**Annex XX**

**SHORT GUIDANCE ON APPROACHES FOR TRACEABILITY ASSURANCE IN GBON STATIONS**

The main objective of the **calibration strategy for traceability assurance as defined under** [**Annex 1.B. Strategy for Traceability Assurance, Volume I, Chapter 1**](https://library.wmo.int/viewer/68695/?offset=#page=57&viewer=picture&o=bookmark&n=0&q=) **of the** [**Guide to Instruments and Methods of Observation**](https://library.wmo.int/records/item/68695-guide-to-instruments-and-methods-of-observation?language_id=13&back=&offset=4) **(WMO-No.8)**  is to ensure the proper traceability of measurement and calibration results to the International System of Units (SI), through an unbroken chain of calibrations, each contributing to the measurement uncertainty.

Lack of metrological traceability leads to a lack of reliability of meteorological measurements, and consequently, highly reduces confidence in the implications of measurement data such as weather forecasts, warnings, and climate analyses. Ultimately this brings into question the usefulness of meteorological measurements for the global community. Therefore, the consequences of untraceable measurement results are severe.

**1. RESPONSIBILITIES FOR TRACEABILITY ASSURANCE**

* **The responsibilities of the WMO Members** for traceability of the measurements are defined in the [Manual on WIGOS](https://library.wmo.int/records/item/55063-manual-on-the-wmo-integrated-global-observing-system?offset=3) (WMO-No.1160) as below (Section 2.3. Instrumentation and Methods of Observation):
* *Members shall ensure that observations are traceable to the International System of Units (Système international d'unités (SI)) standards, where these exist.*
* *Members shall use properly calibrated instruments and sensors that provide observations satisfying at least measurement uncertainties that meet the specified requirements, including for emerging technologies.*
* *Members should describe uncertainty of observations and observational metadata as specified in the Guide to Instruments and Methods of Observation (WMO-No. 8), Volume I, Chapter 1, 1.6.*
* **National Meteorological and Hydrological Services (NMHSs)** must develop and implement a proper strategy for traceability assurance in a sustainable manner.

**2. APPROACHES TO ACHIEVE TRACEABILITY**

Different approaches can be considered to achieve the traceability based on the resources available for the operation and maintenance of the stations and calibration of the instruments.

Proper approach should be determined after making a comprehensive assessment on the capacities of NMHS, available capacities for calibration at the national level, possible calibration services from Regional Instrument Centers ([RICs](https://community.wmo.int/en/activity-areas/imop/Regional_Instrument_Centres)), National Metrology Institutions ([NMIs](https://www.bipm.org/en/cipm-mra/participation)) and other Third party entities.

Calibration intervals of the instruments should be determined for each sensor considering the recommendations from the manufacturers, operation conditions and environmental exposure.

It should be kept in mind that for any approach that preventive and corrective maintenance of the stations should be performed within the scope of an operation and maintenance plan.

All activities performed within the traceability assurance strategy should be well documented, preferably in electronic format.

**A. FIRST OPTION FOR TRACEABILITY WITH CALIBRATION LABORATORIES OPERATED BY NMHS**

* NMHS operating laboratories (existing or to be established) need to consider the staff and funding to calibrate the instruments
* Sufficient capacity of technical infrastructure, well-trained and competent staff and funding for operating laboratories (existing or to be established)
* Laboratories available preferably for basic parameters (temperature, humidity, pressure and precipitation and one or two parameters can also be selected depending on the capacity of NMHS)
* Development of Standard Operating Procedures (SOPs) and feasibility of ISO/IEC 17025 accreditation
* The quality management system, including all the calibration procedures, working instructions and forms, is well documented and applied in calibration process
* [National Metrology Institution (NMI)](https://www.bipm.org/en/cipm-mra/participation) is available to calibrate the reference instruments of the NMHS to ensure the traceability against national standard.
* If an NMI is unavailable, calibration services can be obtained from other laboratories accredited to ISO/IEC 17025, operated by public or private agencies, to ensure traceability for NMHS reference instruments.
* If no NMI or accredited laboratories exist in the country, NMHS reference instruments should be calibrated at [Regional Instrument Centres (RICs)](https://community.wmo.int/en/activity-areas/imop/Regional_Instrument_Centres).
* If neither in-country calibration services nor RIC support is feasible, instruments must be calibrated in laboratories located in other countries, including those operated by manufacturers.

**B. SECOND OPTION FOR TRACEABILITY ASSURANCE WITHOUT CALIBRATION LABORATORIES IN NMHS**

If the NMHS lacks the capacity to establish or operate calibration laboratories:

* Instruments can be calibrated by a National Metrology Institution (NMI) to ensure traceability to national standards.
* If no NMI is available, calibration services may be obtained from other laboratories accredited to ISO/IEC 17025, operated by public or private agencies.
* If neither an NMI nor accredited laboratories exist in the country, calibration can be performed at Regional Instrument Centres (RICs).
* If no local or regional calibration services are available, instruments should be calibrated in laboratories abroad, including those operated by manufacturers

**C. THIRD OPTION FOR TRACEABILITY ASSURANCE WITH AND WITHOUT CALIBRATION LABORATORIES IN NMHS USING FIELD VERIFICATION KITS**

* + **Field verification kits** used for on-site instrument verification
  + Must meet required metrological specifications and include calibration certificates from [NMI](https://www.bipm.org/en/cipm-mra/participation), [RIC](https://community.wmo.int/en/activity-areas/imop/Regional_Instrument_Centres), or accredited laboratories.
  + Personnel designated to operate the field verification kit should take part in appropriate training courses organized by RIC, NMI, or other relevant institutions
  + Technical procedures for operating the field verification kit should be documented and checked before and after field use.
* **Important Notes**:
* Field verification is not a substitute for calibration. Kits require periodic recalibration in an accredited laboratory.
* The initial calibration of instruments is followed only by one point field of verification.

**3. CONTROL OF THE OBSERVING SITE**

Site maintenance is equally important to ensure traceability. Regular checks should address:

* **Environmental factors**: Obstacles, vegetation, and changes to siting classifications (refer to [WMO-No. 8, Volume I, Chapter 1, Annex 1.D](https://library.wmo.int/viewer/68695/download?file=8_I-2023_en.pdf&type=pdf&navigator=1)).
* **Vegetation management**: Cutting vegetation and maintaining instrument fields.
* **Infrastructure maintenance**: Fencing, corrosion prevention, and structural support.
* **Power supply**: Cleaning solar panels, replacing batteries, and maintaining surge protection systems.
* **Instrument cleaning**: Performed regularly according to user manuals.

**4. AVAILABILITY OF SKILLED PERSONNEL**

The availability and expertise of personnel are essential for effective and sustainable calibration operation and traceability assurance.

* **Competent Staff for Calibration Laboratories:**
  + Ensure compliance, accuracy, quality assurance, and troubleshooting.
  + Operate and maintain calibration equipment.
* **Competent Staff for maintenance:**
  + Performing preventive and corrective maintenance of the stations
  + Using field verification kit to check instrument performance
* **Continuous Training and Capacity Development:**
  + Training programs provided and collaborations with manufacturers, [WMO RICs](https://community.wmo.int/en/activity-areas/imop/Regional_Instrument_Centres), [Regional Training Centers (RTCs)](https://community.wmo.int/en/wmo-regional-training-centres), NMIs and relevant organizations (see [WMO-No. 8, Volume V, Chapter 5](https://library.wmo.int/viewer/68663/download?file=8_V-2023_en.pdf&type=pdf&navigator=1))
  + Webinar on Calibration approaches for the instruments at GBON stations [SOFF: Webinar on calibration approaches for the instruments at GBON stations | ETRP Moodle Site](https://etrp.wmo.int/mod/page/view.php?id=27353&forceview=1)