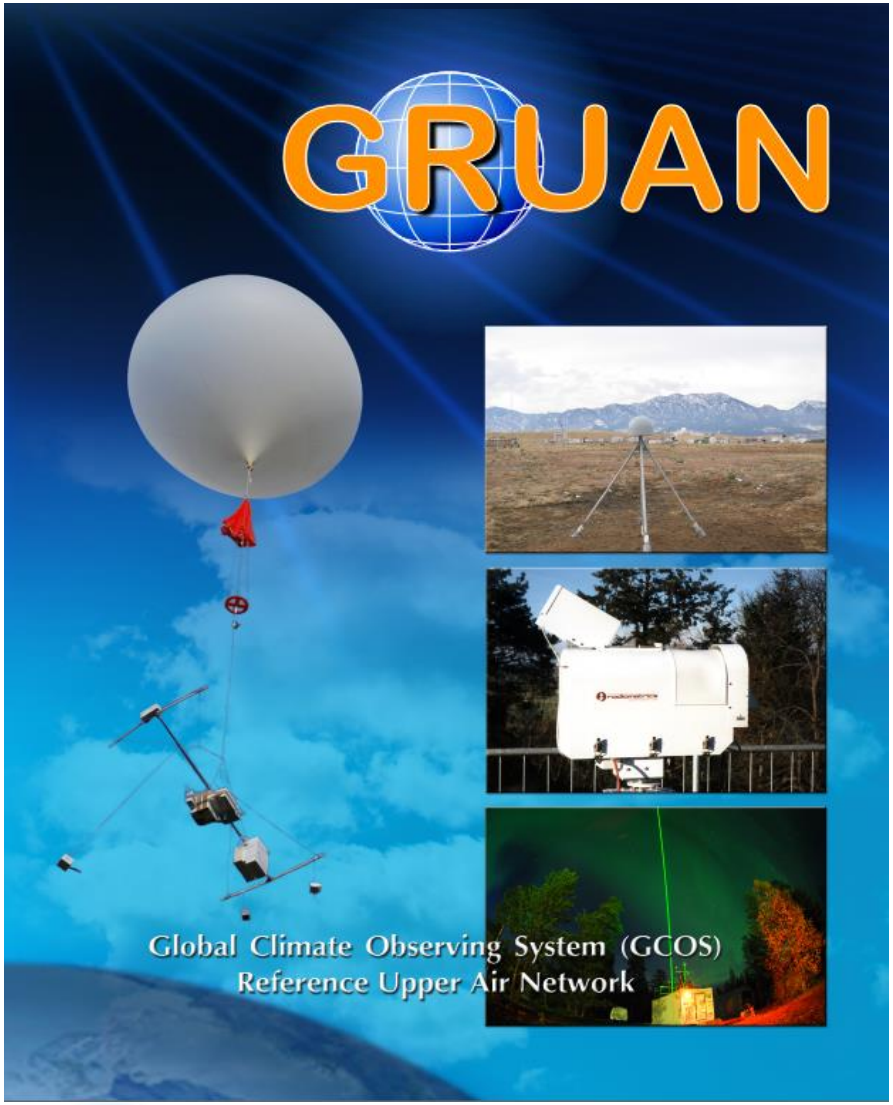

Support to GRUAN QA&QC activities from C3S and CRIM

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CC4: QA/QC framework for GDPs

Co-chairs to create a team, including all centers providing GRUAN GDPs, to (i) draft a TN describing a framework for the standardization of QA/QC procedures and nomenclature, following the principles agreed and discussed at ICM-15. (ii) Assess on whether current products meet the agreed approach or provide an alternative plan.

WG co-chairs, all center providing GDPs

Next ICM-16 (Sep-Oct. 2025)

QA/QC Member Group

- Sommer Michael
- Masatomo Fujiwara
- Tim Oakley
- Alessandro Fassò
- Tom Gardiner
- Axel Von Engeln
- Takuji Sugidachi (杉立 卓治)
- Xavier Calbet
- Zeinab Ali Fahmy
- Belay Demoz
- Marco Rosoldi

Other volunteers are welcome!

Quality assurance

Includes all planned and systematic actions necessary to provide adequate confidence that a product, process or service will satisfy

Are the GDP provided according to the GRUAN requirements and recommendations?

Quality Checks

Quality control (QC) is a part of quality management and focuses on fulfilling quality requirements. It could be defined as the operational procedures, techniques, and activities that are used to fulfil the quality requirements (as defined by QA). It is a key aspect for climate datasets.

The quality controla can be divided generally in a few categories:

- Controls on data

- General controls

- Periodical revision of the data quality.

A flagging system must be generated to report in the data files the outcome of the quality checks.

QCs in the data processing phases

Quality control of scientific data is a process implemented in several steps which can be typically grouped in the following three steps:

I. Automatic QC of raw data;

II. Automatic QC of processed data, before the product delivery to the users;

III. QC of processed data operated on the basis of users' feedback or of the support of specific projects, scientific activities, external advising.

The objective of quality control is to verify whether a reported data value is representative of what was intended to be measured and has not been contaminated by unrelated factors.

Status of GDPs

- No uniform standard for quality control
- Many specific steps of quality control (raw, in between, final)
- No assessment is made as to whether these are realistic measurements.

"Guide to Climatological Practices"
(https://library.wmo.int/doc_num.php?explnum_id=5541)
where in Section 3.3 the quality control procedures are described.

Proposed QA/QC Framework (under discussion)

1. **Pre-Processing (Data Intake)**
   - Verify temporal/vertical sampling, physical plausibility, and metadata correctness.
   - Detect data/instrument errors, format issues, and completeness.
   - Failed checks → investigation and feedback to data provider.
2. **During Processing**
   - Apply corrections/filters with empirical/statistical checks.
   - Ensure algorithm performance and data consistency (e.g., spike removal).
3. **Post-Processing**
   - Verify vertical range, resolution, systematic/random uncertainty.
   - Flag data not meeting standards; maintain traceability.
   - Additional checks for CDR quality:
     - Internal, temporal, spatial consistency
     - Summarization & tolerance tests
     - Coverage, continuity, homogeneity, physical plausibility
   - Consider compliance with GCOS, manufacturer specs, trend detection capacity.

Implementation Notes:

- QC outcome supports site certification but remains independent.
- Quality levels can be flagged per GDP to indicate standards met.
- Decision on approach coordinated by WG GRUAN, LC, and Processing Centre.

C3S2 311 Bis: Rescue, collection and processing of in-situ observations

- **Data Rescue:** Enhance WMO-C3S data rescue portal, develop image repository, improve deposition service, and explore AI/ML and educational approaches.
- **In-situ Observations:** Expand and standardize datasets in the Climate Data Store; improve land, marine, and atmospheric data access with timely updates.
- **Gridded & Climate Products:** Develop European, Alpine, Fennoscandia, and radar-based datasets; support Climate Intelligence Service and joint C3S-WMO reports.
- **Resilience & Management:** Identify single points of failure, ensure redundant storage, and maintain oversight.

WP2: Station Climate Observation Timeseries

Goal: The objective of this work-package is to increase the quality and quantity of climate observations readily available to support climate research via the CDS.

Task 2.7 C3S2 311_Bis Serving reference observation networks datasets.

Start: M1 end M 34 (Lead: UNISA, Contributing TalTech)

- Provide annual updates to GRUAN and USCRN datasets;
- Deliver time aggregated data, and climate anomaly datasets for GRUAN and USCRN, to support trend detection and variability analysis;
- Deliver a gridded dataset version of USCRN for improved compatibility with reanalyses and climate model evaluation frameworks.
- Extend the uncertainty quantification for USRCN from precipitation data, through hourly to monthly temporal aggregations using a metrologically rigorous approach;
- Provide the new GNSS GRUAN data products
- Provide the DORIS reference dataset for satellite orbitography including all key parameters positioning parameters

CA24155 - Climate Reference Instruments and Measurements (Upper-air, Column and Near Surface)

- WG1: Enhancing upper-air radiosonde and lidar measurements for climate study
- WG2: Metrology for near-surface climate reference sites
- WG3: Metrology for GNSS water vapour measurements and retrievals
- WG4: Dissemination and Knowledge transfer (incl. Involvement of stakeholders)

WG1 chair A. Apituley, vice-chiar R. Dirksen

CRIM WG1 - Task 1.1: Traceability and quality of upper-air radiosonde and lidar measurements

Main activities:

- Support the development of end-to-end guidelines and standardised protocols for upper-air
- radiosonde and lidar measurements and their processing, ensuring traceability to SI or community standard
- Analyse the impact of calibration methodologies on data accuracy and consistency
- Provide a quality assurance framework for those measurements

Deliverables

- Deliverable D1: Report on the end-to-end guidelines and standardised protocols for upper-air radiosonde and lidar measurements (month 12)

- Deliverable D2: Recommendation for the quality assurance framework to adopt for upper-air radiosonde and lidar measurements (month 36)

CRIM WG3 - Task 3.1: Towards a better quality of GNSS-PWV

Main Activities:

- Estimating the quality of current GNSS-PWV values collected by single GNSS receivers.
- Benchmarking the GNSS processing types and GNSS stations towards a better quality of GNSS-PWVs.
- Create guidelines for processing the GNSS observations to meet the requirements of end-users.

Deliverables

- Deliverable D9: Report on current types of processing of GNSS observations and its impact on current GNSS PWV values.
- Deliverable D10: Guidance on processing GNSS observations for achieving the best quality of GNSS PWV for weather and climate applications.

What has been done

- Review the GRUAN documents (input still needed from LC)
- Review QA/QC procedure from other initiatives (IGRA, ACTRIS, ICOS)
- Review the new «GRUAN operations manual»
- Proposed additional type of QCs in a draft of TN for QA/QC with a rationale.

Final goal: Draft a TN with a general framework for the QA/QC for all GDPs, harmonizing the existing QCs applied by GRUAN and adding what's needed to ensure a robust QA/QC.

Do we need to rescope or expand the action? Should we agree on the type of QCs or also specificaly define them?

Proposal for a way forward

- Define the QCs needed (by Mar. 2026), online meeting needed.
- Use C3S resources to implement the scripts (by August 2026). This activity includes also the implementation of and derived products (e.g. monthly averages, anomalies, atmospheric layering, homogenization controls, …)
- Consolidate the framework and list of QCs to apply with the implementation and test of dedicated scripts (GRUAN group for QA/QC and UNISA, by next ICM-17, with the support of CRIM Cost Action WG1/WG3)

Question? Comments? Other proposals?