



TT-GSRN Work Plan (2021-2024)

Deliverable 2c – Network governance and Organisational Structure

| | |
|----------------|---|
| Summary | <p>This document provides the GSRN governance guidance as approved by TT-GSRN. The governance detailed in this document is on the reporting, responsibilities, structures and processes, and should primarily be used as a working document for the pilot phase of GSRN and when defining the implementation of the operational GSRN. These statements will support, amongst others, the management of the GSRN pilot phase, the operations of the GSRN Lead Centre, the data providers and the collaboration/reporting between all the groups detailed in plot-1.</p> <p>Annex 1 contains, for reference, the relevant governance statements from the GCOS-226 publication</p> <p>During the transition from the pilot GSRN to the operational GSRN it would be expected that the relevant contents of this document are transferred into the GSRN manual and guide.</p> |
|----------------|---|

Version history:

| Version | Date | Status | Comment |
|----------------|-------------|--------------------|---|
| 1.0 | Dec 2021 | Draft | Secretariat version |
| 2.0 | Jan 2022 | Draft | Secretariat and Subgroup 2 |
| 3.0 | Feb 2022 | Partially-Approved | Approved by TT-GSRN (Sections 1-2) |
| 4.0 | June 2022 | Draft | TT-GSRN-1 (Improved sections 3-6) |
| 5.1 | Nov 2022 | Draft | Version for TT-GSRN (meeting 8th Nov) |
| 6.0 | Dec 2022 | Approved | TT-GSRN Approved. Includes comments which should be addressed during the pilot phase of GSRN. |

GSRN GOVERNANCE

The following document describes the governance of the operational GCOS Surface Reference Network (GSRN) starting with the establishment of the initial GSRN. During the GSRN pilot phase, the governance is used as a guideline. The GSRN Task Team has the role of the GSRN Steering Committee as long as the GSRN Steering Committee is not established. The GSRN governance can be modified by the GSRN Steering Committee or GSRN Task Team during the pilot phase as necessary. The GSRN governance needs to be approved by GCOS(AOPC) and WMO SC-ON before the start of the operational GSRN.

1 External Reporting, Responsibilities and Guidance

- 1.1 The GSRN Steering Committee shall report to, and receive guidance from, the relevant teams within GCOS and WMO. Currently this is the GCOS atmospheric and terrestrial panels (AOPC and TOPC) and the WMO Standing Committee on Observations Networks (SC-ON).
- 1.2 The teams in 1.1 shall approve the membership of the GSRN Steering Committee and shall nominate a representative(s) as a member of GSRN Steering Committee.
- 1.3 The teams in 1.1 shall regularly review the GSRN Steering Committee membership, at least every 4 years.
- 1.4 Further 'upward' reporting of the GSRN work, and requests to GCOS and WMO, shall be according to the governance of GCOS and WMO. *[Note: A link to the relevant GCOS and WMO governance needs to be added to this item]*

2 Internal Reporting, Responsibilities and Guidance

2.1 Steering Committee;

- 2.1.1 The Steering Committee shall consist of representatives of the GCOS Panels, SC-ON, SC-MINT, the Lead Centre (see 2.2 below), representatives of BIPM and invited scientific/technical experts.
- 2.1.2 The Steering Committee is responsible for managing, the strategy and goals of the GSRN, providing scientific and technical support and ensuring that the Lead Centre delivers to its mandate (requirements and agreed work-plan).
- 2.1.3 Only the Steering Committee can initiate, approve, manage and dissolve, as appropriate, task and analysis teams established to undertake specific activities in support of GSRN.
- 2.1.4 The Steering Committee should meet, either in-person or virtually, on at least an annual basis.
- 2.1.5 The Steering Committee is responsible for fostering and encouraging the collaboration between the Science and Research Institutes, SC-MINT and BIPM.

2.2 Lead Centre (s);

- 2.2.1 The Lead Centre shall be responsible for all the operational processes of the GSRN, according to its terms of reference.
- 2.2.2 The Lead Centre is responsible for monitoring the operation of the network, managing the certification, review and recertification processes for all GSRN stations and coordinating these processes with the National GSRN focal point.
- 2.2.3 The Lead Centre shall report to the Steering Committee on an annual basis, detailing the status of the GSRN, the performance against agreed activities and any issues. It shall also maintain a risk-register which should be updated at least annually.

- 2.2.4 The Lead Centre, or a nominated GSRN station representative/WMO member, shall organise a regular GSRN management meeting, at least annually.
- 2.2.5 The Lead Centre can delegate some of its responsibilities to other GSRN teams (i.e. regional centres, expert teams) with the approval of the GSRN-SC.

2.3 Expert teams;

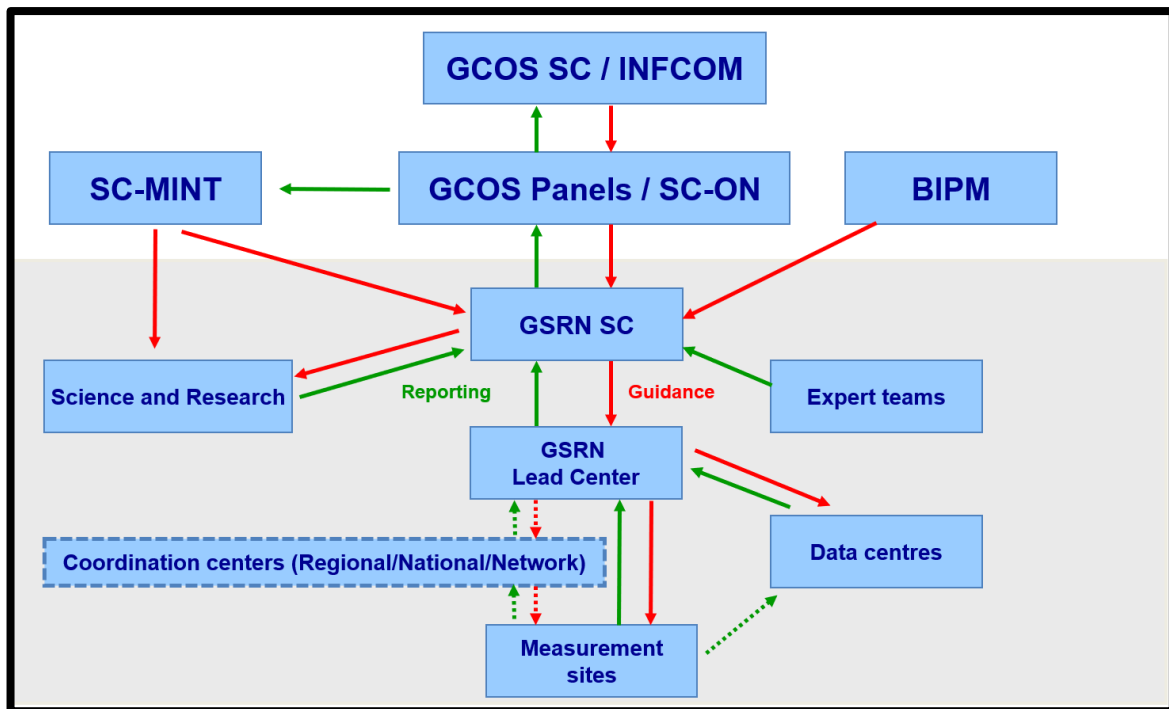
- 2.3.1 Expert teams can only be created/dissolved with the approval of the GSRN Steering Committee.
- 2.3.2 The Terms of Reference and Work Plan for all Expert Teams requires the approval of the GSRN Steering Committee.
- 2.3.3 The GSRN Steering Committee shall approve the Chair/Co-Chairs of the Expert Team and shall be informed of all Members of the team.
- 2.3.4 All Expert Teams shall be represented and report, as necessary, at the annual GSRN management meeting.
- 2.3.5 Expert teams should support the Lead Centre in the quality monitoring of the GSRN measurements, updating requirements and in the (re)certification process for the Measurement Sites.

2.4 Measurement Sites;

- 2.4.1 A measurement site shall agree to contribute to the GSRN for a multi-decadal period and provide a plan, on how it will achieve/ensure this long-term partnership (part of certification).
- 2.4.2 A measurement site shall demonstrate that it can fulfil all the relevant requirements as per sections 3 and 4.
- 2.4.3 A measurement site is required to pass a certification process and will need to be routinely recertified (at least every 10 years). *[Note: This statement needs to be clarified as an outcome of the GSRN (Pilot) including checks during the 10-year period.]*
- 2.4.4 If there are substantial changes at a measurement site that negatively impacts on the responsibilities detailed in 2.4.2, then the measurement site should have its certification reassessed.
- 2.4.5 A measurement site shall appoint a dedicated national GSRN focal point of contact who is responsible for the timely distribution of data, QC, and maintenance of instrumentation. Note – the national focal point can represent more than one measurement site.
- 2.4.6 If a measurement site does not deliver to a minimum set of requirements (see section 3.3) for more than 1 year, a process to remove its GSRN status will be initiated (see section 3.2).

2.5 Data Centre(s);

- 2.5.1 A Data Centre(s) is responsible for the archival and user access to GSRN data/data products, according to its Terms of Reference (TOR).
- 2.5.2 The TOR shall detail the data management responsibilities and the working relationship between the Data Centre and the Lead Centre. This TOR shall be managed by the GSRN Lead Centre.
- 2.5.3 All Data Centre(s) require the approval of the GSRN Steering Committee.
- 2.5.4 Data Centre(s) shall be co-ordinated with the teams referenced in 1.1, to ensure a consistent and collaborative process for climate observations.
- 2.5.5 Data Centre(s) shall provide access to GSRN data on a free and unrestricted basis, as long as the source of the data is referenced, and they should operate according to the FAIR Guiding Principles.



Plot 1 – GSRN Structure

3 Network Management

See also WMO Unified Data Policy for the International Exchange of Earth System Data, the Technical Regulations (WMO-No. 49), Volume I, the Manual on the WIGOS (WMO-No.1160) and the Guide to Instruments and Methods of Observation (WMO-No. 8).

[Note: The terms of reference for the role of the GSRN national focal point needs to detailed as an outcome of the GSRN (Pilot).]

3.1 Site Requirements

- 3.1.1 The GSRN site requirements, as approved by the GSRN Steering Committee, are documented in Annex A of the GSRN Pilot Network Requirements and Station Nomination document. All certified GSRN stations shall conform to the mandatory site requirements detailed in that document.
- 3.1.2 The mandatory site requirements in 3.1.1, shall be used as a primary component of the certification process to be (re-)assessed as a GSRN station.
- 3.1.3 The GSRN station supervising organisation shall be responsible for all resources required to operate and maintain the station according to the GSRN site requirements.
- 3.1.4 The GSRN station shall record, retain and make available, as requested by the GSRN Lead Centre, observational and siting metadata as specified in the Manual on the WIGOS and the WIGOS Metadata Standard.
- 3.1.5 The GSRN station shall ensure that any changes to the observational programme, site or station adhere to the GCOS Climate Monitoring Principles.

3.2 Site Certification

- 3.2.1 A site must be nominated for GSRN and then assessed by the GSRN Lead Centre and the GSRN Steering Committee before being endorsed by WMO as a candidate GSRN station.
- 3.2.2 If a candidate GSRN station has not completed the site certification process within 24 months of being endorsed, it may be removed from the candidate station list by GSRN Steering Committee.
- 3.2.3 The GSRN site certification requirements and processes are documented in the GSRN PILOT Network Requirements and Station Nomination, which can be accessed for the GSRN website. All candidate GSRN stations, and GSRN stations requiring recertification, shall undertake the site certification process. It is possible that the recertification process may be a less exhaustive version of the certification process.
- 3.2.4 If a GSRN station has not completed the site recertification process within 24 months of reaching the agreed recertification date, a process to remove its GSRN status will be initiated.
- 3.2.5 Recertification process shall be initiated by the GSRN Lead Centre at routine intervals at least every 10 years. *[Note: This statement needs to be clarified as an outcome of the GSRN (Pilot).]*
- 3.2.6 If a measurement site does not deliver to a minimum set of requirements, or there are quality issues, for more than 1 year, a process to support improvement in the site including recertification will be initiated by the GSRN Lead Centre. A process to remove its GSRN status will be initiated by the GSRN-SC once all other avenues have been exhausted.

3.3 Monitoring Requirements

- 3.3.1 The GSRN station shall monitor the reporting and data quality of their GSRN data.
- 3.3.2 The GSRN Lead Centre shall provide a monitoring service on required data availability and quality.
- 3.3.3 The GSRN Lead Centre shall monitor the data acquisition, data quality, data anomalies, network performance and website operations.
- 3.3.4 The GSRN Lead Centre shall implement an incident management system for the GSRN, in accordance with the Manual on WIGOS (Section 2.4.5 Incident management).

3.4 Reporting Requirements

- 3.4.1 The GSRN station shall provide to the GSRN Lead Centre, or an approved GSRN data centre, the required data and metadata with an agreed latency and in the correct data format.
- 3.4.2 The GSRN station shall report as soon as possible, any substantial operational exceptions to the GSRN Lead Centre which will impact on 3.4.1.
- 3.4.3 The GSRN Lead Centre shall provide annual GSRN site specific performance reports and invite the GSRN National Focal Points to respond accordingly.
- 3.4.4 The GSRN National Focal Points shall report any changes to the observational programme, site or station as specified in the Manual on WIGOS (Section 2.4.6 Change management).
- 3.4.5 The GSRN Lead Centre shall provide annual reports to the GSRN Steering Committee, detailing the status of the GSRN, the performance against agreed activities and any significant variations from expected performance.

3.5 Network design

- 3.5.1 The Steering Committee, through relevant Expert Teams, will be responsible for the overall network design and how it fits into existing WMO/GCOS structures.
- 3.5.2 The GSRN Lead Centre and GSRN focal points will monitor, and document, any changes to the observational programme, site or station to show adherence to the [GCOS Climate Monitoring Principles](#).
- 3.5.3 The GSRN network should cover the globe as evenly as possible, and provide statistically significant representativity for all climate zones.
- 3.5.4 The horizontal resolution, accuracy and timeliness of GSRN network should meet the requirements of climate-related application areas, in terms of a reference network under the WMO tiered network concept.
- 3.5.5 Each GSRN site shall, as far as possible, meet the requirements as documented in the GSRN Pilot Network Requirements and Station Nomination document.
- 3.5.6 Every GSRN sites should be associated with a Regional and National observation network.

4 Data Management

See also [WMO Unified Data Policy for the International Exchange of Earth System Data](#), the [Technical Regulations](#) (WMO-No. 49), Volume I, the [Manual on the WIGOS](#) (WMO-No.1160) and the [Guide to Instruments and Methods of Observation](#) (WMO-No. 8).

4.1 Measurement Requirements

- 4.1.1 The GSRN measurement requirements, as approved by the GSRN Steering Committee, are documented in the GSRN Pilot Network Requirements and Station Nomination document. All certified GSRN stations shall conform to the mandatory measurement requirements detailed in that document.
- 4.1.2 The mandatory measurement requirements (see 4.1.1) will be used as a primary component of the certification process to be (re-)assessed as a GSRN station.
- 4.1.3 The measurement requirements shall be expressed in a technology-free manner.
- 4.1.4 Changes to measurement requirements can only be initiated and approved by the GSRN Steering Committee with support as required from the GSRN Lead Centre and/or Expert Team

4.2 Data Policy

- 4.2.1 Each station shall conform with the WMO Unified Data Policy for the International Exchange of Earth System Data and as expressed in the Manual on the WIGOS and the Manual on WIS (WMO-No.1060).
- 4.2.2 Each GSRN member or measurement site shall ensure that data sharing complies with the national laws and regulations on data management, sharing and security.

4.3 Data Quality

The GSRN Quality Management document detailed the relevant documents and processes which should be considered for GSRN data quality. This can be accessed through the GSRN website.

See also Guide to the Implementation of Quality Management (WMO-No.1100) and Quality control (WMO-No. 1269)

- 4.3.1 The GSRN Lead Centre shall determine the QC requirements to be performed for each GSRN site.
- 4.3.2 The GSRN Lead Centre shall determine the Metadata requirements for each GSRN site. See also 3.3)
- 4.3.3 The national GSRN focal point shall be responsible for the implementation of a national quality management system (QMS).
- 4.3.4 The national GSRN focal point shall be responsible for ensuring their station performs QC as specified by the GSRN Lead Centre and approved by GSRN Steering Committee.

4.4 Data Archive and Accessibility

- 4.4.1 The GSRN Lead Centre shall take the responsibility of the whole life cycle data management. It shall archive data and metadata from GSRN sites.
- 4.4.2 Each measurement site shall archive the GSRN data and metadata for at least 20 years, as defined in the “Requirements for GSRN sites”, as backup for the main archive of the Data Centre.
- 4.4.3 The GSRN Lead Centre shall make data and metadata of GSRN sites accessible to global legitimate users conforming to the data policy. *[Note: The GSRN data policy needs to be detailed as an outcome of the GSRN (Pilot).]*

4.5 Data Transmission

- 4.5.1 The GSRN Lead Centre acts as a link between GSRN sites and the GSRN end-users. For example, the data to the end user is not directly provided by the GSRN sites, but after conducting QA/QC procedures by each GSRN site and then submitted to the GSRN database by the GSRN Lead Centre.
- 4.5.2 The GSRN Lead Centre shall define the timeliness of the data transmission.
- 4.5.3 Each site is responsible for the uploading of all data and metadata to the approved GSRN data repository (as defined by the GSRN Lead Centre) and for ensuring that the data is transferred according to the agreed timeliness.

5 Finance Management

- 5.1.1 The GSRN Lead Centre is responsible for the provision of all finance with respects to the operation of the GSRN Lead Centre.
- 5.1.2 The measurement sites are responsible for the provision of all finances with respects to the operations at their measurement sites.

6 Science and Research

6.1 Background

Providing climate reference data is a technical and scientific process requiring continuous research and innovation, to constantly improve the quality of measurement results. Methods to evaluate measurement uncertainty, improvements of measurement methods, evaluation of associated influence quantities, optimization of calibration procedures and interval, studies on evolving technologies, should be initiated and addressed by the GSRN. Measurement requirements prescribe specific recording frequency, instrument redundancy, technological features of data-loggers and sensor coupling in order to minimise effects and contributions to the overall measurement uncertainty.

Variety of commercial solutions and products, different measuring principles and techniques, evolving technologies all have impact on observational accuracy and stability of data series. A key consideration in upgrades of existing systems or introduction of new systems is the likelihood of the new system operating effectively better, and providing continuous and homogeneous long-term observations. Since Climate Reference Stations participating in the GSRN are not requested to operate the same instrumentation, there would be value in side-by-side operations, testing and comparison of the different configurations to ensure long-term comparability.

Intense scientific and technical efforts are therefore required to constantly improve measurement procedures taking advantage of technology evolution, support uncertainty evaluation and, understand environmental effects and quantities of influence.

6.2 GSRN affiliated Research Facility (GSRN-RF)

[Note: The governance of the GSRN-RF needs to be detailed in section 2 of this document as an outcome of the GSRN (Pilot).]

A GSRN affiliated research facility (GSRN-RF) should work in close collaboration with the GSRN and should be linked to the GSRN operational structure. In principle, such a facility is not a standard station of the GSRN and it is not necessarily requested to provide climate reference data.

The main goals of a GSRN-RF are to:

- conduct studies, testing and characterization of instruments and logging systems
- test new systems and new measuring principles
- improve measurement and calibration procedures
- contribute to the revision of instrument requirements when necessary
- organize and perform instrument intercomparison both in laboratory and in field
- evaluate drifts and maintenance interval also for specific and challenging uses
- plan large scale and long-lasting experiments if scientifically required
- improve knowledge on uncertainty evaluation and effects of associated quantities of influence
- undertake parallel observation and evaluate redundancy benefit

A GSRN-RF should therefore be based on both laboratory and field facilities.

- **Laboratory**
The use of dedicated laboratory instrumentation, able to generate the environmental conditions met by the instruments in the field, in a metrologically characterized way is a pre-

requisite for testing and characterisation of commercial and prototype systems. Climatic chambers, humidity generators, wind tunnels, barometric chambers, all of them equipped with reference standards are necessary to complete a sound laboratory equipment for the scope.

- **Field**

A research field is also required as part of the research facility to perform: on site uncertainty evaluation, parallel observations, field testing of evolving technologies, intercomparisons of instrumentation, study of environmental factors in measurements uncertainty determinations. The field test site shall meet top quality requirements (class 1 of the siting classification) and be positioned in the centre of a flat area of at least 100 m of radius, free from obstacles such as roads, trees, buildings, water sources and any other kind of object that could affect the variables and the quantities of influence. At the same time, nearby the site, farer than 100 m from the reference measuring point and possibly in similar meteorological conditions, the presence of obstacles such as roads, water sources, trees, buildings, is also welcome for testing their influence on instrumentation (which is a side aspect of the siting classification, not related to the representativeness of the measurand).

6.3 Interactions

Any GSRN-RF shall interact with and report to the GSRN Steering Committee, on topics related to measurement techniques and data quality for GSRN stations. The GSRN-RF should establish a direct link with a National Institute of Metrology (NMI) and appropriate WMO Measurement Lead Centre/s, and work under a framework agreement with the GSRN-LC. The link with an NMI will provide direct traceability and access to primary standards, top-level calibration facilities and metrological capabilities and knowledge to evaluate uncertainties. The involvement of the metrology community and staff from NMIs sets the basis for further beneficial collaboration within the GSRN and is aligned with the participation of BIPM in the GSRN initiative.

A GSRN-RF is also tasked to

- Establish links with manufacturers, to offer testing facilities for instruments of interest for GSRN stations aiming at a user perspective impact on technological advances in instrumentation and measurement methods.
- Consider scientific production as a key aspect, through publishing studies and results in peer reviewed international journals, to increase the impact of the overall GSRN.
- Disseminate the results to the GSRN stations and to the wider community.
- Organize training events in collaboration with the GSRN Lead Center on related topics.

7 Capacity Building

This section will be completed at a later stage once the pilot phase is operating and the required capacity building is further assessed.

Annex 1: Governance text from GCOS-226 publication

- A successful GSRN requires sustained governance, management and coordination, and oversight. Given the global nature of the network, with observations made by multiple sovereign nations, it will be necessary to take a federated approach to aspects of network and data management. Furthermore, to realise the system-of-system benefits (Section 4) the GSRN has to be integrated into the broader WIGOS activities so that key insights can be effectively integrated into remaining components of the global observing system. Key aspects of network management and coordination are discussed below.
- The GSRN will be sponsored by one or more relevant global bodies. Considering the different roles in the instigation and maintenance of the GSRN, it is likely that the GCOS programme, relevant WMO programmes and BIPM will all have a formal role in the network governance.
- GSRN Steering Committee A steering committee, should be formed, tentatively consisting of representatives of the sponsors, the director of the Lead Centre (see below) and scientific and technical experts. The role of this group would be to provide guidance on the development of GSRN, monitor network performance as well as providing scientific, technical and management guidance to the Lead Centre. The WG-GRUAN of AOPC provides a working model of such a group that oversees the development and operations of GRUAN.
- Lead Centre The establishment and operation of a Lead Centre to manage implementation and operations of GSRN is critical to the success of the network. It will need to work in conjunction with the steering committee to:
 - develop a network based on existing reference quality monitoring stations;
 - coordinate reference stations;
 - ensure that all observations are of reference quality;
 - establish common procedures and standards across the GSRN;
 - certify stations as being of reference quality and contributing to the GSRN;
 - establish systems to monitor station performance and perform QA/QC;
 - ensure data is easily discoverable and freely and openly available to all;
 - develop a plan for the long-term operation and development of GSRN;
 - report to the GSRN steering committee;
 - promote research activities, including a visiting scientist programme, that apply GSRN data to climate research and monitoring issues;
 - provide training at the lead centre of on-site scientists to ensure required performance;
 - undertake development and provision of guidelines to harmonize long-time series of surface observations, especially for archived data sets. Staffing Commitment