

Task Team GCOS Surface Reference Network

27th AOPC Session

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Rationale for a Global Surface Reference Network

Historical climate records contain irreducible and poorly quantified uncertainties arising from the heterogeneity and imperfect understanding of historical measurement techniques.

A well-maintained reference network would ensure greater confidence in the assessment of future climate change and variability and would help understand other measurements.

These observations will support decisions on adaptation and monitoring and quantifying the effectiveness of mitigation.

A Global Surface Reference Network does not just benefit climate – other benefits: satellite cal/val, instrument development, improvements in NWP and in disaster and emergency response systems, process studies.

A GCOS Surface Reference Network



Improved long-term accuracy, stability and comparability of observations.

- To achieve simultaneous high-quality observations of many ECVs
- Provide reference data to constrain and calibrate more spatially comprehensive observing systems
- Is traceable to an internationally accepted standard and has a comprehensive uncertainty analysis and is validated
- Is documented in accessible literature and includes complete metadata description
- Will measure temperature and precipitation and a range of other surface ECVs
- Based on existing networks where possible (e.g. USCRN, Cryonet)



GRUAN measurements provide long-term, high-quality climate data records from the surface, through the troposphere, and into the stratosphere.

GRUAN is envisaged as a global network of eventually 30-40 measurement sites.

ECV: Temperature, humidity

GCOS Reference Upper-Air Network



As at August 2020, GRUAN comprises of 30 sites, 12 of which have been GRUAN certified.

Radioonde launch at Ny-Ålesund, Norway



GRUAN Lead Centre

The Lead Centre at the Lindenberg Meteorological Observatory/ Richard-Assmann-Observatory (MOL-RAO), Germany became fully operational in summer of 2008:

- Coordination of the network
- Training, education and research
- Data management including reanalysis
- Reporting

Establishment of the GSRN Task Team

2017: the GCOS/WCRP Atmospheric Observation Panel for Climate agrees on

- creation of a dedicated task-team to scope a potential GCOS global surface reference network
- based on a paper by Thorne et al (2018)

2018: Paper published in the Intl Journal of Climatology

["Towards a global land surface climate fiducial reference measurements network"; Thorne et al. (2018)]

Gives firm underlying scientific foundation regarding what would be involved in implementing and maintaining a suitably stable and metrologically well-characterized global land surface climate fiducial reference measurements network, including:

- Background
- Rationale
- Metrological principles
- Practical considerations

Establishment of the GSRN Task Team

2019: The task team publishes a report (GCOS-226), which includes:

- a proposal for the establishment of a GCOS Surface Reference Network
- the outline next steps required for the implementation of a GSRN:
 - i. approval of the proposed GSRN by relevant WMO programmes, the GCOS programme and other sponsors
 - ii. solicitation of offers to host and staff appropriately the proposed Lead Centre, and
 - iii. the selection of suitable sites for an initial GSRN.

2020: The GCOS Surface Reference Network Task Team (GSRN TT) is established by the President of Commission for Observation, Infrastructure and Information Systems (INFCOM) with concurrence of the Commission per Decision 5 (INFCOM-1).

Under the leadership of the GCOS Steering Committee and of the INFCOM Standing Committee on Earth Observing Systems and Monitoring Networks (SC-ON), and in close collaboration with the Standing Committee on Measurements, Instrumentation and Traceability (SC-MINT), **the task team will be responsible for the initial implementation of the GSRN.**

2021, 24th March: 1st Meeting of the GSRN TT (online)

List of members

No.	Representative	Name	Gender	Organisation
1	Co-Chair TT-GSRN, SC-ON, GCOS	Sarah Gallagher	F	Met Éireann, Ireland
2	Co-Chair TT-GSRN, S-MINT	Tilman Holfelder	M	DWD, Germany
3	TT-GSRN Member	Elian Augusto Wolfram	M	Servicio Meteorológico Nacional (SMN), Argentina
4	TT-GSRN Member	Howard Diamond	M	National Oceanic and Atmospheric Administration (NOAA), USA
5	TT-GSRN Member	Sergey Chicherin	M	Voeikov Main Geophysical Observatory, Russia
6	TT-GSRN Member	Xiaolan Wang	F	Environment and Climate Change Canada (ECCC), Canada
7	GCOS Secretariat	Caterina Tassone	F	WMO, Geneva
8	AOPC Chairman	Peter Thorne	M	National University of Ireland, Maynooth
9	JET EOSDE (Joint Expert Team on Earth Observing System Design and Evolution)	Seiyoung Park	F	Korea Meteorological Administration (KMA)
10	SC-MINT	Jitze van der Meulen	M	KNMI, The Netherlands
11	SC-IMT	Li Xiang	F	CMA (China Meteorological Administration), China
12	AOPC (GCOS - Atmospheric Observation Panel for Climate)	Maria Hakuba	F	NASA JPL, USA

List of members

No.	Representative	Name	Gender	Organisation
13	TOPC (GCOS - Terrestrial Observation Panel for Climate)	Nigel Tapper	M	Monash University, Australia
14	BIPM (Bureau International des Poids et Mesures)	Dolores del Campo Maldonado	F	CEM (Centro Espanol de Metrología), Spain
15	GRUAN (GCOS Reference Upper-Air Network)	Shwei Lin WONG	M	NEA (National Environment Agency), Singapore
16	GSN (GCOS Surface Network)	Tim Oakley	M	WMO, Geneva
17	GCW representative (Global Cryosphere Watch)	Jiankai Wang	M	CMA (China Meteorological Administration), China
18	CMA representative and official representative of the lead centre	Nan Zhang	F	CMA (China Meteorological Administration), China
19	Satellite community	Albrecht von-Bargen	M	Deutsches Zentrum für Luft- und Raumfahrt (DLR), Germany
20	HMEI (Hydro-Meteorological Equipment Industry)	Foeke Kuik	M	Campbell Scientific, Inc, The Netherlands
21	CCI document "Climatological reference stations: definitions and requirements"	Andrea Merlone	M	INRiM (Istituto Nazionale di Ricerca Metrologica), Italy
22	CCI document "Climatological reference stations: definitions and requirements"	Andrew Harper	M	NIWA (National Institute of Water and Atmospheric Research Ltd.), New Zealand

- 20+ members/representatives from regions & across topics such as:
 - Met Éireann, DWD, NOAA, ECCO, SMN Argentina, Voeikov Geophysical Observatory, Russia
 - AOPC (GCOS - Atmospheric Observation Panel for Climate)
 - JET EOSDE (Joint Expert Team on Earth Observing System Design and Evolution)
 - GCOS Secretariat
 - SC-MINT/SC-IMT/SC-ON
 - TOPC (GCOS - Terrestrial Observation Panel for Climate)
 - BIPM (Bureau International des Poids et Mesures)
 - GRUAN (GCOS Reference Upper-Air Network)
 - GCW (Global Cryosphere Watch)
 - HMEI (Hydro-Meteorological Equipment Industry)
 - Satellite Community
 - Lead Centre (CMA)

Fundamental questions – 10 year goals

The full implementation of all goals named in GCOS-226 , based on the experience of implementing GRUAN, will take decades. The TT-GSRN has therefore agreed to define the following goals, to be achieved in a 10-year timeframe, within the initial GSRN:

10-year goals

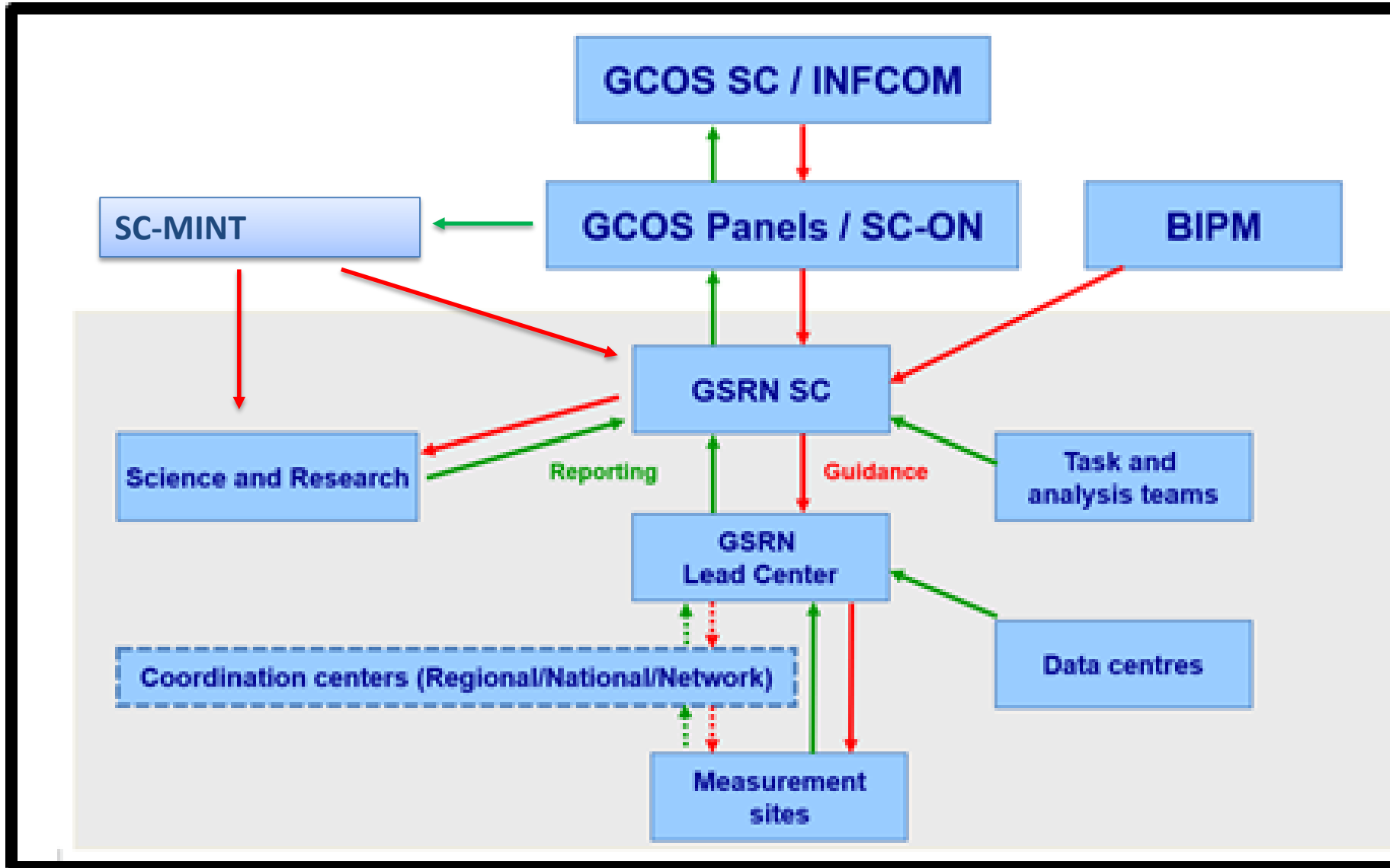
1. Provide sustained reference quality observations, with full traceability and fully defined uncertainty, on a global scale (on land) of at least the ECVs **surface temperature and precipitation** in order to quantify their variability, long-term change and inform on extremes
2. Deliver an implementation plan for the inclusion of additional ECVs
3. Be a recognized reference network within the WMO tiered system which primarily supports the climate community in quantifying climate change
4. Publish operational procedures and practices for knowledge transfer and capacity building
5. Ensure a free and open access archive of accredited GSRN data products
6. Establish a GSRN affiliated research facility delivering scientific advances in measurement techniques and improving knowledge on climate reference data and instrumentation

GSRN Subgroups

Following the TOR, GSRN TT developed a workplan for the following 4 years, which includes 6 topics:

n.	workplan	Tasks
1	Lead Center and TOR	<ul style="list-style-type: none">• Develop initial ToR for the LC• Propose a supporting structure for the LC with the other countries who expressed interest• Refine ToR of LC and finalize them
2	Concept for Network governance and structure of GSRN	<ul style="list-style-type: none">• Draft concept for Network governance and organizational structure
3	Requirements for GSRN sites	<ul style="list-style-type: none">• Define the requirements for the mandatory parameters and the relevant (specific) areas of expertise (e.g. measurement protocols, data transfer, metadata retention and the criteria for site and instrumentation)• Develop provisions of the Manual on the WMO Integrated Global Observing System, (WMO-No. 1160) regarding the implementation of the GSRN
4	Pilot stations and initial composition	<ul style="list-style-type: none">• Generate Document with the guidelines and implementation for the pilot project• Develop a proposal for the initial composition of the GSRN
5	Climatological Reference stations document	<ul style="list-style-type: none">• Finalize existing document on Climate reference stations• Publish technical documentation
6	Certification and nomination process	<ul style="list-style-type: none">• Generate a final document with the process for nomination, review and site certification that can be used for the certification process

Organisational structure of GSRN*



*as currently approved by TT-GSRN only

TT-GSRN Plenary 21-24th June 2022



Process for Implementation of Pilot GSRN

1. Mandatory variables **Temperature** and (or) **Precipitation**
 - and their Associated Quantities of Influence (AQI)
2. Definition and description of Pilot GSRN station requirements
 - Long term operation of measurements and stations
 - Siting requirements and metadata
 - Measurement requirements
 - Free and open access to data and metadata
 - QA/QC and maintenance
3. Nomination and selection Process (Pilot Phase)
4. Implementation of the Pilot network
5. Evaluation process
6. Recommendation for initial GSRN → Decision at INFCOM 2 to approve this process and encourage members to contribute to GSRN and nominate stations for a pilot network

- A well-maintained reference network to ensure greater confidence in the assessment of future climate change and variability and help understand other measurements
- A Global Surface Reference Network does not just benefit climate – other benefits: satellite cal/val, instrument development, improvements in NWP and in disaster and emergency response systems, process studies
- Data sparse regions are crucial - we encourage members to contribute to GSRN and nominate stations for a Pilot Network (post INFCOM 2 approval) October 2022

Thank you



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OBSERVING SYSTEM**

KEEPING WATCH OVER OUR CLIMATE



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