Uncertainty, Stability and Traceability in Global Monitoring of Atmospheric Composition and the Role of WMO/GAW Central Calibration Facilities – Reality and Plans

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GAW: Mission to Observe Atmospheric Composition

Better understanding of the increasing influence of human activities on Atmospheric Composition and subsequent environmental impacts through:

- ❑ Global network of stations doing long term quality controlled observations.
- ❑ Detect and document changes in atmospheric composition and its impact on air quality, weather and climate.
- ❑ Understand the underlaying processes and their causes.
- ❑ Service to public and policy makers

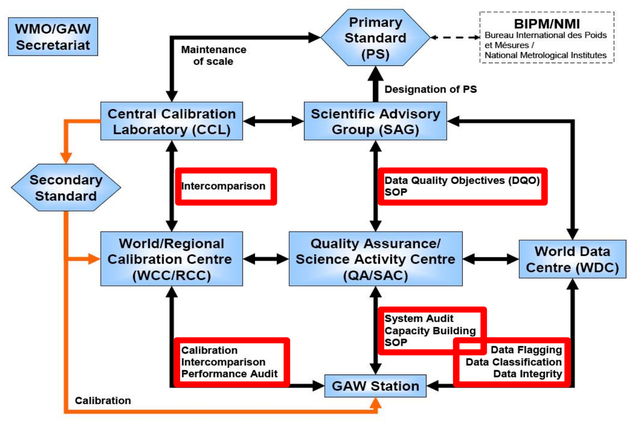
GAW-Global Network of Observation Stations
https://gawsis.meteoswiss.ch

>> Promote a "value chain" from observations to services

Present QA/QC-Framework of WMO/GAW

GAW-Station = Class of Measured GAW Variables:

- GHG's
- RG's
- O3
- Aerosols
- TAD
- Radiation (UV-Vis.)



QA/QC schemes for the different classes of measured variables are coordinated independently from each other → New **ET-ACMQ** also for coordination among the different classes of measured variables

Interaction ET-ACMQ within GAW-Infrastructure

GAW QA-Central Facilities (GAW QA-CF's)
(about 30-40 QA/QC Facilities)

CCL's | **WCC's** | **QA/SAC's**

INFCOM: SC-MINT
Infrastructure Commission: Standing Committee on Measurement, Instrumentation and Traceability

ET-Atmospheric Composition Measurement Quality (ET-ACMQ)
(Core Group on QA/QC: 15 permanent members & liaison members & experts on invitation)

SAG's:
- RG's
- Aerosols
- Ozone/UV
- GHG's
- TAD
- *On Demand*

Metrology (NMI's: e.g. BIPM)

ET-Atm.Comp. Network Evolution

ET-Atm.Comp. Data Management

CCL. = Central Calibration Laboratory
WCC = World Calibration Center
QA/SAC= Quality Assurance/ Scientific Activ ity Centers
SAG= Scientific Advisory Group

GAW-QA/QC: Expert Team on Atmospheric Composition Measurement Quality (ET-ACMQ)

Mission

Bridging the QA/QC efforts in the different observation networks through:

- **Standardization and Harmonization** of **common** QA/QC components in the different observation networks:

  >>>> What do we have? and What can we improve?

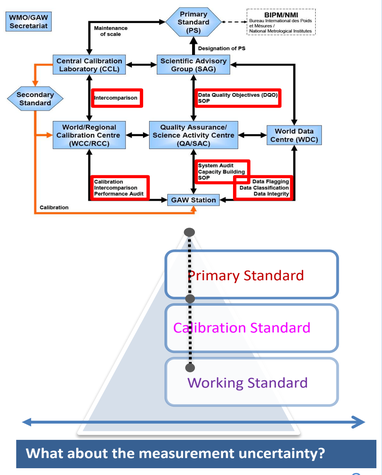
- **Monitoring and Evaluation of QA/QC** of the measurements done in the different observation networks: Develop and establish a common QA/QC Evaluation frame work (using e.g. templates for protocolls etc.)

  >>>> Quality assessed data in the different data centers

ET-ACMQ Direct Interaction with Metrology Community: Traceability and Uncertainty

- ❑ Traceability in GAW: What about measurement uncertainty?
- ❑ Which uncertainty shall be included?
- ❑ Measurement compatibility? How to compare measurements in time and space? Intercomparsion made "blinded"?
- ❑ How to maintain calibration chain short?
- ❑ How to maintain long-term stability?
- ❑ Are uncertainty on primary standards now comparable to DQO?
- ❑ How far GAW-CCL taking part in CIPM key comparison programme

➢ Among the different classes of measured variables there is a large inhomogeneity >>> **Need for harmonisation**



Storage of Data

Leading principle should be that ***each stored GAW-measurement*** should be traceable and consists of:

A. Measured value as obtained following the SOPs of the measuring GAW instrument.

B. Overall Uncertainty in same physical quantity as measured value.

It consists of the uncertainty contributions of calibration, in-situ performance (incl. sampling) as described in the SOPs of the measuring GAW instrument.

C. Flag Code Scheme:

(i) giving state of processing/validation (NRT, LO, L1, L2..) ;

(ii) reliability and representativeness.

D. Meta Data

Uncertainty Reporting (4) : Summary of Data Quality Reporting in GAW

- Uncertainty reporting method highly consistent for each data center, while significant difference exists between the data centers
  - Not all measurements report uncertainty, and some uncertainty variables have fill values only
  - Some uncertainty definition is not readily available and consistency with metrological terms should be improved
  - Standard deviation is commonly reported, which includes both measurement uncertainty and ambient variability
- Lack of reporting of Meta Data for data re-processing
- Missing of QC-flagging

Uncertainty and Data Quality Reporting in Future Practice

- Encourage reporting uncertainties and data quality information
- Increase uniformity among the data centers
- uncertainty quantities according to user needs and feasibility and link these quantities to VIM vocabularies
- Usable by those who are not familiar with the measurements
- Quantifiable by instrument scientists
- Promote use of VIM vocabulary
- Develop metadata standards common to all measurements as well as specific measurements
- Provide definitions readily usable by researchers and tag to VIM vocabularies
- Provide examples for different types of measurements to ensure usability

GAW-QA/QC Evaluation Concept: Objectives

To establish procedures for regular documentation and evaluation of the quality of the GAW measurements and their harmonisation through developing and testing/evaluation of:

- **A harmonized QA/QC- concept based on the largest possible uniformity to achieve among the different observing systems**
- **QA/QC procedures and their traceabilitiy** (link to Metrology)
- **Tools to evaluate on internal and external consistency of the measurements.**

Essentially thereby is to ***obtain a full documentation*** of the standard operating procedures (SOPs) and quality control procedures for each instrument, making the measured data transparently ***traceable to established standards***.

The overall goal thereby should be that these procedures will be ***established as an essential component of the QA/QC plan of the WMO/GAW and that they are monitored and regularly evaluated.***

Monitoring and Evaluation of GAW-QA/QC: Concept of Framework