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Maintenance of Accurate Metadata for all Automatic Weather Station Installations

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Summary and Purpose of Document

The document contains a proposal for a standard set of metadata elements for all Automatic Weather Station Installations.

ACTION PROPOSED

The meeting is invited to examine the proposal with a view of possible publishing in the relevant WMO Guides or Manuals.

References:

1. Final Report, CBS/OPAG-IOS/ET On Requirements For Data From Automatic Weather Stations, Geneva, Switzerland, 28 June – 2 July 2004, www.wmo.int/web/www/OSY/Reports/ET-AWS3_Geneva2004.pdf
2. Guide to Meteorological Instruments and Methods of Observation, WMO-No. 8
3. Manual on GOS, WMO-No. 544
4. International Meteorological Vocabulary, WMO-No. 182
5. Guidelines On Climate Metadata And Homogenization, (WMO-TD No. 1186), www.wmo.ch/web/wcp/wcdmp/html/WCDMP-53.pdf
6. Automated Weather Stations for Applications in Agriculture and water Resources Management: Current Use and Future Perspectives, Proceedings of an International Workshop, 6-10 March 2000, Lincoln, Nebraska, USA
7. AMS The Glossary of Meteorology, http://amsglossary.allenpress.com/glossary

Maintenance of Accurate Metadata for all Automatic Weather Station Installations

I. BACKGROUND

Metadata (data about data), as applied to measurement and observation, describe the location, instrument and method of observation, quality, and other characteristics of data. Metadata are important for data users, as they need to know the circumstances of the observations/ measurements and understand the origins of the meteorological values themselves. Metadata are especially important for the elements that are particularly sensitive to exposure, such as precipitation, wind and temperature.

Metadata can be considered as an extended version of the station administrative record, containing all possible information related to the station and instruments installed, type and time of changes that occurred during the history of an observing system. The expanded metadata information can include digital images, a wide range of instrument specifications, calibration and maintenance records, and many other pieces of information.

Metadata are dynamic. Station location, ground cover, instruments, observation/ measurement practices, processing algorithms, data formats etc. change over time. The system has to track all these changes.

As computer data management systems gradually become an important component of the data delivery systems, it is desirable that metadata are available as a computer database enabling computerized composition, updating, and use.

II. ELEMENTS OF A METADATA DATABASE RELATED TO AN AUTOMATIC WEATHER STATION

The proposal for a standard set of metadata elements

A metadata database should provide detailed information necessary for users to gain adequate background knowledge about the station and observational data, together with updates due to changes that occur.

Major database elements include the following:

- Network information (beyond a scope of this document);
- Station information;
- Individual instrument information;
- Data processing information;
- Data handling information;
- Data transmission information.

2.1 Station information

There is a great deal of information related to a station's location, local topography and others. Basic station metadata include:

Type of metadata	***Explanation***	***Examples***
Station name	Official name of the station	Prievidza
Station index number(s)	Number used by the National Meteorological Service to identify a station	11867
Geographical co-ordinates	Latitude and longitude of the station reference point	18.7697 18.5939
Elevation above mean sea level	Vertical distance of a reference point of the station measured from mean sea level	260.25 m
Types of soil, physical constants and profile of soil	Description of soil type below the station, its characteristics	clay
Types of vegetation and condition	Description of the station's environment land	natural; grass
Local topography description	Description of the station's surroundings, with emphasis on topographic features that may influence the weather at the station	valley station
Type of AWS, manufacturer, model, serial number	Basic information on the AWS installed	MILOS 500, Vaisala, DMF50, S14507
Observing programme of the station:	Information on types of observation made, variables measured	1-hour synoptic obs.
▪ parameters measured	List of variables measured	T, P, U, DF, …
▪ reference time	Reference time of observations	UTC
▪ times at which observations are made	Actual time of observations	50.-59.min.
The datum level to which atmospheric pressure data of the station refer	MSL or geopotential of the datum level to which the atmospheric pressure is reduced	MSL; 925 hPa; 850 hPa;

2.2 Individual instrument information

Relevant metadata should be:

Type of metadata	***Explanation***	***Examples***
Sensor type:	Technical information on the sensor used for the measurement of the variable	Temperature; humidity; pressure …
▪ manufacturer		Vaisala, Campbell, …
▪ model		HMP45C, PTU-2000
▪ serial number		12345…

Type of metadata	***Explanation***	***Examples***
Principle of operation:	Description of method or system used	
▪ method of measurement / observation	Type of operation principle describing method of measurement/observation used	constant current principle, polymer capacitance
▪ type of detection system	Complete set of measuring instruments and other equipment assembled to carry out specified measurements	optical scatter system combined with precipitation occurrence sensing system
Performance characteristics	Operating range of sensors	-50 - +60 ºC, 0 - 100 %
Unit of measurement	SI unit in which the variable is measured	K, Pa, m s^{-1}
Measuring range	Interval between upper and lower value limits for which a variable is reported	-50 - +60 ºC, 0 – 75 m s^{-1}
Resolution	The smallest change in a physical variable which will cause a variation in the response of a measurement system.	0.01 K,
Uncertainty	Variable associated with the result of a measurement that characterizes the dispersion of the values that could be reasonably attributed to the measurand; the interval in which the “the value” of the variable at the time of measurement is expected to lie.	±0.1 K
Time constant	Time required for an instrument to indicate a given percentage (63.2 %) of the final reading resulting from an input signal	20 s;
Time resolution	Frequency of sampling	3 s, 10 s
Output averaging time	Time period used for the purpose of determining of reported value	1 min.; 2 min; 10min.
Siting and exposure:		
▪ location		screen, mast, tower
▪ shielding		screen, naturally aspirated
▪ height above ground (or level of depth)		1.75 m, -0.1 m
Data acquisition:		
▪ sampling interval	Time between successive observations	3 s, 10s, 30s
▪ averaging interval	Time interval from which samples are used	1, 2, 10, 30 minutes
▪ type of averaging	Method used for the calculation of the average	arithmetic; exponential; harmonic

Type of metadata	***Explanation***	***Examples***
Correction procedures	Corrections applied to the data	for temperature, for gravity, for wind speed
Calibration data		
▪ correction	Value to be added to or subtracted from the reading of an instrument to obtain the correct value	C = R (1+0.6R)
▪ time of calibration	Date when the last calibration was made	12/12/2003
Preventive and corrective maintenance:		
▪ recommended / scheduled maintenance	Frequency of preventive maintenance	one per 3 months
▪ calibration procedures	Type of method/procedure used	static/dynamic calibration
▪ calibration frequency	Recommended frequency	12 months
▪ procedure description		
Results of comparison with traveling standard	Result of the field tests of the sensor	98%

2.3 Data processing information

For each individual meteorological parameter, metadata related to processing procedures should include:

Type of metadata	***Explanation***	***Example***
Measuring / observing programme:		
▪ time of observation		10^{th}, …,60^{th} min.
▪ reporting frequency		10 min.
▪ data output	Quantity that is delivered by an instrument or system	2-min. average value
▪ processing interval	Time interval from which the samples are taken	2, 10 min. (wind)
▪ reported resolution	Resolution of variable reported	0.1 ms^{-1}
Data-processing method, procedure, algorithm	Method used	running 10-min. average
Formula to calculate the element		$VIS=N/(1/V_1+1/V_2+ \ldots +1/V_n)$
Mode of observation / measurement	Type of data being reported	instantaneous, total, mean value, variability,
Input source (instrument, element, etc.)	Measured or derived variable	WAA 151
Constants and parameter values	Constants, parameters used in computation of derived parameter	g=9.806 65ms^{-2}

2.4 Data handling information

Metadata elements of interest include:

Type of metadata	***Explanation***	***Example***
Quality control procedures, algorithms	Type of QC procedures	plausible value check; time consistency check, internal consistency check
QC flags definition	Description of QC flags	1 good, 2 inconsistent, 3 doubtful 4 erroneous, 5 not checked, 6 changed
Processing and storage procedures	Different procedures used in the process of data reduction and data conversion	computation of visibility from extinction coefficient
Constants and parameter values		

2.5 Data transmission information

The transmission-related metadata of interest are:

Type of metadata	**Explanation**	**Example**
Method of transmission	Means of transmission	GSM/GPRS, OrbComm; radio
Data format	Type of message used for data transmission	BUFR; SYNOP
Transmission time	Time of regular transmission of data	11^{th} minute; 60^{th} minute
Transmission frequency	Frequency of data transmission	10 minute; 1 hour

III. RESPONSIBILITIES

3.1 Maintenance of metadata

Meteorological data producers should take responsibility for maintenance of up-to-date metadata files.

3.2 Exchange of metadata

Metadata should be disseminated jointly with the AWS data. BUFR templates for AWS data after an appropriate adjustment would be the suitable tools for this purpose.

3.3 Publication of guidelines

Guidelines for maintenance of accurate metadata for all automatic weather station installations should be published in Manual on GOS, WMO-No. 544 and Guide to Meteorological Instruments and Methods of Observation, WMO-No. 8 to ensure complete and correct information about data.