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CLASSIFICATION OF SURFACE OBSERVING STATIONS WITHIN WIGOS

Classification for Performance Characteristics *(Draft classification)*

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Summary and Purpose of Document

The document contains a proposal for a classification for performance characteristics of surface observing stations to be used within WIGOS.

ACTION PROPOSED

The meeting is invited to review the proposal, provide comments on how to improve it and agree on a final version that should be submitted to WMO Members for their approval to include it in the relevant WMO regulatory material. The meeting is also invited to recommend in which document this standard should be published and whether it would be beneficial to develop a common ISO-WMO document out of this classification.

CLASSIFICATION FOR PERFORMANCE CHARACTERISTICS
(DRAFT CLASSIFICATION)

A primary quality factor of a measurement is the set of “intrinsic” characteristics of the equipment used. They are the characteristics related to the design of the instrument. They are known from the manufacturer documentation and/or from laboratory or field tests. The actual performances are sometimes worst that the announced performances, depending on the “objectivity” of the manufacturer. The statement of achievable measurement uncertainty included in Chapter 1 of doc WMO n° 8 (Guide to Meteorological Instruments and Methods of Observation) should be used to check the possible validity of uncertainty announced by a manufacturer. When writing technical specifications to buy equipment, it is necessary to have in mind the achievable measurement uncertainty, recognizing also that even requesting (only) the state of the art achievable uncertainty may result in high costs and/or some exaggeration of their instrument performances from some manufacturers. Therefore, it is highly recommended to be aware of the possible performances (with associated costs) before issuing technical specifications. A value analysis may conduct to look for performances lower than the “required measurement uncertainty” and the “achievable measurement uncertainty” found in Annex 1B of WMO n° 8.
Test reports and intercomparison reports of instruments are very valuable tools to specify and select an instrument with objective information.

Once an instrument is selected and its performance characteristics known, it is necessary to maintain the level of performance during its operational period. Preventive maintenance and calibration are therefore necessary and must be identified to maintain the desired measurement uncertainty.
When delivering observations for various applications (mainly forecasts and climatology), it should be possible to state the “guaranteed” (for example with a 95% level of confidence) accuracy of a measurement. It is not always done and using “by default” the “achievable measurement uncertainty” of WMO n°8, Annex 1B could be a mistake.

In order to document the performance characteristics of the various surface observing networks used, this document defines a classification, called "maintained performance classification", including the uncertainty of the instrument and the periodicity of preventive maintenance and calibration. This classification ranges from A (instrument following the WMO/CIMO recommendations, in particular table in chapter 1 of the CIMO Guide) to D (no maintenance and calibration organized), with an additional class E for unknown characteristics and maintenance.
This classification is related to a network, considering the instruments used and the maintenance organization applied for this network. So, it is an “organization” classification. It doesn’t give the information of what has been made on a particular day on a particular site.

The five levels are:

- Class A: WMO/CIMO recommendations, often the best of what can be done.
- Class B: Specifications lower than WMO recommendations, but still considered as quite “good”, often having a good value to money ratio and more affordable in practice.
- Class C: Specifications and/or maintenance and calibration procedures lower than class B, but known and applied.
- Class D : Specifications lower than class C or no maintenance and calibration organized.
- Class E: Unknown performances and/or maintenance procedures.

Concerning class A, one question is : do we take into account the required uncertainty or the achievable uncertainty?

Parameter	**Class A**	**Class B**	**Class C**	**Class D**
Air temperature	Required measurement uncertainty of 0.1°C. But the achievable measurement uncertainty is 0.2°C. Therefore, the uncertainty of the temperature probe lower than 0.1°C and use of a "perfect" artificially ventilated screen.	Platinum temperature probe (Pt100 or other resistance value at 0°C) of class A (~ ± 0.25°C, IEC 751 standard). Acquisition uncertainty < 0.15°C. Radiation screen with known characteristics and over-estimation of Tx (daily max. temperature) < 0.15°C in 95% of cases. Laboratory calibration of the temperature probe every 5 years.	Temperature probe with uncertainty < 0.4°C. Acquisition uncertainty < 0.3°C. Radiation screen with known characteristics and over-estimation of Tx < 0.3°C in 95% of cases.	Temperature probe and/or acquisition system uncertainty lower than for class C or unknown. Unknown radiation screen or with "unacceptable" characteristics (for example, over-estimation of Tx > 0.7°C in 5% of cases).
Relative humidity	Required measurement uncertainty of 1%! But the achievable measurement uncertainty stated is 3%.	Sensor specified for ± 6%, over a temperature range of –20°C to +40°C. Acquisition uncertainty < 1%. Calibration every year, in an accredited laboratory.	Sensor specified for ± 10%, over a temperature range of –20°C to +40°C. Acquisition uncertainty < 1%. Calibration every two years in an accredited laboratory, or calibration every year in a non-accredited laboratory.	Sensor with unknown performances or specifications worst than ± 10% over the common temperature conditions. Unknown calibration or calibration not organized.
Atmospheric pressure	Required measurement uncertainty of 0.1 hPa But the achievable measurement uncertainty is 0.3 hPa. Influence of dynamic pressure due to wind to be reduced by a static head. Yearly calibration in an accredited laboratory..	Sensor specified for ± 0.5 hPa, including possible drift between calibrations. Two-year calibration in an accredited laboratory.	Sensor specified for ± 1 hPa, including possible drift between calibrations. Calibration organized for this uncertainty..	Specifications lower than for class C or no regular calibration organized.

Parameter	Class A	Class B	Class C	Class D
Wind	Required measurement uncertainty: ± 10% (or ± 0.5 m/s) for wind speed, ± 5° for wind direction. Calculation of wind parameters following WMO recommendations: 4 Hz samples, gust over a 3 seconds period. Starting threshold < 0.5 m/s	Sensor specified for wind speed better than ± 10% (or ± 0.5 m/s) and ± 10° for wind direction. Calculation of wind parameters following WMO recommendations, with the possible difference concerning gust calculation: min. 1 Hz sampling, gust calculated over a period < 3 s. Yearly control of bearings, for rotating anemometers. Starting threshold < 1 m/s	Sensor specified for wind speed better than ± 10% (or ± 0.5 m/s) and ± 10° for wind direction. Two-year control of the mechanical status of sensors and rehabilitation is necessary. Starting threshold < 2 m/s	Specifications lower than for class C or no regular maintenance organized.
Precipitation	Required measurement uncertainty ± 0.1 mm for < 5 mm, ± 2% above 5 mm. But the achievable measurement uncertainty stated is the larger of 5% and 0.1 mm. Reported resolution better than or equal to 0.1 mm. Use of a wind shield.	Sensor specified for precipitation amount better than ± 5% (or ± 0.2 mm). Reported resolution better than or equal to 0.2 mm. Known error related to precipitation intensity. 6 months calibration for tipping bucket rain gauges. Weekly control of the collecting cone for tipping bucket rain gauges.	Sensor specified for precipitation amount better than ± 10% (or ± 0.5 mm). Unknown error related to precipitation intensity. Calibration period of tipping bucket rain gauges lower than 18 months. A preventive maintenance is defined and applied.	Specifications lower than for class C or No control and adjustment methods defined or no regular maintenance organized.
Global solar radiation	Pyranometer of ISO class 1. Uncertainty of 5% for daily total. Ventilated sensor. Calibration every two years. Regular cleaning of the sensor (at least weekly).	Pyranometer of ISO class 1. No ventilation. Calibration every two years. No regular cleaning of the sensor.	Pyranometer of ISO class 2. No ventilation. Calibration every five years. No regular cleaning of the sensor.	Uncertainty > 10% for daily total or sensor not using a thermopile. Or Calibration not organized.

Parameter	**Class A**	**Class B**	**Class C**	**Class D**
Visibility	± 50 m below 600 m, ± 10% between 600 and 1500 m, ± 20% above 1500 , in 95% of cases in homogenous visibility conditions (ratio of standard deviation to mean value over 10 minutes < 0.1).	Sensor specified for MOR better than ± 20% in 90% of cases in homogenous visibility conditions. 6-months calibration (or periodicity recommended by the manufacturer). For forward scatter meters, mastery of the calibration chain: reference transmissomètre, transfer control forward scatter meter, calibration plates. Use of internal warning from the sensor to clean the optics.	Sensor specified for MOR better than ± 40% Yearly calibration. Defined calibration chain (and applied !).	Specifications lower than for class C or No control and adjustment methods defined or no regular maintenance organized.
Temperature above or below ground level.	Not specified by WMO. Measurement uncertainty < 0.5°C?	Platinum temperature probe (Pt100 or other resistance value at 0°C) of class A (~ ± 0.25°C, IEC 751 standard). Acquisition uncertainty < 0.15°C. Laboratory calibration of the temperature probe every 5 years.	Temperature probe with uncertainty < 0.4°C. Acquisition uncertainty < 0.3°C.	Specifications lower than for class C or Height (or depth) of measurement unknown.