WORLD METEOROLOGICAL ORGANIZATION

CBS/OPAG-IOS (ET-AWS-6)/Doc. 8

COMMISSION FOR BASIC SYSTEMS
OPEN PROGRAMME AREA GROUP ON INTEGRATED OBSERVING SYSTEMS

(7.VI.2010)

EXPERT TEAM ON REQUIREMENTS AND IMPLEMENTATION AWS PLATFORMS (ET-AWS)
Sixth Session

ITEM: 8

Original: ENGLISH

GENEVA, SWITZERLAND, 20 – 23 APRIL 2010

AWS METADATA CATALOGUES

Submitted by Rodica Nitu (Canada)

Summary and Purpose of Document

This document provides information on the development of AWS metadata catalogues for WIS and suggested tables of AWS metadata based on BUFR descriptors.

ACTION PROPOSED

The ICT is invited to take the contents of this report into consideration during its deliberations

Appendices:

Appendix 1 Instruments used for variables measured by standard AWS

AWS METADATA CATALOGUES AND WIS DESCRIPTORS BASED ON BUFR DESCRIPTORS

Introduction

1.1 Information used for the assessment:

- Functional Specifications for Automatic Weather Stations, ET AWS-5, Final Report
- WMO 306, Manual on Codes, International Codes, VOLUME I.2, Part B — Binary Codes, Part C — Common Features to Binary and Alphanumeric Codes
- WMO-CIMO Guide No. 8.
- WMO-No. 182, International Meteorological Vocabulary.

1.2 This paper assesses the Code Tables And Flag Tables Associated With BUFR/CREX TABLE B, in relation with the functional specifications for Automatic Weather Stations and the WMO-CIMO Guide-8. The focus is on the measurement of atmospheric pressure, air temperature, relative humidity, wind, precipitation, cloud, present weather. The goal is to document the need for additional descriptors for these parameters and establish the ground rules for any additional descriptors required.

1.3 WMO 306, Manual on Codes, International Codes, VOLUME I.2, Part B — Binary Codes, Part C — Common Features to Binary and Alphanumeric Codes includes two categories of descriptors related to sensors/systems and methods for the measurement of atmospheric parameters.

a) Descriptors 0 02 095 to 0 02 097 are for the types of sensors for pressure, temperature, and humidity, and are applicable for upper air measurements. The types of sensors, in each case, were established as a combination of principles of operation, constructive options, and manufacturers' technologies.
Recommendation: there should be consistency in the definition of descriptors for measuring sensors/systems and that should be based on the principle of operation.

b) For wind measurement, the descriptor 0 02 169, "Anemometer type" is a partial list of instrument types for the application, and descriptor 0 02 002, "Type of instrumentation for wind measurement" provides information on the measurement units. The definitions of the descriptors are not easily correlated with their content.
Recommendation: the two descriptors should be revised and updated to be more self explanatory and applicable to wind measurements for all AWS.

c) Descriptors 0 02 175 – 0 02 189 are applicable to a series of parameters reported from an AWS and they refer to methods of measurement rather than sensor/system type; however, the codes of each descriptor are instrument type based.
Recommendation: these descriptors should be revised together with those discussed at point a) and b) above, to develop a consistent vocabulary for describing the systems used for measurement. Additionally, descriptor codes are proposed for the specific configuration of the measuring sensor, where the configuration is a component of the measuring system.

1.4 The proposed descriptors are listed for each measured parameter as "proposed" and are highlighted in yellow. For each proposed descriptor code, indication is given on whether

the terminology is available (Y) or not (N) in IVM No.-182. Where the terminology in IVM is somewhat different than that in the BUFR descriptors, the IVM term is provided.

More detailed information on instrument types and principle of operation are provided in Appendix 1.

2. **Assessment of BUFR descriptors by measured parameters**:

ATMOSPHERIC PRESSURE

0 10 004	**Atmospheric Pressure**	
0 02 095	***Type of pressure sensor*** ***Proposed: Method of atmospheric pressure measurement***	
Code figure		**IMV No 182**
0	Capacitance aneroid	N
1	Derived from GPS	N
2	Resistive strain gauge	N
3–29	Reserved	
30	Other	
31	Missing value	
proposed	*Aneroid displacement transducers*	N
proposed	*Digital piezo-resistive barometers*	N
proposed	*Cylindrical resonator barometers*	N
Proposed	*No venting device*	N
Proposed	*Use venting device*	N
Proposed	*Installed indoors*	N
Proposed	*Installed outdoors: sheltered*	N
Proposed	*Installed outdoors: not sheltered*	N

TEMPERATURE

0 12 101	Ambient air temperature (over specified surface)	
0 12 113	Ground (*surface*) temperature (*over specified surface*)	
0 12 130	Soil temperature	
0 02 096	***Type of temperature sensor*** ***Proposed: Method of temperature measurement***	***IMV No 182***
Code figure		
0	Rod thermistor	N
1	Bead thermistor	N
2	Capacitance bead	N
3–29	Reserved	
30	Other	
31	Missing value	
proposed	*Electrical resistance thermometers*	Y
proposed	*Thermistor (semiconductor) thermometer*	Y

proposed	*Thermocouple sensor*	Y
proposed	*Ultrasonic sensor (virtual temperature)*	
proposed	*No Radiation shield*	N
proposed	*Naturally aspirated radiation shield (screen)*	N
proposed	*Artificially aspirated radiation shield (screen)*	
Proposed	*Single sensor measurement*	N
Proposed	*Multiple sensor measurement*	N

0 12 103	Dew-point temperature	
Proposed	*wet-bulb temperature measurement system*	*Wet-bulb thermometer*
proposed	*Chilled mirror system*	
Proposed	*Dewcel system*	

Existing Descriptor **0 02 039,** ***Method of wet-bulb temperature measurement*** has the following codes:

Code figure	
0	Measured wet-bulb temperature
1	Iced bulb measured wet-bulb temperature
2	Computed wet-bulb temperature
3	Iced bulb computed wet-bulb temperature
4–6	Reserved
7	Missing value

HUMIDITY

Relative humidity		0 13 003
0 02 097	***Type of humidity sensor*** ***Proposed: Method of humidity measurement***	
Code figure		
0	VIZ Mark II carbon hygristor	N
1	VIZ B2 hygristor	N
2	Vaisala A-Humicap	N
3	Vaisala H-Humicap	N
4	Capacitance sensor	N
5	Vaisala RS90	N
6	Sippican Mark IIA carbon hygristor	N
7-29	Reserved	
30	Other	
31	Missing value	
proposed	*chilled-mirror hygrometer*	*N*
proposed	*dew cell*	*N*
proposed	*electrical resistance humidity sensor*	*N*
proposed	*No Radiation shield*	N
proposed	*Naturally aspirated radiation shield (screen)*	N

proposed	*Artificially aspirated radiation shield (screen)*	N

WIND

Direction		0 11 001
Speed		0 11 002
Gust Speed		0 11 041
0 02 169	***Anemometer type***	***IVM No.-182***
Code figure		
0	Cup rotor	Cup anemometer
1	Propeller rotor	N
2	Wind Observation Through Ambient Noise (WOTAN)	N
3	Sonic/*ultrasonic*	N
4–14	Reserved	
15	Missing value	
proposed	*Direction vane*	Vane anemometer
proposed	*Hot wire anemometer*	Y (H0790)
Proposed	*Installation at 10-m height*	
Proposed	*Installation at 2-m height*	

PRECIPITATION

Accumulation [7)]	0 13 011
Depth of fresh snowfall	0 13 015
Duration	0 26 020
Size of precipitating element	N
Intensity – quantitative	0 13 055
Type	0 20 021
Rate of ice accretion	N

0 02 175	***Method of precipitation measurement***	***IVM No.-182***
Code figure		
0	Manual measurement	
1	Tipping bucket method (*sensitivities could constitute an additional criterion: 0.1mm, 0.2mm, 0.25mm, 0.5mm)*	Tipping bucket rain gauge
2	Weighing method (*capacity and/or sensitivity could constitute an additional criterion)*	Weighing rain gauge
3	Optical method: *based on scintillation*	N
proposed	*Optical method: optical extinction*	N
proposed	*Optical method: optical scattering*	N
4	Pressure method	N
5	Float method	N
6	Drop counter method	N
7–13	Reserved	
14	Others	

15	Missing value	
Proposed	*Capacitive method (from 0 02 178)*	
Proposed	*Wind shield not used*	
Proposed	*Single Alter wind shield*	
Proposed	*Double Alter wind shield*	
Proposed	*Nipher wind shield*	
Proposed	*Tretyakov wind shield*	
Proposed	*Small DFIR*	
Proposed	*WMO DFIR*	
Proposed	*Weighing gauge with funnel*	
Proposed	*Weighing gauge without funnel*	
Proposed	*TBRG with siphon*	
Proposed	*TBRG with no siphon*	
proposed	*TBRG with mechanical corrections*	
Proposed	*TBRG with software corrections*	
Proposed	*the single point electronic load weighing gauge*	
Proposed	*Strain gauge weighing gauge*	
proposed	*vibrating wire load weighing gauge*	
proposed	*Weight sensor (snow pillow sensor)*	
Proposed	*X-band radar*	
proposed	*Doppler radar*	
Proposed	*Heated TBRG*	
Proposed	*Heated Weighing gauge*	

0 02 178	***Method of liquid content measurement of precipitation***	***Proposed to be included in 0 02 175 and 0 02 178 descriptor, reassigned.***
Code figure		
0	Manual observation	***Same as 0 of 0 02 175***
1	Optical method	***Same as 3 of 0 02 175***
2	Capacitive method	***Proposed to be transferred to 0 02 175***
3–13	Reserved	
14	Others	
15	Missing value	

OTHER SURFACE VARIABLES

Snow depth	0 13 013

0 02 177	***Method of snow depth measurement***	
Code figure		
0	Manual observation	

1	Ultrasonic method *(proposed: sonic ranging depth sensors)*	
2	Video camera method	
3–13	Reserved	
14	Others	
15	Missing value	
proposed	*Laser sensor*	
proposed	*optical snow detector sensor*	
proposed	*Single sensor*	
Proposed	*Multi-sensor (2, 3)*	
proposed	*Windshield used*	
Proposed	*Windshield not used*	
Proposed	*Target surface: ground/grass*	
Proposed	*Target surface: gravel*	
Proposed	*Target surface: while PVC*	

Instruments used for variables measured by standard AWS (basis for this catalogue would be the Instrument/Product catalogues by CIMO/CMA and HMEI respectively)

ET-AWS-5: final report:

Taking into account the development of WMO Core Profile of the Metadata Standards, it was noted that catalogues of standard AWS metadata should be prepared to support information sharing.

In a dynamic system such as an AWS, metadata is subject to change during the life of the station. Therefore, keeping the station history and tracking the changes of station, metadata are important for different reasons. The method to record the history of metadata was demonstrated using a number of examples.

Four metadata catalogues would comprise:

- Variables measured by a standard AWS (see Item 3 "Functional Specifications for AWS");
- Instruments used for variables measured by standard AWS (basis for this catalogue would be the Instrument/Product catalogues by CIMO/CMA and HMEI respectively);
- Data processing procedures (algorithms) used by AWS (basis for this catalogue would be IOM Report 78);
- Data quality control procedures used for AWS data (basis for this catalogue would be relevant part of the Guide on the GOS, WMO-No. 488).

The meeting identified the requirement that terminology used in BUFR tables should be transparent to the WMO Technical Regulations. The use of traceable and unambiguous descriptors will assist in the process of correct coding and sharing of information.

Parameter	**Type of Instrument**	**Principle of operation**	**Type of detection system (raw sensor data)**	**Additional information**	**Configuration**	**Siting and exposure**
Precipitation	Tipping Bucket Rain Gauge	Tipping balance of two buckets	Counting of electrical impulses (reed switch)	Correction: N/A, software, mechanical	Wind shield type: N/A, Alter, Nipher, Tretyakov Heating: Y/N	Height above ground Siting class
	Level measurement rain gauge	Measuring the water level in a tube	Conductivity measurement, acoustic distance measurement.			

	Weighing gauge	Weighing of precipitation accumulated in a storage container	Measurement of differential pressure, frequency measurement of a vibrating wire, electronic precision balance.		Type;	
	Drop counters	Counting the number of uniform droplets corresponding to a fixed volume of water	Pulse generated by an optical system			
	Impact distrometers	Impact of precipitation particles on a plastic or metal membrane	Spectrum analysis of an electrical signal (amplitude, frequency)			
	Optical optical/capacitive distrometers	thin laser light sheets crossing the measuring volume: particle volume, speed (forward scatter)	Spectrum analysis of an electrical signal (amplitude, frequency)			
		Backscatter (intensity of backscattered signal related to the number of particles and/or their water content)	Fourier processing of the Doppler shift associated to the falling speed			
Snow on the ground	Sonic ranging	measure the elapsed time between emission and return of an ultrasonic pulse sent vertically down to the snow covered ground surface	Integration of the elapse time			Height above ground Siting class
	Laser	emits modulated visible laser light and determines the distance to an object by comparing phase information	Phase shift calculation			
	Snow pillows	Tensiometric sensors detect the hydrostatic pressure caused by the layer of snow on top of the pillow	Hydrostatic pressure measurement			
Ice accumulation	Ice accretion sensors	Energized vibrating probe	Frequency shift due to ice accumulation			

Humidity	chilled-mirror hygrometers	condensation is detected on the surface of a small polished metal reflecting surface (a mirror), using optical means. The temperature at which condensation is formed is the dew point.	Optical detection of condensation.		Shield/screen type Artificially ventilated: Y/N	Height above ground Siting class
	dew cells	A dew cell heats a salt solution until its equilibrium vapour pressure equals to the ambient vapour pressure, and maintains this equilibrium The temperature when this occurs is measured and it provides a measure of the ambient vapour pressure	Measures current applied to heat solution and applies empirical methods to determine the temperature.			
	electrical resistance or capacitance sensors	certain materials interact with water vapour and undergo a change in electrical resistance or capacitance, in relation to ambient humidity.	Measure changes in the electrical properties of materials (resistance, capacitance)			
Air Temperature	Electrical resistance thermometers	For small temperature changes, the increase in resistance of pure metals is proportional to the change in temperature	Measure the electrical resistance of the sensing element		Shield/screen type Artificially ventilated: Y/N Heating for decontaminatio n: Y/N	Height above ground Siting class
	Thermistor type (semiconduct or) thermometers	Based on the variation of resistance of a semiconductor with a relatively large temperature coefficient of resistance, either positive or negative depending upon the actual material				

	Thermocouples	Based on the generation of an electromotive force at the junction between two metals in contact, which is function of the temperature of the two metals	Measures the electromotive force of the junction of two metals			
Wind	Cup and propeller sensors	the angular velocity of the cup or propeller rotor is directly proportional to the component of the wind speed parallel to the axis of rotation.	the cup and propeller rotors turn with an angular velocity that is directly proportional to speed or to the axial component.	Dead band		Height above ground Siting class
	direction vane	The signal generator is a shaft-angle transducer: potentiometers, alternating and direct current synchros, digital angle-encoder disks, direct reading dials, and rotary switches	Angular displacement			
	Ultrasonic	A sonic signal is emitted by sensor transducers.	Integration of traveling time between two transducers.			