operating status	The status of an instrument with respect to its operation	O	3
	5-05	Vertical distance of sensor	Vertical distance of the sensor from a (specified) reference level such as local ground, or deck of a marine platform at the point where the sensor is located; or sea surface	C*	1
	5-06	Configuration of instrumentation	Description of any shielding or configuration/setup of the instrumentation or auxiliary equipment needed to make the observation or to reduce the impact of extraneous influences on the observation	C*	3
	5-07	Instrument control schedule	Description of schedule for calibrations or verification of instrument	C	3
	5-08	Instrument control result	The result of an instrument control check, including date, time, location, standard type and period of validity	C*	3
	5-09	Instrument model and serial number	Details of manufacturer, model number, serial number and firmware version if applicable	C*	3
	5-10	Instrument routine maintenance	A description of maintenance that is routinely performed on an instrument	C*	3
	5-11	Maintenance party	Identifier of the organization or individual who performed the maintenance activity	O	2
	5-12	Geospatial location	Geospatial location of instrument/sensor	C*	2
	5-13	Maintenance Activity	Description of maintenance performed on instrument	O	3
	5-14	Status of observation	Official status of observation	O	3
	5-15	Exposure of instruments	The degree to which an instrument is affected by external influences and reflects the value of the observed variable	C	2
Sampling	6-01	Sampling procedures	Procedures involved in obtaining a sample	O	3
	6-02	Sample treatment	Chemical or physical treatment of sample prior to analysis	O	3
	6-03	Sampling strategy	The strategy used to generate the observed variable	O*	1
	6-04	Sampling time period	The period of time over which a measurement is taken	M*	3
	6-05	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	M*	2
	6-06	Temporal sampling interval	Time period between the beginning of consecutive sampling periods	M	3
	6-07	Diurnal base time	Time to which diurnal statistics are referenced	M	1
	6-08	Schedule of observation	Schedule of observation	M	1

Category	Id	Name	Definition	MCO	Phase
Data processing and Reporting	7-01	Data processing methods and algorithms	A description of the processing used to generate the observation and list of algorithms utilized to derive the resultant value	O	3
	7-02	Processing/analysis center	Center at which the observation is processed	O	2
	7-03	Temporal reporting period	Time period over which the observable variable is reported	M*	1
	7-04	Spatial reporting interval	Spatial interval at which the observed variable is reported	C*	1
	7-05	Software/processor and version	Name and version of the software or processor utilized to derive the element value	O	3
	7-06	Level of data	Level of data processing	O	2
	7-07	Data format	Description of the format in which the observed variable is being provided	M	3
	7-08	Version of data format	Version of the data format in which the observed variable is being provided	M	3
	7-09	Aggregation period	Time period over which individual samples/observations are aggregated	M	2
	7-10	Reference time	Time base to which date and time stamps refer	M	2
	7-11	Reference datum	Reference datum used to convert observed quantity to reported quantity	C	1
	7-12	Numerical resolution	Measure of the detail in which a numerical quantity is expressed	O	3
	7-13	Latency (of reporting)	The typical time between completion of the observation or collection of the datum and when the datum is reported	M	3
Data quality	8-01	Uncertainty of measurement	Non-negative parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the observation/measurand	C**	2
	8-02	Procedure used to estimate uncertainty	A reference or link pointing to a document describing the procedures / algorithms used to derive the uncertainty statement	C**	2
	8-03	Quality flag	An ordered list of qualifiers indicating the result of a quality control process applied to the observation	M*	2
	8-04	Quality flagging system	Reference to the system used to flag the quality of the observation	M*	2
	8-05	Traceability	Statement defining traceability to a standard, including sequence of measurement standards and calibrations that is used to relate a measurement result to a reference [VIM 3.2.4.2]	C**	2
Ownership and data policy	9-01	Supervising organization	Name of organization who owns the observation	M	2
	9-02	Data policy/use constraints	Details relating to the use and limitations surrounding data imposed by the supervising organization	M*	1
Contact	10-01	Contact (Nominated Focal Point)	Principal contact (Nominated Focal Point, FP) for resource	M	1

III – A Note on Space and Time

It is important to understand that WIGOS metadata are intended to describe an individual observation or a dataset, i.e. one or several observations, including the where, when, how, and even why the observations were made. As a consequence, references to space and time are 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, including sampling strategy, analysis, data processing and reporting.

The concepts and terms used to describe **spatial aspects** (i.e., geospatial location) of observations are even more complex (cf. Fig. 3). For example, for ground-based in-situ observations, the spatial extent of the observation coincides with the geospatial location of the sensor, which in most cases will be time-invariant and is normally close to the geospatial location 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 elements as:

1. The spatial extent of the observed variable (e.g. atmospheric column above a Dobson Spectrophotometer) (cf. 1-04)
2. The geospatial location of the station/platform (e.g. radar transmitter/receiver or aircraft position/route) (cf. 3-07)
3. The geospatial location of the instrument (e.g. the anemometer is adjacent to a runway) (cf. 5-05 Vertical Distance and 5-12 geospatial location)
4. The spatial representativeness of the observation (cf. 1-05)

All these are expressed in terms of geospatial location, 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).

A station/platform can be:

1. Collocated with the observed quantity as for in situ surface observing station (e.g. an Automatic Weather Station - 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. AMDAR - Aircraft Meteorological Data Relay - equipped aircraft)
5. In motion and remote to the observed medium (e.g. satellite platform)

An instrument can be:

1. Collocated with the observed variable (e.g. surface temperature sensor)
2. Remote to the observed variable (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)

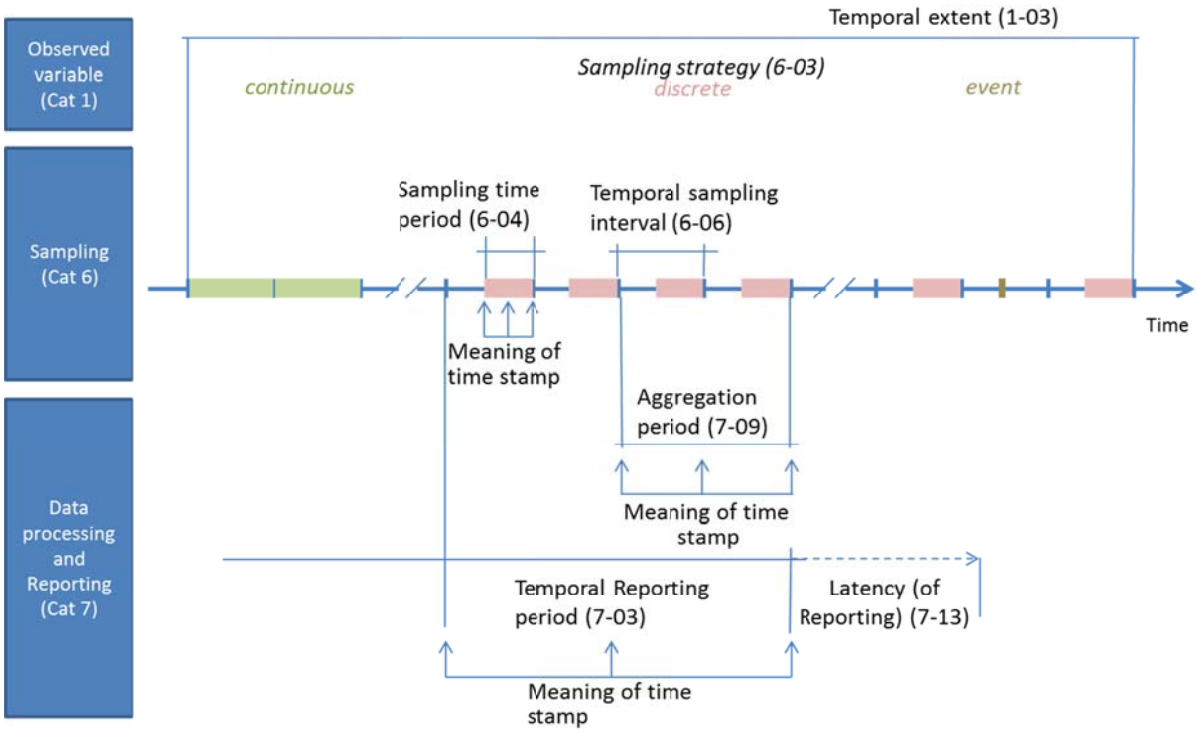


Figure 2. Graphical representation of temporal elements referenced in WIGOS Metadata categories

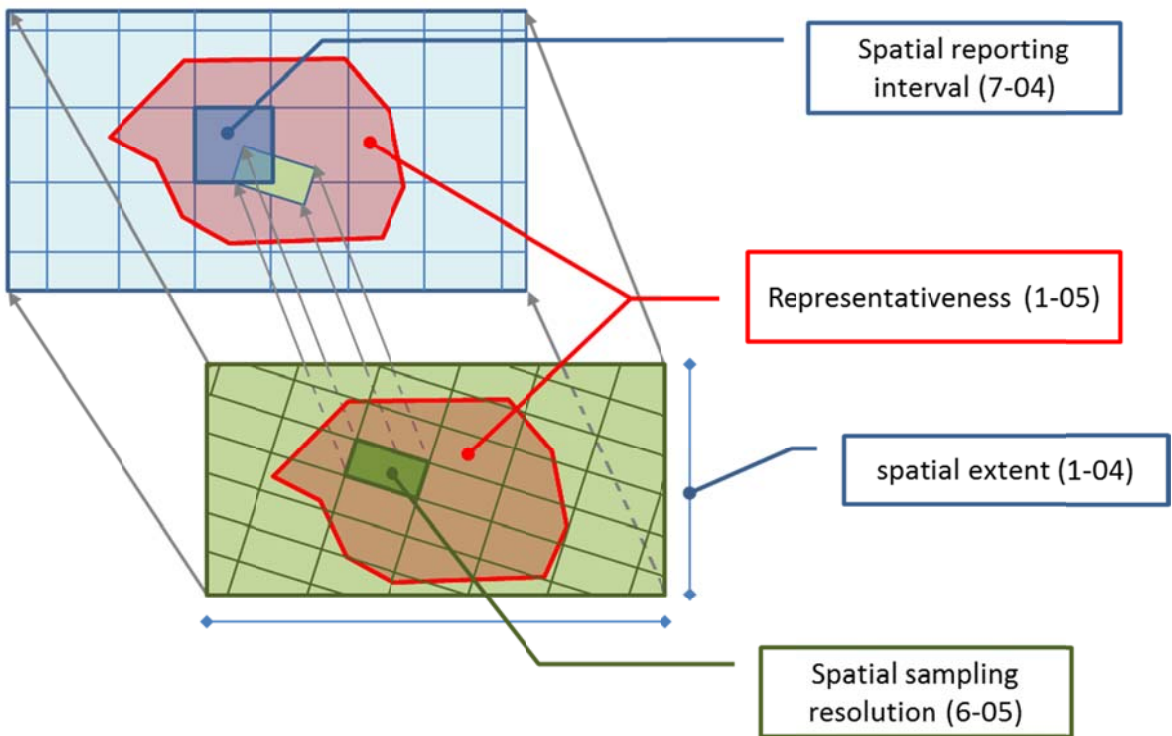


Figure 3. Graphical representation of spatial elements referenced in WIGOS Metadata categories

IV – Reporting Obligations for WIGOS Metadata

According with the International Organization for Standardization (ISO), the metadata elements are classified as either mandatory (M), conditional (C), or optional (O).

Mandatory metadata elements shall always be made available. The content of the corresponding fields shall never be empty, either the metadata “value” or the reason for no-value, shall be made available.

Most of the elements in this standard are considered **mandatory** in view of enabling adequate future use of observations by all WMO Application Areas. 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. If Members cannot provide all the Mandatory elements the reason for that shall be reported as “not applicable” or “unknown” or “not available”. 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. In the tables of chapter VII, these cases are indicated with M[#].

Conditional metadata elements shall be made available when the specified condition or conditions are met, in which case the content of the corresponding fields shall never be empty, either the metadata “value” or the reason for no-value, shall be made available. For example, the element “Spatial reporting interval” is classified as conditional, because it only applies to remote sensing observations and mobile platforms. Therefore, the elements in this category should be considered mandatory for remote sensing and mobile observing systems but not so for e.g., surface land stations.

Optional metadata elements should also be made available. They provide useful information that can help to better understand an observation. In this version of the standard, very few elements are considered optional. Optional elements are likely to be important for a particular community, but less so for others.

V – Technical Implementation and Use of Standard

This document is a semantic standard that specifies the elements that exist and that can be recorded and 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 (Extensible Markup Language), 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 categories 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 may 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. Users 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 4.

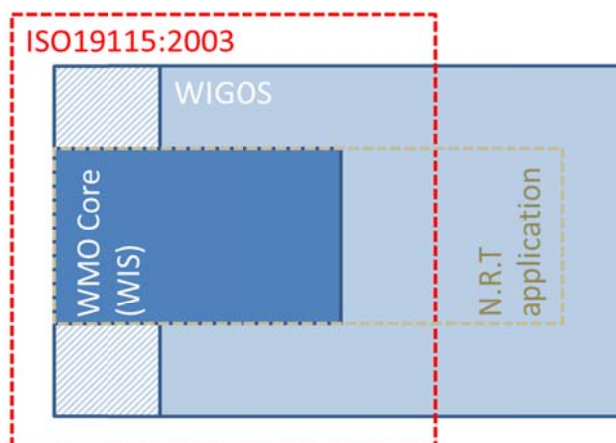


Figure 4. Schematic of the relationship of WIS and WIGOS metadata and the scope of the ISO19115 standard. The WMO Core is a profile of ISO19115. WIGOS metadata exceed the scope of ISO19115 standard. A possible profile (subset) of WIGOS metadata elements for some specific near-real-time application is also shown.

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. The specification of time stamps should also include a statement on the use of daylight savings time. 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, establishing the full history of a particular observation with time.

VI – Adoption through a Phased Approach

Making available WIGOS metadata will generate substantial benefits for Members, but developing the capacity to make available these metadata also requires a substantial effort on the part of (meta)data providers. To help Members comply with obligations, guidance material will be developed and provided.

Moreover, obligations will be enforced in phases in order to allow Members sufficient time to develop the capacity to comply. Balancing the effort required to generate and make available the metadata elements, and the need to have this information to make adequate use of observations, implementation will proceed through three phases as shown in Table 3. Importantly, elements required by the end of **Phase I** are either listed as mandatory elements in WMO-No. 9, Vol. A or are of critical importance for the Observing Systems Capability Analysis and Review (OSCAR) tool of the WIR (WIGOS Information Resource), and are considered of benefit for all application areas. **Phase II** adds elements recognized to be more challenging for Members, but the knowledge of which is still of rather immediate need for the adequate use of observations, in particular for assessing quality of observations. **Phase III** adds the remaining elements specified in this version of the standard.

Elements emerging as being important for specific application areas or observing programmes will be added to the standard as it evolves.

Table 3. List of elements specified in the WIGOS Metadata Standard and the phases for implementation by Members

Category	Phase I	Phase II	Phase III
	2016	2017–2018	2019–2020
1. Observed variable	1-01 Observed variable – measurand (M)	1-05 Representativeness (O)	
	<i>1-02 Measurement unit (C)</i>		
	1-03 Temporal extent (M)		
	1-04 Spatial extent (M)		
2. Purpose of observation	2-01 Application area(s) (M)		
	2-02 Programmes/Network affiliation (M)		
3. Station/ Platform	<i>3-01 Region of origin of data (C)</i>	3-04 Station/platform type (M)	3-05 Station/platform model (M)
	<i>3-02 Territory of origin of data (C)</i>	3-08 Data communication method (O)	
	3-03 Station/platform name (M)		
	3-06 Station/platform unique identifier (M)		
	3-07 Geospatial location (M)		
	3-09 Station status (M)		
4. Environment		4-04 Events at Station/platform (O)	<i>4-01 Surface cover (C)</i>
		4-05 Site information (O)	<i>4-02 Surface Cover classification scheme (C)</i>
			<i>4-03 Topography or Bathymetry (C)</i>

Category	Phase I	Phase II	Phase III
	2016	2017–2018	2019–2020
5. Instruments and Methods of Observation	5-01 Source of observation (M)	5-11 Maintenance party (O)	5-04 Instrument operating status (O)
	5-02 Measurement/observing method (M)	5-12 <i>Geospatial location (C)</i>	5-06 <i>Configuration of instrumentation (C)</i>
	5-03 Instrument specifications (M)	5-15 <i>Exposure of instrument (C)</i>	5-07 <i>Instrument control schedule (C)</i>
	5-05 <i>Vertical distance of sensor (C)</i>		5-08 <i>Instrument control result (C)</i>
			5-09 <i>Instrument model and serial number (C)</i>
			5-10 <i>Instrument routine maintenance (C)</i>
			5-13 Maintenance Activity (O)
			5-14 Status of observation (O)
6. Sampling	6-03 Sampling strategy (O)	6-05 Spatial sampling resolution (M)	6-01 Sampling procedures (O)
	6-07 Diurnal base time (M)		6-02 Sample treatment (O)
	6-08 Schedule of observation (M)		6-04 Sampling time period (M)
			6-06 Temporal sampling interval (M)
7. Data Processing and Reporting	7-03 Temporal reporting period (M)	7-02 Processing/analysis center (O)	7-01 Data processing methods and algorithms (O)
	7-04 Spatial reporting interval (C)	7-06 Level of data (O)	7-05 Software/processor and version (O)
	7-11 Reference datum (C)	7-09 Aggregation period (M)	7-07 Data format (M)
		7-10 Reference time (M)	7-08 Version of data format (M)
			7-12 Numerical resolution (O)
			7-13 Latency (of reporting) (M)
8. Data Quality		8-01 Uncertainty of measurement (C)	
		8-02 Procedure used to estimate uncertainty (C)	
		8-03 Quality flag (M)	
		8-04 Quality flagging system (M)	
		8-05 Traceability (C)	
9. Ownership and Data Policy	9-02 Data policy/use constraints (M)	9-01 Supervising organization (M)	
10. Contact	10-01 Contact (Nominated Focal Point) (M)		

VII – Detailed specification of WIGOS metadata elements

Category 1: Observed variable

Specifies the basic characteristics of the observed variable and the resulting datasets. It includes an element describing the spatial representativeness of the observation as well as the biogeophysical compartment the observation describe.

Id	Name	Definition	Note or Example	Code Table	ItemMCO ¹
1-01	Observed variable (measurand)	Variable intended to be measured or observed or derived, including the biogeophysical context	<p>[ISO19156] NOTE 1: 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>NOTE 2: The biogeophysical context is expressed in terms of Domain, Subdomain/Matrix, and Layer, and variables are organized hierarchically using these dimensions. Relevant domains, matrices and layers include atmosphere, aerosol, lake, river, ocean, soil, cloud water, aerosol particulate phase, land surface, troposphere, upper troposphere/lower stratosphere, space, etc.</p> <p>EXAMPLES: In hydrology, this would typically be stage or discharge. Present weather; Air temperature near the surface; CO₂ mixing ratio in the atmosphere</p>	1-01	M* (Phase 1)
1-02	Measurement unit	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 a number [VIM3, 1.9]	<p>[JCGM 200:2012, 1.9] NOTE 1. Measurement units are designated by conventionally assigned names and symbols.</p>	1-02	C* (Phase 1)

¹ An asterisk (*) denotes the element is required for the WIGOS Rolling Review of Requirements (RRR) process. A hash sign (#) denotes that it is acceptable to record a "mandatory" element with a value of nilReason (that indicates that the metadata is either "unknown", or "not applicable", or "not available").

Id	Name	Definition	Note or Example	Code Table	ItemMCO ¹
1-03	Temporal extent	Time period covered by a series of observations inclusive of the specified date-time indications (measurement history)	<p>JJCGM 200:2012, 1.9j NOTE 2 Measurement units of quantities of the same quantity dimension may be designated by the same name and symbol even when the 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>JJCGM 200:2012, 1.9j NOTE 3 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>JJCGM 200:2012, 1.9j NOTE 4 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>EXAMPLE In hydrology, this would typically be m for stage or m^3/s for discharge.</p> <p>NOTE 1: The Temporal Extent is defined through the begin and end dates of observations.</p> <p>NOTE 2: If the data are still being added to, omit the End date (but specify a Begin date).</p> <p>NOTE 3: 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.</p>		M* (Phase 1)

Id	Name	Definition	Note or Example	Code Table	ItemMCO ¹
1-04	Spatial extent	Typical spatial georeferenced volume covered by the observations	<p>EXAMPLES: 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 to 2011-12-31</p> <p>NOTE 1: 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 geospatial locations describing a geometric shape.</p> <p>NOTE 2: A zero-dimensional geospatial location of an observation implies either an in-situ (point) observation or, by convention, a column-averaged quantity above the specified geospatial location in nadir. One-dimensional geospatial location 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 geospatial location 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 geospatial location of an observation implies a volume-averaged quantity (e.g., a radar pixel in 3D-space).</p> <p>EXAMPLES: i) Air temperature at a surface observing site: Sydney Airport NSW: Lat: -33.9465 N; Lon. 151.1731 E; Alt: 6.0 m above msl. ii) The projected area or volume of the cone around a particular weather radar with a maximum range of 370 km (radar reflectivity) and 150 km (Doppler); to be expressed as a geometric shape. iii) 3-dimensional grid of radar pixels iv) Infrared and visible imagery by meteorological satellite (synchronous): VIRR (FY-3), Global coverage twice/day (IR) or once/day (VIS) v) River discharge by gauge: size and geometric shape of a river Catchment.</p>		M* (Phase 1)

Id	Name	Definition	Note or Example	Code Table	ItemMCO ¹
1-05	Representativeness	Spatial extent of the region around the observation for which it is representative	<p>NOTE: 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 (WMO-No. 8, 2008). Representativeness of an observed value describes the concept that the result of an observation made at a given geospatial location would be compatible with the result of other observations of the same quantity at other geospatial locations. In statistics, the term describes the notion that a sample of a population allows an 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.</p>	1-05	O (Phase 2)

Condition:

{1-02} variables that are measured, rather than classified

Category 2: Purpose of Observation

Specifies the main application area(s) of the observation and the observing programme(s) and networks the observation is affiliated to.					
Id	Name	Definition	Note or Example	Code Table	Item/MCO
2-01	Application area(s)	Context within, or intended application(s) for which the observation is primarily made or which has/have the most stringent requirements	<p><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.</p> <p><i>EXAMPLES:</i> GUAN, AMDAR, GAW, RBSN, WHOS, etc. (full names to be referenced in code table)</p>	2-01	M* (Phase 1)
2-02	Program/Network affiliation	The global, regional or national program/network(s) that the station/platform is associated with		2-02	M (Phase 1)

Category 3: Station/Platform

Specifies the environmental monitoring facility, including fixed station, moving equipment or remote sensing platform at which the observation is made.

Id	Name	Definition	Note or Example	Code Table	ItemMCO
3-01	Region of origin of data	WMO Region	<i>NOTE:</i> WMO divides Member countries into six Regional Associations responsible for coordination of meteorological, hydrological and related activities within their respective Regions. <i>NOTE:</i> Mandatory for fixed stations, optional for mobile stations <i>EXAMPLE:</i> Australia.	3-01	C* (Phase 1)
3-02	Territory of origin of data	Country or territory name of the location of the observation	<i>EXAMPLES:</i> Mauna Loa, South Pole	3-02	C* (Phase 1)
3-03	Station/platform name	Official name of the station/platform			M (Phase 1)
3-04	Station/platform type	A categorization of the type of environmental monitoring facility at which an observed variable is measured	<i>NOTE:</i> Code table according to See [INSPIRE D2.8.III.7, 2013]	3-04	M* (Phase 2)
3-05	Station/platform model	The model of the monitoring equipment used at the station/platform	<i>EXAMPLES:</i> 'Landsat 8' is a platform/station model of 'satellite'; 'Almos Automatic Weather Station (AWS)' is a model of a 'land station'; 'Airbus A340-600' is a model of an 'aircraft'.		M** (Phase 3)
3-06	Station/platform unique identifier	A unique and persistent identifier for an environmental monitoring facility (station/platform), which may be used as an external point of reference	<i>NOTE:</i> 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. <i>EXAMPLE:</i> Ship: Call sign.		M* (Phase 1)
3-07	Geospatial location	Position in space defining the location of the environmental monitoring station/platform at the time of observation	<i>NOTE 1:</i> Required for fixed stations; for stations following pre-determined trajectory (e.g. satellites); <i>NOTE 2:</i> The elevation of a fixed terrestrial station is defined as the height above sea level of the ground on which the station stands ("Hha" in WMO Pub. 9 Vol A).	11-01 11-02	M* (Phase 1)

Id	Name	Definition	Note or Example	Code Table	ItemMCO
			<p><i>NOTE 3:</i> The geospatial location can be a zero-, one-, two-, or three-dimensional feature.</p> <p><i>NOTE 4:</i> Geographical coordinates can be specified in decimal degrees. Latitudes are specified with reference to the equator, with positive sign for latitudes north of the equator, and negative sign for latitudes south of the equator. Longitudes are specified with reference to the Greenwich meridian, with positive sign for longitudes east of Greenwich, and negative sign for meridians west of Greenwich. Elevation is a signed number specified in some distance measure (e.g., meters) relative to a reference elevation, with positive sign in the direction away from the Earth centre.</p> <p><i>NOTE 5:</i> 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 (WMO-No. 8, 2008, Part I, Chapter 1, 1.3.3.2).</p> <p><i>NOTE 6:</i> This element comprises 3 entities, the coordinates (Lat/Long/Alt), the "geopositioning method" (code table 11-01) which produced the coordinates, as well as the "geospatial reference system" (code table 11-02) used.</p> <p>EXAMPLES:</p> <p>(i) The station Jungfraujoch is located at 46.54749°N 7.98509°E (3580.00 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) [sun-synchronous satellite] NOAA-19 Height 870 km; Local Solar Time (LST) 13:39</p> <p>(v) Weather Watch Radar: Warruwi NT -11.6485° N, 133.3800 E, Height 19.1 m amsl.</p> <p>(vi) River discharge gauge: Warrego River at Cunnamulla Weir 28.1000 S, 145.6833 E, Height: 180 m amsl.</p>		

Id	Name	Definition	Note or Example	Code Table	ItemMCO
3-08	Data communication method	Data communication method between the station/platform and some central facility	<p><i>EXAMPLES:</i> Inmarsat-C, ARGOS, Cellular, Globalstar, GMS(DCP), Iridium, Orbcomm, VSat, landline telephone, mail</p>	3-08	O (Phase 2)
3-09	Station status	Declared reporting status of the station	<p><i>NOTE:</i> Refer to the code table</p>	3-09	M (Phase 1)

Conditions:

{3-01, 3-02}: Mandatory for fixed land-based stations, optional for mobile stations

Category 4: Environment

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

Id	Name	Definition	Note or Example	Code table	ItemMCO
4-01	Surface cover	The observed (bio)physical cover on the Earth's surface in the vicinity of the observation	<p>NOTE 1: To be applied to 3 different geographic scales of the vicinity of the observation, namely horizontal radii of <100 m, of 100 m to 3 km, and of 3 km to 100 km.</p> <p>NOTE 2: Surface cover or 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>NOTE 3: 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>NOTE 4: 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.glcen.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 (Phase 3)

Id	Name	Definition	Note or Example	Code table	ItemMCO
4-02	Surface cover classification scheme	Name and reference or link to document describing the classification scheme	IGBP, UMD, LAI/fPAR, NPP and PFT, LCCS (recommended implementation as a URI pointing to the code table)	4-02	C (Phase 3)
4-03	Topography or bathymetry	The shape or configuration of a geographical feature, represented on a map by contour lines	NOTE 1: Topography shall be formally expressed with the four elements 'local topography', 'relative elevation', 'topographic context', and 'altitude/depth'. NOTE 2: The term 'altitude' is used for elevations above mean sea level. The term 'depth' is used for elevations below mean sea level. EXAMPLES (can be converted into entries of the code table): "a ridge at low relative elevation within valleys of middle altitude" "a depression within plains of very low depth"	4-03	C (Phase 3)
4-04	Events at station/platform	Description of human action or natural event at the station or in the vicinity that may influence the observation		4-04 or free text	O (Phase 2)
4-05	Site information	Non-formalized information about the location and its surroundings at which an observation is made and that may influence it	NOTE 1: This information may be frequently changing (for example ocean debris impacting buoys). NOTE 2: 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. EXAMPLES: maps, plans, photographs, descriptions and other unique site information that is difficult to express in words or that cannot easily be quantified.		O (Phase 2)

Conditions:

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.

Category 5: Instruments and Methods of Observation

Specifies the method of observation and describes characteristics of the instrument(s) used to make the observation. If multiple instruments are used to generate the observation, then this category should be repeated.

Id	Name	Definition	Note or Example	Code Table	Item/MCO
5-01	Source of observation	The source of the dataset described by the metadata	NOTE: Refer to the Code table	5-01	M (Phase 1)
5-02	Measurement/observing method	The method of measurement/observation used	EXAMPLES: 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. Examples of satellite observation principles: Cross-nadir scanning IR sounder, MW imaging/sounding radiometer, conical scanning, etc. Visual observation of weather, cloud type, etc.	5-02	M [#] (Phase 1)
5-03	Instrument specifications	Intrinsic capability of the measurement/observing method to measure the designated element, including range, stability, precision, etc.	NOTE 1: The metadata record can be "not available". NOTE 2: Includes the Upper limit of operational range and the Lower limit of operational range EXAMPLES: 1) Barometer measurement range 800–1100 hPa (i.e. unsuitable for some mountain ranges, Mt Everest ~300hPa) 2) Maximum distance a human observer can observe given the topography.		M [#] (Phase 1)
5-04	Instrument operating status	The status of an instrument with respect to its operation	NOTE: To be recorded by data providers for each individual observation	5-04	O (Phase 3)

Id	Name	Definition	Note or Example	Code Table	ItemMCO
5-05	Vertical distance of sensor	Vertical distance of the sensor from a (specified) reference level such as local ground, or deck of a marine platform at the point where the sensor is located; or sea surface	<p>NOTE 1: The reference surface (generally a surface which will strongly influence the observation) must be specified.</p> <p>NOTE 2: Away from center of earth, positive. Negative values indicate position below reference surface.</p> <p>EXAMPLES:</p> <ul style="list-style-type: none"> i) Air temperature: height of the temperature sensor is 1.50 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. v) Weather Watch Radar: Warruwi AU 24.3 m above ground surface (see 7-07) vi) Transmissometer 2.55 above runway surface vii) depth of buoy relative to lowest astronomical tide viii) Pressure sensor: vertical distance above mean sea level ix) For satellites, e.g., geostationary orbit at 36000 km above geoid, or LEO at 800 km above geoid <p>EXAMPLES: shelter, temperature control, etc. Internal volume: [m³] Aspirated: [Natural/forced/na] Aspiration rate: m³s⁻¹ Shielding from: [radiation/precipitation/wind/etc.]</p>		C* (Phase 1)
5-06	Configuration of instrumentation	Description of any shielding or configuration/setup of the instrumentation or auxiliary equipment needed to make the observation or to reduce the impact of extraneous influences on the observation			C# (Phase 3)
5-07	Instrument control schedule	Description of schedule for calibrations or verification of instrument	EXAMPLE: Every year on first week of February		C (Phase 3)

Id	Name	Definition	Note or Example	Code Table	ItemMCO
5-08	Instrument control result	The result of an instrument control check, including date, time, location, standard type and period of validity	<p>NOTE 1: For the result of control check code table 5-08 is to be used</p> <p>NOTE 2: record even if "not available"</p> <p>NOTE 3: Information should contain at least the following elements: 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> <p>NOTE 4: Can be implemented with a URI pointing to a document containing this information</p> <p>EXAMPLE: 20140207 15:30 UTC, travelling standard, <name>, <S/N>, field calibration, result: in calibration, validity: 4 years</p>	5-08	C# (Phase 3)
5-09	Instrument model and serial number	Details of manufacturer, model number, serial number and firmware version if applicable	<p>NOTE 1: Record "not available"</p> <p>NOTE 2: Use the following formats: Instrument manufacturer: [free text] Instrument model: [free text] Instrument serial number: [free text] Firmware version: [free text] EXAMPLE: Vaisala PTB330B G2120006</p> <p>EXAMPLE: Daily cleaning of a radiation sensor.</p>		C# (Phase 3)
5-10	Instrument routine maintenance	A description of schedule maintenance that is performed on an instrument			C# (Phase 3)
5-11	Maintenance party	Identifier of the organization or individual who performed the maintenance activity			O (Phase 2)

Id	Name	Definition	Note or Example	Code Table	ItemMCO
5-12	Geospatial location	Geospatial location of instrument/sensor	<p><i>NOTE 1:</i> Geographic location of instrument such as airfield anemometer or transmissometer.</p> <p><i>NOTE 2:</i> This element comprises 3 entities, the coordinates (Lat/Long/Alt), the "geopositioning method" (code table 11-01) which produced the coordinates, as well as the "geospatial reference system" (code table 11-02) used.</p> <p><i>EXAMPLES:</i> 1) Melbourne Airport AU (East anemometer) -37.6602 N, 144.8443 E, 122.00 m amsl. 2) relative position of wind sensor aboard ship 3) 30 km upstream of river mouth</p>	11-01 11-02	C* (Phase 2)
5-13	Maintenance Activity	Description of maintenance performed on instrument	<p><i>NOTE:</i> A log of actual maintenance activity, both planned and corrective</p>		O (Phase 3)
5-14	Status of observation	Official status of observation	<p><i>NOTE:</i> A binary flag</p>	5-14	O (Phase 3)
5-15	Exposure of instruments	The degree to which an instrument is affected by external influences and reflects the value of the observed variable	<p><i>NOTE:</i> The exposure of an instrument results from joint appraisal of the environment, measurement interval and exposure against the requirements of some particular application. Expressed in terms of code table.</p>	5-15	C (Phase 2)

Conditions:

{5-07, 5-08, 5-09, 5-10, 5-15} mandatory for instrumental observations

{5-05} mandatory for instrumental observations and if proximity of reference surface impacts on observation

{5-06} mandatory for instrumental observations and if prescribed by "best practice".

{5-12} mandatory for instrumental observations and if different from station/platform

Category 6: Sampling

Specifies how sampling and/or analysis are used to derive the reported observation or how a specimen is collected.

Id	Name	Definition	Note or Example	Code Table	Item/MCO
6-01	Sampling procedures	Procedures involved in obtaining a sample	<p>EXAMPLES: Temperature measurements are made using a XYZ thermometer and reported results are an average of 10 measurements made in a given hour. Aerosols may be sampled with an inlet with size-cutoff at 2.5 µm and be deposited on a teflon filter. Manual reading of a liquid-in-glass thermometer every three hours. As an exception, an observer may observe the state of the sky from home rather than at the station during night. Rain fall is accumulated during the whole week-end and distributed evenly over these 2 days.</p>		O (Phase 3)
6-02	Sample treatment	Chemical or physical treatment of sample prior to analysis	<p>EXAMPLES: Homogenization, milling, mixing, drying, sieving, heating, melting, freezing, evaporation...</p>		O (Phase 3)
6-03	Sampling strategy	The strategy used to generate the observed variable	<p>EXAMPLES: Continuous: global radiation, atmospheric pressure, or continuous ozone monitoring with a UV monitor; Discrete: gas chromatographic analysis of carbon monoxide, radar rainfall; Event: grab water samples, flask sampling of air, etc.</p>	6-03	O* (Phase 1)
6-04	Sampling time period	The period of time over which a measurement is taken	<p>NOTE: Includes the sampling time period, plus the meaning of time stamp (11-03). EXAMPLES: surface winds sampled every 0.25 s (frequency 4 Hz) (WMO, 2008); surface winds measured once per hour; Barometric pressure measured once every 6 minutes; water column height measured every 15 seconds; water temperature measured once per hour (NOAA, 2009); For each example, Time stamp indicates "end of period".</p>	11-03	M# (Phase 3)

Id	Name	Definition	Note or Example	Code Table	Item/MCO
6-05	Spatial sampling resolution	<p>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.</p>	<p>EXAMPLES: AVHRR: 1.1 km IFOV s.s.p. The sample is a point in space or a very small volume resembling a point, e.g., a temperature sampled by a thermocouple element: No size to be reported; 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 'length' of the line is to be reported; 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 'length x length' of the area is to be reported; The sample is a volume, e.g. a water sample or a well-mixed volume of air sampled by flask. The 'length x length x length' of the volume is to be reported.</p>		M [#] (Phase 2)
6-06	Temporal sampling interval	Time period between the beginning of consecutive sampling periods			M (Phase 3)
6-07	Diurnal base time	Time to which diurnal statistics are referenced	<p>Examples Rain fall observation is accumulated for 24 hours up until 0700z, the diurnal base time here is 0700z. Daily temperature maxima refer to the period 0600 local time, the diurnal base time here is 0600z.</p>		M (Phase 1)
6-08	Schedule of observation	Schedule of observation	<p>EXAMPLES: AMDAR profiling observations are available from Zurich airport between 0600 and 1200 local time; Radio-sondes are collected at a particular station from January to August on weekdays at 0000z and 1200z</p>		M (Phase 1)

Category 7: Data Processing and Reporting

Specifies how raw data are transferred into the observed variables and reported to the users.

Id	Name	Definition	Note or Example	Code table	Item/MCO
7-01	Data processing methods and algorithms	A description of the processing used to generate the observation and list of algorithms utilized to derive the resultant value	<i>NOTE:</i> In hydrology, this would be the equation(s) defining the rating curve and any shifts or corrections applied to the data or the curve. <i>EXAMPLES:</i> Chemical analysis, AMDAR processing center, National Hydrological Service office.		O (Phase 3)
7-02	Processing/analysis center	Center at which the observation is processed.	<i>NOTE:</i> Includes the temporal reporting interval, plus the meaning of time stamp. <i>EXAMPLES:</i> Hourly, daily, monthly, seasonal, event-based, 80 seconds interval during the day, etc. In each case, the meaning, "beginning", "middle", or "end" of period is indicated.	11-03	O (Phase 2)
7-03	Temporal reporting period	Time period over which the observed variable is reported	<i>NOTE:</i> This is applicable only to remote sensing observations and mobile platforms in general. For most remote-sensing observations, this will be redundant with element 6-06. <i>EXAMPLES:</i> – An observation from a satellite may be reported with a spatial resolution of 10 km x 20 km. – An aircraft may sample every 1 km along its trajectory (cf. 6-06), but may report at a spatial interval of 10 km.		M* (Phase 1)
7-04	Spatial reporting interval	Spatial interval at which the observed variable is reported	<i>EXAMPLES:</i> Avionics version, retrieval algorithm version; MCH Database Management System version 25/10/2013.		C* (Phase 1)
7-05	Software/processor and version	Name and version of the software or processor utilized to derive the element value			O (Phase 3)

Id	Name	Definition	Note or Example	Code table	ItemMCO
7-06	Level of data	Level of data processing	<i>NOTE:</i> Pre or Post processing.	7-06	O (Phase 2)
7-07	Data format ²	Description of the format in which the observed variable is being provided.	<i>EXAMPLES:</i> ASCII, BUFR, NASA AMES, HDF, XML, AMDAR, comma-separated (CSV), tab-separated (.txt), MCH (for interchange)		M (Phase 3)
7-08	Version of data format ³	Version of the data format in which the observed variable is being provided.	<i>EXAMPLES:</i> FM 12-XIV Ext. SYNOP; FM 42-XI Ext. AMDAR, FM 94-XIV BUFR Version 20.0.0, Radar: ODIM_H5		M (Phase 3)
7-09	Aggregation period	Time period over which individual samples/observations are aggregated	<i>NOTE:</i> Includes the aggregation interval, plus the meaning of time stamp. <i>EXAMPLES:</i> 5 minute mean, meaning of time stamp is "middle of period"; daily maximum, meaning of time stamp is "end of period"; event based, meaning of time stamp is "beginning of period".	11-03	M (Phase 2)
7-10	Reference time	Time base to which date and time stamps refer	<i>NOTE:</i> The reference time must not be confused with the time zone (which is part of the representation of the time stamp), but indicates what the source of the time stamp is, i.e., to which reference time the time stamps of the observation are aligned. <i>EXAMPLES:</i> NIST time server NTP pool project	7-10	M (Phase 2)

² Provided as part of the WIS metadata records

³ Provided as part of the WIS metadata records

Id	Name	Definition	Note or Example	Code table	ItemMCO
7-11	Reference datum	Reference datum used to convert observed quantity to reported quantity	<p>NOTE 1: Atmospheric pressure can be reported as (i) Field elevation Pressure (QFE), where the reference datum is the elevation corresponding to the official elevation of the aerodrome; (ii) Atmospheric pressure at nautical height (QNH), where the reference datum is mean sea level and the pressure altitude relationship of the ICAO standard atmosphere is used. Where observed atmospheric pressure cannot be reduced to mean sea level, a station should, by regional agreement, report either the geopotential of an agreed 'constant pressure level' or the pressure reduced to an agreed datum for the station. The level chosen for the station should be reported in this field. (Ref: WMO-No. 8 3.11.1).</p> <p>NOTE 2: Hydrology may report a gauge zero which is the gauge height of zero flow.</p> <p>NOTE 1: The resolution of a numerical quantity is a measure of the detail in which the quantity is expressed. It can be expressed as the smallest possible difference between two numbers. It can also be expressed as the number of significant figures of a number, which are those digits that carry meaning contributing to its resolution.</p>		C (Phase 1)
7-12	Numerical resolution	Measure of the detail in which a numerical quantity is expressed	<p>NOTE 1: The resolution of a numerical quantity is a measure of the detail in which the quantity is expressed. It can be expressed as the smallest possible difference between two numbers. It can also be expressed as the number of significant figures of a number, which are those digits that carry meaning contributing to its resolution.</p>		O (Phase 3)

Id	Name	Definition	Note or Example	Code table	ItemMCO
			<p>EXAMPLE: if a measurement resolution to four decimal places (0.0001) is given as 12.23 then it might be understood that only two decimal places of resolution are available. Stating the result as 12.2300 makes clear that it is precise to four decimal places (in this case, six significant figures).</p> <p>NOTE 2: The notion of measurement resolution is related but must not be confounded with the uncertainty of an observation</p> <p>EXAMPLES:</p> <ul style="list-style-type: none"> – An anemometer may measure wind speed with a measurement resolution of 0.1 ms^{-1} with a 1 Hz scan rate. Observations may be aggregated to 1-minute values and may be rounded and reported with a (reduced) measurement resolution of 1 ms^{-1}. – A barometer may be capable of measuring atmospheric pressure with a readout resolution of 1 hPa and an uncertainty of 5 hPa ($k=2$). The data can be reported to the nearest hPa, however, the measurement resolution should be stated as "5 hPa" or "3 significant digits". – An ocean thermometer measures temperature to $0.0001 \text{ }^\circ\text{C}$. – Seawater salinity measured to 0.001 salinity units (derived from conductivity measurements with a resolution of 0.01 Sm^{-1}) 		

Id	Name	Definition	Note or Example	Code table	Item/MCO
7-13	Latency (of reporting)	The typical time between completion of the observation or collection of the datum and when the datum is reported	<p>(i) For satellite data, the “observation” (e.g. a complete image) can take 20 minutes to generate. Hence the latency would be the time between the completion of the image collection, and when it is available. Typically this can be 2–3 minutes. Some satellite products such as SST can take about 10 minutes of processing until it is available.</p> <p>(ii) A radar volumetric scan can take 6–10 minutes (in Australia), so the latency would be the time between the completion of the scan and when the data is locally available. In Australia, this varies between a few seconds to several minutes depending on delays in data communications.</p> <p>(iii) AWS data may have a latency of 1–20 seconds (or considerably more in some places) between the completion of the observation and arrival of the data at a central archive.</p>		M (Phase 3)

Conditions:

{7-04}: mandatory for remote sensing observations and mobile platforms in general

{7-11}: mandatory for stations/platforms that report a derived observation value that depends on a local datum

Category 8: Data Quality

Specifies the data quality and traceability of the observation

Id	Name	Definition	Note or Example	Code Table	Item/MCO
8-01	Uncertainty of measurement	Non-negative parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the observation/measurand	<p>NOTE 1: In principle, an uncertainty statement needs to be reported for each observation, as it can change from observation to observation. If the uncertainty of observations remain virtually constant over time, it is sufficient to report the uncertainty at the beginning of the period and then again when substantial changes of the uncertainty occur. The actual uncertainty statements should be reported with the observations.</p> <p>NOTE 2: Complex observations such as gridded satellite imagery may contain large error covariance matrices that are not useful for the purpose of this standard. Such information must be kept with the data, and it is sufficient to report an aggregate (e.g., mean or median) uncertainty in the metadata.</p> <p>NOTE 3: Uncertainty may be expressed, for example, as a standard deviation (or a given multiple of it), or the half-width of an interval having a stated level of confidence.</p> <p>NOTE 4: 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>NOTE 5: 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>EXAMPLE: A thermometer reading may yield a value of 13.7 °C. A quality assessment of that observation may indicate that it has an expanded uncertainty of ± 0.3 °C ($k=2$), where $k=2$ is a coverage factor corresponding approximately to a confidence interval of 95%</p>		C*# (Phase 2)
8-02	Procedure used to estimate uncertainty	A reference or link pointing to a document describing the procedures/algorithms used to derive the uncertainty statement	<p>NOTE: Uncertainty is a well-defined term, and guidance material exists to assist in the assessment of the uncertainty of observations and a formulation of adequate uncertainty statements. The authoritative source is the "Guide for the Expression of Uncertainty in Measurement" (JCGM 100:2008).</p>		

Id	Name	Definition	Note or Example	Code Table	ItemMCO
8-03	Quality flag	An ordered list of qualifiers indicating the result of a quality control process applied to the observation	NOTE 1: BUFR code table series 0-33 contains data quality flags/definitions. NOTE 2: To be recorded by data providers for each individual observation	8-03	M# (Phase 2)
8-04	Quality flagging system	Reference to the system used to flag the quality of the observation	NOTE 1: At present, there is no single, globally accepted flagging system. The purpose of this element is to make reference to the flagging system used. This reference should either be a URL to a document explaining the meaning of the quality flag, or a link to a code table where this information can be found. NOTE 2: The use of the BUFR quality codes listed above is recommended (WMO, 2013)	8-04	
8-05	Traceability	Statement defining traceability to a standard, including sequence of measurement standards and calibrations that is used to relate a measurement result to a reference [VIM 3 2.4.2]	NOTE 1: A metrological traceability chain is defined through a calibration hierarchy; [VIM 3, 2.4.2] NOTE 2: A metrological traceability chain is used to establish metrological traceability of a measurement result. [VIM 3, 2.4.2] NOTE 3: 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; [VIM 3, 2.4.2] NOTE 4: For the statement on traceability, code table 8-05 is to be used	8-05	C*# (Phase 2)

Conditions:

{8-01, 8-02 and 8-05} variables that are measured, rather than classified

Category 9: Ownership & Data Policy

Specifies who is responsible for the observation and owns it.

Id	Name	Definition	Note or Example	Code Table	ItemMCO
9-01	Supervising organization	Name of organization who owns the observation	<p><i>EXAMPLES:</i> for <i>satellite operators</i> EUMETSAT, ESA, NOAA, NASA, CMA, RapidEye, ISRO</p>		M (Phase 2)
9-02	Data policy/use constraints	Details relating to the use and limitations surrounding data imposed by the supervising organization	<p><i>NOTE:</i> Only one single use constraint with a value taken from WMO_DataLicenseCode is allowed to ensure unambiguity. (WMO, 2013b, p15)</p>	9-02	M* (Phase 1)

Category 10: Contact

Specifies where information about an observation or dataset can be obtained.

Id	Name	Definition	Note or Example	Code Table	ItemMCO
10-01	Contact (Nominated Focal Point)	Principal contact (Nominated Focal Point, FP) for resource	<p><i>NOTE:</i> The FP would be able to provide data users with information regarding individual observing platforms and their observations.</p> <p><i>EXAMPLES:</i> Programme or Network Manager, e.g. E-AMDAR Technical Coordinator (TC) has responsibility for data quality of several airlines' fleets, has information on aircraft type/software/known errors etc.</p>		M (Phase 1)

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ANNEX – Code Tables

Code table: 1-01

Code table title: Observed variable – measurand [Code table under development]

#	Domain	Sub-domain	Matrix	VARIABLE	Mode of Observation	WMO 306 code (BUFR / CREX)
1-01-01	Atmosphere	Atmospheric Pressure		Atmospheric Pressure	I, V	0 10 004
1-01-02		Temperature		Ambient air temperature (over specified surface)	I, V	0 12 101
				Maximum temperature		
1-01-03		Temperature		Dew-point temperature	I, V	0 12 103
1-01-04		Temperature		Ground (surface) temperature (over specified surface)	I, V	0 12 120
1-01-05	Terrestrial	Temperature	Soil	Soil temperature	I, V	0 12 130
1-01-06		Temperature		Snow temperature	I, V	0 12 131
1-01-07		Temperature		Water temperature – river, lake, sea, well	I, V	0 13 082 or 0 22 043
1-01-08		Humidity		Relative humidity	I, V	0 13 003
1-01-09		Humidity		Mass mixing ratio	I, V	0 13 110
1-01-10		Humidity		Soil moisture	I, V	0 13 111
1-01-11		Humidity		Water vapour pressure	I, V	0 13 004
1-01-12		Humidity		Evaporation/evapotranspiration	T	0 13 033
1-01-13		Humidity		Object wetness duration	T	0 13 112
1-01-14	Atmosphere	Wind		Direction	I, V	0 11 001
1-01-15		Wind		Speed	I, V	0 11 002
1-01-16		Wind		Gust Speed	I, V	0 11 041
1-01-17		Wind		X,Y component of wind vector	I, V	0 11 003
1-01-18		Wind		Z component of wind vector (horizontal and vertical profile)		0 11 004, 0 11 006
1-01-19		Wind		Turbulence type (Low levels and wake vortex)	I, V	-
1-01-20		Wind		Turbulence intensity	I, V	-
1-01-21		Radiation		Sunshine duration	T	0 14 031
1-01-22		Radiation		Background luminance	I, V	0 14 056
1-01-23		Radiation		Global downward solar radiation	I, T, V	0 14 028
1-01-24		Radiation		Global upward solar radiation	I, T, V	0 14 052
1-01-25		Radiation		Diffuse solar radiation	I, T, V	0 14 029
1-01-26		Radiation		Direct solar radiation	I, T, V	0 14 030
1-01-27		Radiation		Downward long-wave radiation	I, T, V	0 14 002
1-01-28		Radiation		Upward long-wave radiation	I, T, V	0 14 002
1-01-29		Radiation		Net radiation	I, T, V	0 14 053
1-01-30		Radiation		UV-B radiation	I, T, V	0 14 072

#	Domain	Sub-domain	Matrix	VARIABLE	Mode of Observation	WMO 306 code (BUFR / CREX)
1-01-31		Radiation		Photosynthetically active radiation	I, T, V	0 14 054
1-01-32		Radiation		Surface albedo	I, V	0 14 019
1-01-33		Radiation		Soil heat Flux	I, T, V	0 14 057
1-01-34		Clouds		Cloud base height	I, V	0 20 013
1-01-35		Clouds		Cloud top height	I, V	0 20 014
1-01-36		Clouds		Cloud type, convective vs other types	I	0 20 012
1-01-37		Clouds		Cloud hydrometeor concentration	I, V	0 20 130
1-01-38		Clouds		Effective radius of cloud hydrometeors	I, V	0 20 131
1-01-39		Clouds		Cloud liquid water content	I, V	0 20 132
1-01-40		Clouds		Optical depth within each layer	I, V	-
1-01-41		Clouds		Optical depth of fog	I, V	-
1-01-42		Clouds		Height of inversion	I, V	0 20 093
1-01-43		Clouds		Cloud cover	I, V	0 20 010
1-01-44		Clouds		Cloud amount	I, V	0 20 011
1-01-45		Precipitation		Accumulation	T	0 13 011
1-01-46		Precipitation		Depth of fresh snowfall	T	0 13 118
1-01-47		Precipitation		Duration	T	0 26 020
1-01-48		Precipitation		Size of precipitating element	I, V	0 13 058, 0 20 066
1-01-49		Precipitation		Intensity - quantitative	I, V	0 13 155
1-01-50		Precipitation		Type	I, V	0 20 021
1-01-51		Precipitation		Rate of ice accretion	I, V	0 13 114
1-01-52		Obscuration		Obscuration type	I, V	0 20 025
1-01-53		Obscuration		Hydrometeor type	I, V	0 20 025
1-01-54		Obscuration		Lithometeor type	I, V	0 20 025
1-01-55		Obscuration		Hydrometeor radius	I, V	0 20 133
1-01-56		Obscuration		Extinction coefficient	I, V	0 15 029
1-01-57		Obscuration		Meteorological Optical Range	I, V	0 15 051
1-01-58		Obscuration		Runway visual range	I, V	0 20 061
1-01-59		Obscuration		Other weather type	I, V	0 20 023
1-01-60		Lightning		Lightning rates of discharge	I, V	0 20 126
1-01-61		Lightning		Lightning discharge type (cloud to cloud, cloud to surface)	I, V	0 20 023
1-01-62		Lightning		Lightning discharge polarity	I, V	0 20 119
1-01-63		Lightning		Lightning discharge energy	I, V	-
1-01-64		Lightning		Lightning - distance from station	I, V	0 20 127
1-01-65		Lightning		Lightning - direction from station	I, V	0 20 128
1-01-66		Hydrologic And Marine Observations		Flow discharge - river	I, V	0 23 040

#	Domain	Sub-domain	Matrix	VARIABLE	Mode of Observation	WMO 306 code (BUFR / CREX)
1-01-67		Hydrologic And Marine Observations		Flow discharge – well	I, V	0 23 041
1-01-68		Hydrologic And Marine Observations		Ground water level	I, V	0 13 074
1-01-69		Hydrologic And Marine Observations		Ice surface temperature	I, V	0 12 132
1-01-70		Hydrologic And Marine Observations		Ice thickness - river, lake	I, V	0 08 029, 0 13 115
1-01-71		Hydrologic And Marine Observations		Ice thickness - glacier, sea	I, V	0 08 029, 0 13 115
1-01-72		Hydrologic And Marine Observations		Ice thickness	T	2 01 133, 2 02 129, 0 20 031, 2 02 000, 2 01 000
1-01-73		Hydrologic And Marine Observations		Water level	I, V	0 13 071, 0 13 072
1-01-74		Hydrologic And Marine Observations		Wave height	V	0 22 021
1-01-75		Hydrologic And Marine Observations		Wave period	V	2 01 129, 0 22 011, 2 01 000
1-01-76		Hydrologic And Marine Observations		Wave direction	V	0 22 001
1-01-77		Hydrologic And Marine Observations		1D spectral wave energy density	V, T	2 01 135, 0 22 069, 2 01 000
1-01-78		Hydrologic And Marine Observations		2D spectral wave energy density	V, T	2 01 135, 0 22 069, 2 01 000
1-01-79		Hydrologic And Marine Observations		Water practical salinity	I, V	2 01 130, 0 22 064, 2 01 000

#	Domain	Sub-domain	Matrix	VARIABLE	Mode of Observation	WMO 306 code (BUFR / CREX)
1-01-80		Hydrologic And Marine Observations		Water conductivity	I, V	2 01 132, 0 22 066, 2 01 000
1-01-81		Hydrologic And Marine Observations		Water pressure	I, V	2 07 001, 0 22 065, 2 07 000
1-01-82		Hydrologic And Marine Observations		Ice mass	T	0 20 135
1-01-83		Hydrologic And Marine Observations		Snow density (liquid water content)	T	0 13 117
1-01-84		Hydrologic And Marine Observations		Tidal elevation with respect to local chart datum	I, V	2 01 129, 0 22 038, 2 01 000
1-01-85		Hydrologic And Marine Observations		Tidal elevation with respect to national land datum	I, V	2 01 129, 0 22 037, 2 01 000
1-01-86		Hydrologic And Marine Observations		Meteorological residual tidal elevation (surge or offset)	I, V	0 22 040
1-01-87		Hydrologic And Marine Observations		Ocean Current - Direction	I, V	0 22 004 or 0 22 005
1-01-88		Hydrologic And Marine Observations		Ocean Current - Speed	I, V	0 22 031 or 0 22 032
1-01-89		Other Surface Variables		Runway conditions	I, V	0 20 085
1-01-90		Other Surface Variables		Braking action/friction coefficient	I, V	0 20 089
1-01-91		Other Surface Variables		State of ground	I, V	0 20 062
1-01-92		Other Surface Variables		Type of surface specified	I, V	0 08 010
1-01-93		Other Surface Variables		Snow depth	T	0 13 013
1-01-94		Other		Gamma radiation dose rate	I, T	0 24 014
1-01-95		Other		Categories of stability	I, V	0 13 041

Code table: 1-02

Code table title: Measurement unit [according to common code table C-6 (WMO, 2013)]

#	Name	Conventional abbreviation	Abbreviation in IA5/ASCII	Abbreviation in ITA2	Definition in base units
1-02-1	metre	m	m	M	-
1-02-2	kilogram	kg	kg	KG	-
1-02-3	second	s	s	S	-
1-02-4	ampere	A	A	A	-
1-02-5	kelvin	K	K	K	-
1-02-6	mole	mol	mol	MOL	-
1-02-7	candela	cd	cd	CD	-
1-02-8	radian	rad	rad	RAD	-
1-02-9	steradian	sr	sr	SR	-
1-02-10	hertz	Hz	Hz	HZ	s ⁻¹
1-02-11	newton	N	N	N	kg m s ⁻²
1-02-12	pascal	Pa	Pa	PAL	kg m ⁻¹ s ⁻²
1-02-13	joule	J	J	J	kg m ² s ⁻²
1-02-14	watt	W	W	W	kg m ² s ⁻³
1-02-15	coulomb	C	C	C	A s
1-02-16	volt	V	V	V	kg m ² s ⁻³ A ⁻¹
1-02-17	farad	F	F	F	kg ⁻¹ m ⁻² s ⁴ A ²
1-02-18	ohm	Ω	Ohm	OHM	kg m ² s ⁻³ A ²
1-02-19	siemens	S	S	SIE	kg ⁻¹ m ⁻² s ³ A ²
1-02-20	weber	Wb	Wb	WB	kg m ² s ⁻² A ⁻¹
1-02-21	tesla	T	T	T	kg s ⁻² A ⁻¹
1-02-22	henry	H	H	H	kg m ² s ⁻² A ²
1-02-23	degree celsius	°C	Cel	CEL	K+273.15
1-02-24	lumen	lm	lm	LM	cd sr
1-02-25	lux	lx	lx	LX	cd sr m ⁻²
1-02-26	becquerel	Bq	Bq	BQ	s ⁻¹
1-02-27	gray	Gy	Gy	GY	m ² s ⁻²
1-02-28	sievert	Sv	Sv	SV	m ² s ⁻²

#	Name	Conventional abbreviation	Abbreviation in IA5/ASCII	Abbreviation in ITA2	Definition in base units
1-02-29	degree (angle)	°	deg	DEG	
1-02-30	minute (angle)	'		MNT	
1-02-31	second (angle)	"	"	SEC	
1-02-32	litre	l or L	l or L	L	
1-02-33	minute (time)	min	min	MIN	
1-02-34	hour	h	h	HR	
1-02-35	day	d	d	D	
1-02-36	tonne	t	t	TNE	
1-02-37	electron volt	eV	eV	EV	
1-02-38	atomic mass unit	u	u	U	
1-02-39	astronomic unit	AU	AU	ASU	
1-02-40	parsec	pc	pc	PRS	
1-02-41	nautical mile	mile			
1-02-42	knot	kt	kt	KT	
1-02-43	decibel	dB	dB	DB	
1-02-44	hectare	ha	ha	HAR	
1-02-45	week				
1-02-46	year	a	a	ANN	
1-02-47	per cent	%	%	PERCENT	
1-02-48	parts per thousand	‰	0/00	PERTHOU	
1-02-49	eighths of cloud	okta	okta	OKTA	
1-02-50	degrees TRUE	°	deg	DEG	
1-02-51	degrees per second	degree/s	deg/s	DEG/S	
1-02-52	degrees Celsius	°C	C	C	
1-02-53	degrees Celsius per metre	°C/m	C/m	C/M	
1-02-54	degrees Celsius per 100 metres	°C/100 m	C/100 m	C/100 M	
1-02-55	Dobson unit	DU	DU	DU	
1-02-56	month	mon	mon	MON	
1-02-57	per second (same as hertz)	s ⁻¹	/s	/S	
1-02-58	per second squared	s ⁻²	s ⁻²		
1-02-59	knots per 1000 metres	kt/1000 m	kt/km	KT/KM	

#	Name	Conventional abbreviation	Abbreviation in IA5/ASCII	Abbreviation in ITA2	Definition in base units
1-02-60	Foot	ft	ft	FT	
1-02-61	Inch	In	in	IN	
1-02-62	decipascals per second (microbar per second)	dPa s ⁻¹	dPa/s	DPAL/S	
1-02-63	centibars per second	cb s ⁻¹	cb/s	CB/S	
1-02-64	centibars per 12 hours	cb/12 h	cb/12 h	CB/12 HR	
1-02-65	dekapascal	daPa	daPa	DAPAL	
1-02-66	hectopascal	hPa	hPa	HPAL	
1-02-67	hectopascals per second	hPa s ⁻¹	hPa/s	HPAL/S	
1-02-68	hectopascals per hour	hPa h ⁻¹	hPa/h	HPAL/HR	
1-02-69	hectopascals per 3 hours	hPa/3 h	hPa/3 h	HPAL/3 HR	
1-02-70	nanobar=hPa 10 ⁻⁶	nbar	nbar	NBAR	
1-02-71	grams per kilogram	g kg ⁻¹	g/kg	G/KG	
1-02-72	grams per kilogram per second	g kg ⁻¹ s ⁻¹	g kg ⁻¹ s ⁻¹		
1-02-73	kilograms per kilogram	kg kg ⁻¹	kg/kg	KG/KG	
1-02-74	kilograms per kilogram per second	kg kg ⁻¹ s ⁻¹	kg kg ⁻¹ s ⁻¹		
1-02-75	kilograms per square metre	kg m ⁻²	kg m ⁻²		
1-02-76	acceleration due to gravity	g	G		
1-02-77	geopotential metre	gpm	gpm		
1-02-78	millimetre	mm	mm	MM	
1-02-79	millimetres per second	mm s ⁻¹	mm/s	MM/S	
1-02-80	millimetres per hour	mm h ⁻¹	mm/h	MM/HR	
1-02-81	millimetres to the sixth power per cubic metre	mm ⁶ m ⁻³	mm ⁶ m ⁻³		
1-02-82	centimetre	cm	cm	CM	
1-02-83	centimetres per second	cm ⁻¹	cm/s	CM/S	
1-02-84	centimetres per hour	cm h ⁻¹	cm/h	CM/HR	
1-02-85	decimetre	dm	dm	DM	
1-02-86	metres per second	m s ⁻¹	m/s	M/S	
1-02-87	metres per second per metre	m s ⁻¹ /m	m s ⁻¹ /m		
1-02-88	metres per second per 1000 metres	m s ⁻¹ /1000 m	m s ⁻¹ /km		
1-02-89	square metres	m ²	m ²	M2	
1-02-90	square metres per second	m ² s ⁻¹	m ² /s	M2/S	

#	Name	Conventional abbreviation	Abbreviation in IA5/ASCII	Abbreviation in ITA2	Definition in base units
1-02-91	kilometre	Km	km	KM	
1-02-92	kilometres per hour	km h ⁻¹	km/h	KM/HR	
1-02-93	kilometres per day	km/d	km/d	KM/D	
1-02-94	per metre	m ⁻¹	m ⁻¹	/M	
1-02-95	becquerels per litre	Bq l ⁻¹	Bq/l	BQ/L	
1-02-96	becquerels per square metre	Bq m ⁻²	Bq m ⁻²	BQ/M2	
1-02-97	becquerels per cubic metre	Bq m ⁻³	Bq m ⁻³	BQ/M3	
1-02-98	millisievert	mSv	mSv	MSV	
1-02-99	metres per second squared	m s ⁻²	m s ⁻²		
1-02-100	square metres second	m ² s	m ² s		
1-02-101	square metres per second squared	m ² s ⁻²	m ² s ⁻²		
1-02-102	square metres per radian second	m ² rad ⁻¹ s	m ² rad ⁻¹ s		
1-02-103	square metres per hertz	m ² Hz ⁻¹	m ² /Hz		
1-02-104	cubic metres	m ³	m ³		
1-02-105	cubic metres per second	m ³ s ⁻¹	m ³ /s		
1-02-106	cubic metres per cubic metre	m ³ m ⁻³	m ³ m ⁻³		
1-02-107	metres to the fourth power	m ⁴	m ⁴		
1-02-108	metres to the two thirds power per second	m ^{2/3} s ⁻¹	m ^{2/3} s ⁻¹		
1-02-109	logarithm per metre	log (m ⁻¹)	log (m ⁻¹)		
1-02-110	logarithm per square metre	log (m ⁻²)	log (m ⁻²)		
1-02-111	kilograms per metre	kg m ⁻¹	kg/m		
1-02-112	kilograms per square metre per second	kg m ⁻² s ⁻¹	kg m ⁻² s ⁻¹		
1-02-113	kilograms per cubic metre	kg m ⁻³	kg m ⁻³		
1-02-114	per square kilogram per second	kg ⁻² s ⁻¹	kg ⁻² s ⁻¹		
1-02-115	seconds per metre	s m ⁻¹	s/m		
1-02-116	kelvin metres per second	K m s ⁻¹	K m s ⁻¹		
1-02-117	kelvins per metre	K m ⁻¹	K/m		
1-02-118	kelvin square metres per kilogram per second	k m ² kg ⁻¹ s ⁻¹	k m ² kg ⁻¹ s ⁻¹		
1-02-119	moles per mole	mol mol ⁻¹	mol/mol		
1-02-120	radians per metre	rad m ⁻¹	rad/m		
1-02-121	newtons per square metre	N m ⁻²	N m ⁻²		

#	Name	Conventional abbreviation	Abbreviation in IA5/ASCII	Abbreviation in ITA2	Definition in base units
1-02-122	pascals per second	Pa s ⁻¹	Pa/s		
1-02-123	kilopascal	kPa	kPa		
1-02-124	joules per square metre	J m ⁻²	J m ⁻²		
1-02-125	joules per kilogram	J kg ⁻¹	J/kg		
1-02-126	watts per metre per steradian	W m ⁻¹ sr ⁻¹	W m ⁻¹ sr ⁻¹		
1-02-127	watts per square metre	W m ⁻²	W m ⁻²		
1-02-128	watts per square metre per steradian	W m ⁻² sr ⁻¹	W m ⁻² sr ⁻¹		
1-02-129	watts per square metre per steradian centimetre	W m ⁻² sr ⁻¹ cm	W m ⁻² sr ⁻¹ cm		
1-02-130	watts per square metre per steradian metre	W m ⁻² sr ⁻¹ m	W m ⁻² sr ⁻¹ m		
1-02-131	watts per cubic metre per steradian	W m ⁻³ sr ⁻¹	W m ⁻³ sr ⁻¹		
1-02-132	siemens per metre	S m ⁻¹	S/m		
1-02-133	square degrees	degree ²	deg ²		
1-02-134	becquerel seconds per cubic metre	Bq s m ⁻³	Bq s m ⁻³		
1-02-135	decibels per metre	dB m ⁻¹	dB/m		
1-02-136	decibels per degree	dB degree ⁻¹	dB/deg		
1-02-137	pH unit	pH unit	pH unit		
1-02-138	N units	N units	N units		

Code table: 1-05

Code table title: Representativeness [(WMO, 2008) (WMO, 2013)], plus extension

#	Name	Definition
1-05-0	Nil reason	None of the codes in the table is applicable in the context of the observed quantity or unknown, or not available information
1-05-1	microscale	An area or volume less than 100 m horizontal extent (for example, evaporation)
1-05-2	toposcale, local scale	An area or volume of 100 m to 3 km horizontal extent (for example, air pollution, tornadoes)
1-05-3	mesoscale	An area or volume of 3 km to 100 km horizontal extent (for example, thunderstorms, sea and mountain breezes)
1-05-4	large scale	An area or volume of 100 km to 3000 km horizontal extent (for example, fronts, various cyclones, cloud clusters)
1-05-5	planetary scale	An area or volume of more than 3000 km horizontal extent (for example, long upper tropospheric waves)
1-05-6	drainage area	An area (also known as 'catchment') having a common outlet for its surface runoff, in km ²

Code table: 2-01

Code table title: Application area(s) [Code table under development]

#	Name	Definition
2-01-1	Global numerical weather prediction (GNWP)	Source: http://www.wmo.int/pages/prog/www/wigos/wir/application-areas.html
2-01-2	High-resolution numerical weather prediction (HRNWP)	Ibid
2-01-3	Nowcasting and very short range forecasting (NVSFRF)	Ibid
2-01-4	Seasonal and inter-annual forecasting (SIAF)	Ibid
2-01-5	General weather forecasting	Ibid
2-01-6	Aeronautical meteorology	Ibid
2-01-7	Ocean applications	Ibid
2-01-8	Agricultural meteorology	Ibid
2-01-9	Hydrology	Ibid
2-01-10	Climate monitoring (as undertaken through the Global Climate Observing System, GCOS)	Ibid
2-01-11	Climate applications	Ibid
2-01-12	Space weather	Ibid
2-01-13	Cryosphere applications	Source: EGOS-IP
2-01-14	Energy sector	
2-01-15	Transportation sector	
2-01-16	Health sector	
2-01-17	Terrestrial ecology	
2-01-18	Operational air quality forecasting	
2-01-19	Atmospheric composition forecasting	
2-01-20	Atmospheric composition monitoring and analysis	
2-01-21	Large urban complexes	

Code table: 2-02

Code table title: Programme/Network affiliation [Code table under development]

#	Name	Definition	Sponsor and/or Contributing to
2-02-01	AMDAR	Global Aircraft Meteorological Data Relay	WMO/GOS
2-02-02	EPA	Environmental Protection Agency	
2-02-03	EUMETNET	Grouping of European National Meteorological Services	WMO/GOS
2-02-04	WMO/GAW	World Meteorological Organization/Global Atmospheric Watch	
2-02-05	GCOS	Global Climate Observing System	
2-02-06	GCW	Global Cryosphere Watch	
2-02-07	GOOS	Global Ocean Observing System	
2-02-08	IPA	International Permafrost Association	
2-02-09	JCOMM	Joint Technical Commission for Oceanography and Marine Meteorology	WMO/GOS
2-02-10	WMO/GOS	World Meteorological Organization/Global Observing System	
2-02-11	GTOS	Global Terrestrial Observing System	
2-02-12	IAGOS	In-service Aircraft for a Global Observing System	
2-02-13	WHYCOS	World Hydrological Cycle Observing System	
2-02-14	WMO/CLW	World Meteorological Office/Climate and Water Department	
2-02-15	ADNET	Asian dust and aerosol lidar observation network	GALION ; WMO/GAW
2-02-16	Aeronet	Aerosol RObotic NETWORK	NASA?
2-02-17	ANTON	Antarctic Observing Network	WMO/GOS
2-02-18	ASAP	Automated Shipboard Aerological Program	WMO/GOS
2-02-19	BSRN	Baseline Surface Radiation Network	WMO/GAW & GCOS
2-02-20	CASTNET	Clean Air Status and Trends Network	(National – USA)
2-02-21	CIS-LiNet	Lidar network for monitoring atmosphere over CIS regions	GALION ; WMO/GAW
2-02-22	CLN	CREST Lidar Network	GALION ; WMO/GAW
2-02-23	DART	Deep-ocean Assessment and Reporting of Tsunamis	NOAA Centre for Tsunamis Research
2-02-24	E-AMDAR	European - Aircraft Meteorological Data Relay	EUMETNET ; WMO/GOS
2-02-25	E-ASAP	European - Automated Shipboard Aerological Program	EUMETNET ; WMO/GOS
2-02-26	E-GVAP	European - GNSS water vapour programme	EUMETNET ; WMO/GOS
2-02-27	E-PROFILE	European – wind profiles from radar	EUMETNET ; WMO/GOS
2-02-28	E-SURFMAR	European - Surface Marine Operational Service	EUMETNET ; WMO/GOS
2-02-29	EARLINET	European Aerosol Research Lidar Network	GALION ; WMO/GAW
2-02-30	GALION	GAW Aerosol Lidar Observation Network	WMO/GAW

#	Name	Definition	Sponsor and/or Contributing to
2-02-31	GAW-PFR	GAW-Precision Filter Radiometers	WMO/GAW
2-02-32	German AOD Network	German Aerosol Optical Depth Network	WMO/GAW
2-02-33	GLOSS	Global Sea Level Observing System	JCOMM ; WMO/GOS
2-02-34	GRUAN	GCOS Reference Upper Air Network	GCOS
2-02-35	GSN	GCOS Surface Network	GCOS
2-02-36	GTN-G	Global Terrestrial Network - Glaciers	GCOS
2-02-37	GTN-H	Global Terrestrial Network - Hydrology	WMO/CLW ; GCOS ; GTOS
2-02-38	GTN-P	Global Terrestrial Network - Permafrost	IPA ; GCOS ; GTOS
2-02-39	GUAN	GCOS Upper Air Network	GCOS
2-02-40	IAGOS-MOZAIC	Measurement of Ozone and Water Vapour on Airbus in-service Aircraft	IAGOS
2-02-41	LALINET	Latin America Lidar Network	GALION ; WMO/GAW
2-02-42	MPLINET	Micro Pulse Lidar Network	GALION ; WMO/GAW
2-02-43	NDACC	Network for the Detection of Atmospheric Composition Change	GALION ; WMO/GAW
2-02-44	OPERA	European Weather Radar Project	EUMETNET ; (WMO/GOS)
2-02-45	PIRATA	Prediction and Research Moored Array in the Atlantic	GOOS ; WMO/GOS
2-02-46	PolarAOD	Polar Aerosol Optical Depth Measurement Network Project	WMO/GAW
2-02-47	RAMA	Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction	NOAA
2-02-48	RBCN	Regional Basic Climatological Network	WMO/GOS
2-02-49	RBON	Regional Basic Observing Network	WMO/GOS
2-02-50	RBSN	Regional Basic Synoptic Network	WMO/GOS
2-02-51	TAO	Tropical Atmosphere and Ocean Array	NOAA; GCOS
2-02-52	SKYNET	Aerosol -cloud-radiation interaction in the atmosphere project	WMO/GAW
2-02-53	SibRad		WMO/GAW
2-02-54	SOOP	Ship of Opportunity	JCOMM ; WMO/GOS
2-02-55	U.S. IOOS	United States Integrated Ocean Observing System	(National – USA)
2-02-56	VOS	Voluntary Observing Fleet	JCOMM ; WMO/GOS
2-02-57	VOSCLIM	Voluntary Observing Fleet (VOS) Climate Project	JCOMM ; WMO/GOS
2-02-58	WRAP	Worldwide Recurring ASAP Project	JCOMM ; WMO/GOS

Code table: 3-01

Code table title: Region of origin of data

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

Code table: 3-02

Code table title: Territory of origin of data

#	Name	ISO3 Country Code
3-02-01	Afghanistan	AFG
3-02-02	Albania	ALB
3-02-03	Algeria	DZA
3-02-04	Angola	AGO
3-02-05	Antarctica	ATA
3-02-06	Antigua and Barbuda	ATG
3-02-07	Argentina	ARG
3-02-08	Armenia	ARM
3-02-09	Australia	AUS
3-02-10	Austria	AUT
3-02-11	Azerbaijan	AZE
3-02-12	Bahamas	BHS
3-02-13	Bahrain	BHR
3-02-14	Bangladesh	BGD
3-02-15	Barbados	BRB
3-02-16	Belarus	BLR
3-02-17	Belgium	BEL

#	Name	ISO3 Country Code
3-02-18	Belize	BLZ
3-02-19	Benin	BEN
3-02-20	Bhutan	BTN
3-02-21	Bolivia, Plurinational State of	BOL
3-02-22	Bosnia and Herzegovina	BIH
3-02-23	Botswana	BWA
3-02-24	Brazil	BRA
3-02-25	British Caribbean Territories	BCT
3-02-26	Brunei Darussalam	BRN
3-02-27	Bulgaria	BGR
3-02-28	Burkina Faso	BFA
3-02-29	Burundi	BDI
3-02-30	Cabo Verde	CPV
3-02-31	Cambodia	KHM
3-02-32	Cameroon	CMR
3-02-33	Canada	CAN
3-02-34	Central African Republic	CAF
3-02-35	Chad	TCD
3-02-36	Chile	CHL
3-02-37	China	CHN
3-02-38	Colombia	COL
3-02-39	Comoros	COM
3-02-40	Congo	COG
3-02-41	Cook Islands	COK
3-02-42	Costa Rica	CRI
3-02-43	Côte d'Ivoire	CIV
3-02-44	Croatia	HRV
3-02-45	Cuba	CUB
3-02-46	Curaçao and Sint Maarten	CUW
3-02-47	Cyprus	CYP

#	Name	ISO3 Country Code
3-02-48	Czech Republic	CZE
3-02-49	Democratic People's Republic of Korea	PRK
3-02-50	Democratic Republic of the Congo	COD
3-02-51	Denmark	DNK
3-02-52	Djibouti	DJI
3-02-53	Dominica	DMA
3-02-54	Dominican Republic	DOM
3-02-55	Ecuador	ECU
3-02-56	Egypt	EGY
3-02-57	El Salvador	SLV
3-02-58	Eritrea	ERI
3-02-59	Estonia	EST
3-02-60	Ethiopia	ETH
3-02-61	Fiji	FJI
3-02-62	Finland	FIN
3-02-63	France	FRA
3-02-64	French Polynesia	PYF
3-02-65	Gabon	GAB
3-02-66	Gambia	GMB
3-02-67	Georgia	GEO
3-02-68	Germany	DEU
3-02-69	Ghana	GHA
3-02-70	Greece	GRC
3-02-71	Guatemala	GTM
3-02-72	Guinea	GIN
3-02-73	Guinea-Bissau	GNB
3-02-74	Guyana	GUY
3-02-75	Haiti	HTI
3-02-76	Honduras	HND
3-02-77	Hong Kong, China	HKG

#	Name	ISO3 Country Code
3-02-78	Hungary	HUN
3-02-79	Iceland	ISL
3-02-80	India	IND
3-02-81	Indonesia	IDN
3-02-82	Iran, Islamic Republic of	IRN
3-02-83	Iraq	IRQ
3-02-84	Ireland	IRL
3-02-85	Israel	ISR
3-02-86	Italy	ITA
3-02-87	Jamaica	JAM
3-02-88	Japan	JPN
3-02-89	Jordan	JOR
3-02-90	Kazakhstan	KAZ
3-02-91	Kenya	KEN
3-02-92	Kiribati	KIR
3-02-93	Kuwait	KWT
3-02-94	Kyrgyzstan	KGZ
3-02-95	Lao People's Democratic Republic	LAO
3-02-96	Latvia	LVA
3-02-97	Lebanon	LBN
3-02-98	Lesotho	LSO
3-02-99	Liberia	LBR
3-02-100	Libya	LBY
3-02-101	Liechtenstein	LIE
3-02-102	Lithuania	LTU
3-02-103	Luxembourg	LUX
3-02-104	Macao, China	MAC
3-02-105	Madagascar	MDG
3-02-106	Malawi	MWI
3-02-107	Malaysia	MYS

#	Name	ISO3 Country Code
3-02-108	Maldives	MDV
3-02-109	Mali	MLI
3-02-110	Malta	MLT
3-02-111	Mauritania	MRT
3-02-112	Mauritius	MUS
3-02-113	Mexico	MEX
3-02-114	Micronesia, Federated States of	FSM
3-02-115	Monaco	MCO
3-02-116	Mongolia	MNG
3-02-117	Montenegro	MNE
3-02-118	Morocco	MAR
3-02-119	Mozambique	MOZ
3-02-120	Myanmar	MMR
3-02-121	Namibia	NAM
3-02-122	Nepal	NPL
3-02-123	Netherlands	NLD
3-02-124	New Caledonia	NCL
3-02-125	New Zealand	NZL
3-02-126	Nicaragua	NIC
3-02-127	Niger	NER
3-02-128	Nigeria	NGA
3-02-129	Niue	NIU
3-02-130	Norway	NOR
3-02-131	Oman	OMN
3-02-132	Pakistan	PAK
3-02-133	Panama	PAN
3-02-134	Papua New Guinea	PNG
3-02-135	Paraguay	PRY
3-02-136	Peru	PER
3-02-137	Philippines	PHL

#	Name	ISO3 Country Code
3-02-138	Poland	POL
3-02-139	Portugal	PRT
3-02-140	Qatar	QAT
3-02-141	Republic of Korea	KOR
3-02-142	Republic of Moldova	MDA
3-02-143	Romania	ROM
3-02-144	Russian Federation	RUS
3-02-145	Rwanda	RWA
3-02-146	Saint Lucia	LCA
3-02-147	Samoa	WSM
3-02-148	Sao Tome and Principe	STP
3-02-149	Saudi Arabia	SAU
3-02-150	Senegal	SEN
3-02-151	Serbia	SRB
3-02-152	Seychelles	SYC
3-02-153	Sierra Leone	SLE
3-02-154	Singapore	SGP
3-02-155	Slovakia	SVK
3-02-156	Slovenia	SVN
3-02-157	Solomon Islands	SLB
3-02-158	Somalia	SOM
3-02-159	South Africa	ZAF
3-02-160	South Sudan	SSD
3-02-161	Spain	ESP
3-02-162	Sri Lanka	LKA
3-02-163	Sudan	SDN
3-02-164	Suriname	SUR
3-02-165	Swaziland	SWZ
3-02-166	Sweden	SWE
3-02-167	Switzerland	CHE

#	Name	ISO3 Country Code
3-02-168	Syrian Arab Republic	SYR
3-02-169	Tajikistan	TJK
3-02-170	Thailand	THA
3-02-171	The former Yugoslav Republic of Macedonia	
3-02-172	Timor-Leste	TLS
3-02-173	Togo	TGO
3-02-174	Tonga	TON
3-02-175	Trinidad and Tobago	TTO
3-02-176	Tunisia	TUN
3-02-177	Turkey	TUR
3-02-178	Turkmenistan	TKM
3-02-179	Tuvalu	TUV
3-02-180	Uganda	UGA
3-02-181	Ukraine	UKR
3-02-182	United Arab Emirates	ARE
3-02-183	United Kingdom of Great Britain and Northern Ireland	GBR
3-02-184	United Republic of Tanzania	TZA
3-02-185	United States	USA
3-02-186	Uruguay	URY
3-02-187	Uzbekistan	UZB
3-02-188	Vanuatu	VUT
3-02-189	Venezuela, Bolivarian Republic of	VEN
3-02-190	Viet Nam	VNM
3-02-191	Yemen	YEM
3-02-192	Zambia	ZMB
3-02-193	Zimbabwe	ZWE

Code table: 3-04

Code table title: Station/platform type (simplified) [WMO, 2012]

#	Name	Definition
3-04-1	land station	An observing station or field site situated on land, either fixed or mobile.
3-04-2	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, buoys and ice floes).
3-04-3	aircraft	An airplane, helicopter or airship used to make environmental observations.
3-04-4	satellite	A platform placed in orbit around the earth to make environmental observations.
3-04-5	underwater platform	A platform under a lake or sea surface, including autonomous underwater vehicles.

Code table: 3-08

Code table title: Data communication method [Code table under development]

#	Name	Definition
3-08-01	ARGOS	Argos is a Geosynchronous/Geostationary Earth Orbit (GEO) satellite-based system which collects data from Platform Terminal Transmitters, PTTs, and distributes sensor and location data to the final users. http://www.argos-system.org/
3-08-02	Cellular	Land based wireless communication network distributed over land areas, each served by at least one fixed-location transceiver, known as a cell site or base station
3-08-03	Globalstar	Globalstar is a low Earth orbit (LEO) satellite constellation for satellite phone and low-speed data communications
3-08-04	GMS (DCP)	Collection of meteorological data from the Geostationary Meteorological Satellite of the Japan Meteorological Agency (GMS) Data Collection Platform (DCP) installed on ships, buoys, aircraft and weather stations
3-08-05	Iridium	The Iridium satellite constellation is a large group of Low Earth Orbit (LEO) satellites providing voice and data coverage to satellite phones, pagers and integrated transceivers over Earth's entire surface
3-08-06	ORBCOMM	ORBCOMM is a company that offers machine-to-machine global asset monitoring and messaging services from its constellation of LEO communications satellites.
3-08-07	VSAT	A very small aperture terminal (VSAT) is a two-way satellite ground station used in satellite communications of data, voice and video signals which access satellites in geosynchronous orbit to relay data from small remote earth stations (terminals) to other terminals master earth station hubs.
3-08-08	Landline telephone	A landline telephone refers to a phone or modem that uses a physical telephone line for communication.
3-08-09	Radio modem	
3-08-10	E-mail	

Code table: 3-09**Code table title: Station status**

#	Name	Definition
3-09-1	Planned	The station is planned to be deployed sometime in the future, and all information provided is indicative only. No observations are taken.
3-09-2	Pre-operational	The station is deployed and producing data but still not fully ready to start reporting operationally.
3-09-3	Operational/Reporting	The station fully complies with the reporting obligations of the observation programme/network concerned
3-09-4	Partly reporting	The station partially complies with the reporting obligations of the observation programme/network concerned
3-09-5	Temporarily suspended	The station is considered non-reporting/non-operational for a certain period of time; The station is expected to resume its operational/reporting status after the temporarily suspension interval
3-09-6	Closed	The station has been declared as closed by the responsible supervising organization

Code table: 4-01-01**Code table title: Land cover types (IGBP)**

#	Name	Definition
4-01-01-00	Not applicable	None of the codes in the table are applicable in the context of this particular observation (nilReason)
4-01-01-01	Water	Cf. https://pdaac.usgs.gov/products/modis_products_table/mcd12q1
4-01-01-02	Evergreen Needleleaf forest	
4-01-01-03	Evergreen Broadleaf forest	
4-01-01-04	Deciduous Needleleaf forest	
4-01-01-05	Deciduous Broadleaf forest	
4-01-01-06	Mixed forest	
4-01-01-07	Closed shrublands	
4-01-01-08	Open shrublands	
4-01-01-09	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 (UMD)

#	Name	Definition
4-01-02-00	Not applicable	None of the codes in the table are applicable in the context of this particular observation (nilReason)
4-01-02-01	Water	Cf. https://lpdaac.usgs.gov/products/modis_products_table/mcd12q1
4-01-02-02	Evergreen Needleleaf forest	
4-01-02-03	Evergreen Broadleaf forest	
4-01-02-04	Deciduous Needleleaf forest	
4-01-02-05	Deciduous Broadleaf forest	
4-01-02-06	Mixed forest	
4-01-02-07	Closed shrublands	
4-01-02-08	Open shrublands	
4-01-02-09	Woody savannas	
4-01-02-10	Savannas	
4-01-02-11	Grasslands	
4-01-02-12	Croplands	
4-01-02-13	Urban and built-up	
4-01-02-14	Barren or sparsely vegetated	
4-01-02-99	Unclassified	

Code table: 4-01-03

Code table title: Land cover types (LAI/FPAR)

#	Name	Definition
4-01-03-00	Not applicable	None of the codes in the table are applicable in the context of this particular observation (nilReason)
4-01-03-01	Water	Cf. https://lpdaac.usgs.gov/products/modis_products_table/mcd12q1
4-01-03-02	Grasses/Cereal crops	
4-01-03-03	Shrubs	
4-01-03-04	Broadleaf crops	
4-01-03-05	Savanna	
4-01-03-06	Evergreen broadleaf forest	
4-01-03-07	Deciduous broadleaf forest	
4-01-03-08	Evergreen needleleaf forest	
4-01-03-09	Deciduous needleleaf forest	
4-01-03-10	Non vegetated	
4-01-03-11	Urban	
4-01-03-99	Unclassified	

Code table: 4-01-04**Code table title: Land cover types (NPP)**

#	Name	Definition
4-01-04-00	Not applicable	None of the codes in the table are applicable in the context of this particular observation (nilReason)
4-01-04-01	Water	Cf. https://ipdaac.usgs.gov/products/modis_products_table/mcd12q1
4-01-04-02	Evergreen needleleaf vegetation	
4-01-04-03	Evergreen broadleaf vegetation	
4-01-04-04	Deciduous needleleaf vegetation	
4-01-04-05	Deciduous broadleaf vegetation	
4-01-04-06	Annual broadleaf vegetation	
4-01-04-07	Non-vegetated land	
4-01-04-08	Urban	
4-01-04-99	Unclassified	

Code table: 4-01-05**Code table title: Land cover types (PFT)**

#	Name	Definition
4-01-05-00	Water	None of the codes in the table are applicable in the context of this particular observation (nilReason)
4-01-05-01	Evergreen Needleleaf trees	Cf. https://ipdaac.usgs.gov/products/modis_products_table/mcd12q1
4-01-05-02	Evergreen Broadleaf trees	
4-01-05-03	Deciduous Needleleaf trees	
4-01-05-04	Deciduous Broadleaf trees	
4-01-05-05	Shrub	
4-01-05-06	Grass	
4-01-05-07	Cereal crops	
4-01-05-08	Broad-leaf crops	
4-01-05-09	Urban and built-up	
4-01-05-10	Snow and ice	
4-01-05-11	Barren or sparse vegetation	
4-01-05-254	Unclassified	
4-01-05-255	Fill Value	

Code table: 4-01-06**Code table title: Land cover types (LCCS)**

#	Name	Definition
4-01-06-00	Not applicable	None of the codes in the table are applicable in the context of this particular observation (nilReason)
4-01-06-01	Cultivated and Managed Terrestrial Areas	cf. Antonio Di Gregorio (2005)
4-01-06-02	Natural and Semi-Natural Terrestrial Vegetation	
4-01-06-03	Cultivated Aquatic or Regularly Flooded Areas	
4-01-06-04	Natural and Semi-Natural Aquatic or Regularly Flooded Vegetation	
4-01-06-05	Artificial Surfaces and Associated Areas	
4-01-06-06	Bare Areas	
4-01-06-07	Artificial Waterbodies, Snow and Ice	
4-01-06-08	Natural Waterbodies, Snow and Ice	
4-01-06-99	Unclassified	

Code table: 4-02**Code table title: Surface cover classification scheme**

#	Name	Definition
4-02-00	Not applicable	None of the codes in the table are applicable in the context of this particular observation (nilReason)
4-02-01	Land cover types (IGBP)	International Geosphere-Biosphere Programme https://lpdaac.usgs.gov/products/modis_products_table/mcd12q1
4-02-02	Land cover types (UMD)	The University of Maryland Department of Geography generated global land cover classification collection from 1998. http://glcf.umd.edu/data/landcover/
4-02-03	Land cover types (LAI/fPAR)	Leaf Area Index (LAI) and Fractional Photosynthetically Active Radiation (fPAR). fPAR/LAI is the Fraction of Absorbed Photosynthetically Active radiation that a plant canopy absorbs for photosynthesis and growth in the 0.4 – 0.7nm spectral range.
4-02-04	Land cover types (NPP)	Net Primary Production (NPP) land cover scheme
4-02-05	Land cover types (PFT)	Plant Functional Types (PFT) land cover scheme
4-02-06	Land cover types (LCCS)	Land cover classification scheme (LCCS)

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 or subsurface.
4-03-01-2	Ridge	Higher than all or nearly all of the surrounding land or subsurface, 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%.
4-03-01-4	Flat	Slope less than 3% and not a top, ridge, valley bottom or depression. Use for plains.
4-03-01-5	Valley bottom	Lower than nearly all of surrounding land or subsurface, but water can flow out.
4-03-01-6	Depression	Lower than surrounding land or subsurface, with no above-ground 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/Depth

#	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 small	between -100 m and 100 m
4-03-04-2	Small	Between -300 and -100 m or between 100 and 300 m
4-03-04-3	Middle	Between -1000 and -300 m or between 300 and 1000 m
4-03-04-4	Large	Between -3000 and -1000 m Between 1000 and 3000 m
4-03-04-5	Very large	Deeper than -3000 m or above 3000 m

Code table: 4-04

Code table title: Events at station/platform [Code table under development]

#	Name	Definition
4-04-01	Grass-cutting	
4-04-02	Snow clearing	
4-04-03	Tree removal	
4-04-04	Construction activity	
4-04-05	Road work	
4-04-06	Biomass burning	Anthropogenic or natural
4-04-07	Dust storm	
4-04-08	Storm damage	
4-04-09	Wind storm	
4-04-10	Flood	
4-04-11	Fire	
4-04-12	Earthquake	
4-04-13	Land slide	
4-04-14	Storm surge or tsunami	
4-04-15	Lightning	
4-04-16	Vandalism	

Code table: 5-01

Code table title: Source of observation

#	Name	Definition
5-01-1	Automatic observation	Automatically produced measurement result
5-01-2	Manual observation	Manual reading of instrument
5-01-3	Visual observation	Human, non-instrumented observation

Code table: 5-02

Code table title: Measurement/observing method [Code table under development]

Code table: 5-04

Code table title: Instrument operating status

#	Name	Definition
5-04-1	Operational	The instrument is declared operational and subject to routine maintenance
5-04-2	Testing	The instrument is deployed for testing purposes and the information provided may not be reliable
5-04-3	Not in service	The instrument is deployed but presently not in service

Code table: 5-08

Code table title: Instrument control result

#	Name	Definition
5-08-0	no changes - in calibration	Instrument verified and found to be in calibration
5-08-1	no changes - out of calibration	Instrument checked and found to be out of calibration; no changes to calibration function
5-08-2	no changes – calibration unknown	Instrument visited but calibration could not be carried out
5-08-3	recalibrated - in calibration	Instrument checked and found to be out of calibration; instrument recalibrated (calibration function changed)

Code table: 5-14

Code table title: Status of observation

#	Name	Definition
5-14-01	Primary	The primary or official observation of the observed variable
5-14-02	Additional	Additional or supplemented observation of the observed variable

Code table: 5-15

Code table title: Exposure of instrument

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

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.
6-03-2	Discrete	Sampling is done at regular time intervals for certain sampling periods that are smaller than the time interval.
6-03-3	Event	Sampling is not integrating, i.e., parts of the medium escape observation. Sampling is done at irregular time intervals.

Code table: 7-06**Code table title: Level of data**

#	Name	Definition	CEOS (http://www.ceos.org/images/WGISS/Documents/Handbook.pdf)
7-06-0	Unknown	CIMO (WMO-No. 8, 2008, Updated 2010)	
7-06-1	Raw		Physical information: Data in their original packets, as received from a satellite
7-06-2	Level 0	Analogue/digital electric signals	Physical information: Reconstructed unprocessed instrumental data at full space time resolution with all available supplemental information to be used in subsequent processing (e.g., ephemeris, health and safety) appended.
7-06-3	Level I	Level I data (Primary Data): in general, are instrument readings expressed in appropriate physical units, and referred to Earth geographical coordinates. They require conversion to the normal meteorological variables (identified in Part I, Chapter 1). Level I data themselves are in many cases obtained from the processing of electrical signals such as voltages, referred to as raw data. Examples of these data are satellite radiances and water-vapour pressure, positions of constant-level balloons, etc. but not raw telemetry signals. Level I data still require conversion to the meteorological parameters specified in the data requirements.	Physical information: Unpacked, reformatted level 0 data, with all supplemental information to be used in subsequent processing appended. Optional radiometric and geometric correction applied to produce parameters in physical units. Data generally presented as full time/space resolution. A wide variety of sub level products are possible.
7-06-4	Level II	Level II Data (Meteorological parameters). They may be obtained directly from many kinds of simple instruments, or derived from Level I data. For example, a sensor cannot measure visibility, which is a Level II quantity; instead, sensors measure the extinction coefficient, which is a Level I quantity.	Geophysical information. Retrieved environmental variables (e.g., ocean wave height, soil moisture, ice concentration) at the same resolution and location as the level 1 source data.
7-06-5	Level III	Level III (Initial state parameters) are internally consistent data sets, generally in grid-point form obtained from level II data by applying established initialization procedures. NOTE: Data exchanged internationally are level II or level III data.	Geophysical information. Data or retrieved environmental variables which have been spatially and/or temporally re-sampled (i.e., derived from level 1 or 2 products). Such re-sampling may include averaging and compositing.
7-06-6	Level IV		Thematic information. Model output or results from analyses of lower level data (i.e., variables that are not directly measured by the instruments, but are derived from these measurements).

Code table: 7-10

Code table title: Reference time [Code table under development]

#	Name	Definition
7-10-0	Unknown	
7-10-1	Time Server	
7-10-2	Radio Clock	
7-10-3	Manual Comparison	

Code table: 8-03-01

Code table title: Quality flag [From BUFR code table 0 33 020 (WMO, 2013) - Code table under development]

#	Name	Definition
8-03-01-0	Good	
8-03-01-1	Inconsistent	
8-03-01-2	Doubtful	
8-03-01-3	Wrong	
8-03-01-4	Not checked	
8-03-01-5	Has been changed	
8-03-01-6	Estimated	
8-03-01-7	Missing value	

Code table: 8-03-02

Code table title: Quality flag [From OGC WaterML 2.0]

#	Name	Definition
8-03-02-0	Good	The data has been examined and represents a reliable measurement.
8-03-02-1	Suspect	The data should be treated as suspect.
8-03-02-2	Estimate	The data is an estimate only, not a direct measurement.
8-03-02-3	Poor	The data should be considered as low quality and may have been rejected.
8-03-02-4	Unchecked	The data has not been checked by any qualitative method.
8-03-02-5	Missing	The data is missing.

Code table: 8-04

Code table title: Quality Flag System

#	Name	Definition
8-04-0	Unknown	Quality flag system not known
8-04-1	WMO BUFR table 0 33 020	http://codes.wmo.int/bufr4/codeflag/0-33-020
8-04-2	Other quality flagging system	Quality flags are specified according to another system

Code table: 8-05

Code table title: Traceability

#	Name	Definition
8-05-0	Unknown	Traceability not known
8-05-1	Traceable to international standard	Traceable to an international standard
8-05-2	Traceable to other standard	Not traceable to an international standard

Code table: 9-02

Code table title: WMO_DataLicenseCode (WMO 2013a, Table 14)

#	Name	Definition
9-02-1	WMOEssential	WMO Essential Data: free and unrestricted international exchange of basic 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 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 neither 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.

ADDITIONAL CODE TABLES, NOT SPECIFIC TO A PARTICULAR METADATA CATEGORY OR ELEMENT

Code table: 11-01

Code table title: "Coordinates Source/Service" [Code table under development]

#	Name	Definition
11-1-01	GPS	
11-1-02	ARGOS DOPPLER	
11-1-03	IRIDIUM DOPPLER	
11-1-04	ARGOS Kalman	
11-1-05	GALILEO	
11-1-06	LORAN	
11-1-07	Surveyed	
11-1-08	From map	

Code table: 11-02

Code table title: "Coordinates reference" [Code table under development]

#	Name	Definition
11-1-01	WGS84	
11-1-02		
11-1-03		
11-1-04		
11-1-05		
11-1-06		
11-1-07		

Code table: 11-03

Code table title: Meaning of time stamp

#	Name	Definition
11-03-1	Beginning	Time stamps indicate the beginning of a period covering the range up to but excluding the following time stamp.
11-03-2	End	Time stamps indicate the end of a period covering the range up to but excluding the preceding time stamp.
11-03-3	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.