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Virtual Session

**GCOS Network Manager Annual Report of Work
and Network Performance Summary**

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Period: April 2020 to March 2021

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Eighth year on secondment to GCOS as the network manager, continuing to monitor the GSN & GUAN networks, delivering projects through the GCOS Cooperation Mechanism (GCM) and supporting the secretariat. A complete year of working from home, no travel and 100% 'on-line' meetings due to the COVID pandemic. This has impacted significantly on the practical component of my role as GCOS Network Manager.

My summary against agreed objectives was as follows:

I. As GCOS Technical Manager:

1. Support the work of the Atmospheric Observation Panel for Climate (AOPC) in its annual meeting (April 2020) and regular e-meetings; assessing the relevant actions in the update of the GCOS Implementation Plan (Dec 2020); and contributing to the GCOS Adequacy report (Mar 2021).

Virtual AOPC (April 2020) – Presented 2019 summary of the GSN/GUAN network report, completed and ongoing projects in support of atmospheric networks and 2020 GSN & GUAN stations lists were approved. Contributed to break-out groups on ECV requirements and actions within the GCOS Implementation Plan. Supported the Scientific Officer (AOPC) in the organization and running of the meeting, and the final report.

Attended regular meeting with the chairs of AOPC to discuss work-plan progress and address any requests for the support of the panel. Also attended the quarterly telecons of panel.

Contributed to GCOS status report (2021) as one of the primary authors for the chapter on GCOS networks and assessing the implementation plan actions. Draft status report is now out for public review, with the aim to present the final report at the next COP meeting.

Supported the development of the GCOS Surface Reference Network (GSRN) concept and the agreement within WMO (and with SC-ON) for the creation of a task team (TT-GSRN) to oversee the further development and implementation of a GSRN. As GCOS Network Manager I will be a member of TT-GSRN.

Supported, and provided technical advice, to the AOPC task team on Lightning.

Agree with the WMO Director of Infrastructure on the continuation, or not, of the role of GCOS Network Manager from April 2021, under a Letter of Agreement with Met Office. (Agreement by Jan 2021; Signed LoA by March 2021)

Complete – Amendment for LoA has been approved for an additional year, until March 2022. Document is in the process of being signed by both parties and will be complete by the end of March 2021.

II. As GCOS Network Manager:

2. Monitor the GCOS Networks (GSN & GUAN) using statistics provided by ECMWF, DWD and NCEI, and incident manage new & existing issues with the National contacts and other relevant stakeholders. (Monthly)

Monthly reporting and addressing reported issues have been sustained throughout the period. Statistics and plots have been used to advise the GCOS programme, AOPC, WMO and other relevant bodies on the status & challenges of the GSN/GUAN.

3. Produce an annual report on the status of the GSN & GUAN networks for communicating within GCOS & WMO and to allow consideration for targeted support (resources permitting) for priority countries and regions. (March 2021)

Draft 2020 network report and proposed 2021 station list updated has been produced, and will be presented to the next AOPC meeting in April 2021.

4. Work with the CBS Lead/Monitoring Centers on an ongoing basis to resolve issue with reporting and data quality according to the terms of reference of the CBS-LC-GCOS. (Ongoing)

Due to COVID it was not possible for the biennial meeting of CBS-LC-GCOS to take place. Contact with the CBS-LC-GCOS has been as required via email and when addressing specific issues with the GSN and GUAN stations. It is not clear how CBS-LC-GCOS fits within the new WMO structures and with the introduction of the WIGOS regional centers. This has been raised with WMO standing committees SC-MINT and SC-ON.

III. As GCOS Project Manager:

1. Manage projects according to the terms of the GCOS Cooperation Mechanism delivering support/equipment/consumables to Gan, Maldives (June 2020) and Yerevan, Armenia (Sept 2020).

Replacement stock of radiosondes and balloons have been delivered to Armenia and the Maldives during the period, along with emergency spare parts for the Hydrogen Generator at Gan (Maldives). Project work has been limited by the available funds in the GCOS Cooperation Mechanism (GCM) which in 2020 was only received from Japan in support of Gan and Yerevan.

2. Manage the radiosonde component of the WISER/HIGHWAY project (under the management of WMO) delivering support/equipment/consumables to Kenya (Oct 2020) and Tanzania (Dec 2020).

Throughout the reporting period work has continued in support of the UAS in Kenya and Tanzania. Significant delays in the implementation of the UAS at Dar Es Salaam airport were encountered as a result of the COVID pandemic. Regular monthly meetings with the HIGHWAY project team and the country focal points to present progress and discuss any issues. Additional radiosondes and balloons to support the operations of Nairobi were successfully delivered to KMD in Nov 2020. All consignments for the Dar Es Salaam UAS were finally delivered to KMD in Jan & Feb 2021. Further work has been put on hold as engineers from France are not able to travel to Tanzania at the moment due to COVID restrictions. Installation and training will take place as soon as it is possible, and safe, for engineers to travel. The HIGHWAY project will formally close at the end of March 2021 and all reporting/accounting from GCOS to the project has now been completed. Ongoing work will be supported through the GCOS Cooperation Mechanism.

3. Support the WMO Intra-ACP project to develop a sustainable surface network plan for Burkina Faso according to the requirements of the project. Draft plan (Q4 2020)

It has not been possible to undertake any technical visit as part of the Intra-ACP project and this any action here has been limited to virtual meetings and remote technical information. Focus has been on improving the station and network metadata held in the WMO/OSCAR surface database and having active contacts in the target countries for network management. A proposal has also been developed within WMO to resource and hire an in-region technical expert to be responsible for the observational and reporting (WIS) elements.

IV. As GCOS/Met Office Technical Expert:

1. Core member of CIMO Task Team on Upper Air Intercomparison (TT-UAI). Agreed Project Plan (July 2020); Agreed participants (Q3 2020); Support laboratory test phase (Q1 2021).

Assessment and selection of vendor participants was led by me and agreed by August 2020. However, due to the impact of COVID, firstly they laboratory phase was postponed until Q4 2021 and then in January 2021 it was agreed to postpone the Intercomparison until 2022. The original project plan/schedule has been reintroduced but with a 1-year delay on all components.

2. Task Team on WIGOS Metadata (TT-WMD). Attend e-meetings to support & develop the WIGOS metadata standard and it's function within OSCAR/Surface. (At least monthly meetings, ongoing) and Task Team on WIGOS Data Quality (TT-WDQMS). Attend e-meetings to support & develop the WDQMS (ongoing)

Attended monthly TT-WMD/TT-WDQMS meetings and contributed to the update of the WMD tables for the 1st half of the reported period. From October 2020 these teams' responsibilities were transferred to new teams under the new WMO structures. I continued to support the OSCAR/Surface metadata and WDQMS through being a member of the Expert Team on WIGOS-Tools (ET-WT). Attended regular meetings of ET-WT from October 2020 through to March 2021.

3. Member of Expert Team on WMO Centennial Stations. Support the 3rd call for nominations of Centennial Stations. Assessment of Nominations (June 2020); Approval by WMO EC (Q4 2020).

The approval of the updated criteria for Centennial Station nomination and the call for nomination to WMO members was delayed due to COVID, primarily due to the postponement of WMO meetings in the approval process. The 3rd call for nominations was announced in Q4 2020, with the assessment of nominations by the expert panel in Q1/Q2 of 2021. Final approval from WMO EC/Congress is expected by the end of 2021.

4. Support the work of the development of the Global Basic Observing Network (GBON) and the Systematic Observation Funding Facility (SOFF), through WG1 (Benefits of SOFF) and WG2 (Case Studies).

Technical support was provided to these teams, and later as a Member of SG-GBON, in the final development of the GBON concept. This was approved at the INFCOM session in Nov 2020. I have continued to support as requested the teams developing the SOFF proposal within WMO.

5. Member of Standing Committee on Measurements, Instrumentation and Traceability (SC-MINT).

As the Met Office (and GCOS) representative (Radiosonde expert) I have attended the regular sessions of the SC-MINT (#1 – Sept 2020; #2 – Dec 2020 and #3 – Feb 2021) and contributed to the work plan and approval of the work/documents of the corresponding task teams.

V. Network Station List (2021 update)

GCOS Surface Network (GSN)

RA-I	154 Stations (-1) (South Africa) (Tunisia)	Delete 68262 (Pretoria Eendracht) - Station was closed on 31 March 2014, and has stayed closed despite several attempts to reopen. No CLIMAT reports for many years. Confirmed by email with OSCAR/Surface contact Feb 2021. ----- 60767 (Gabes Matmata) to 60765 (Gabes) - Station was closed for many years. Replacement station now providing CLIMAT reports.
RA-II	258 Stations (0)	No Changes
RA-III	101 Stations (0)	No Changes
RA-IV	178 Stations (0) (Canada)	71066 (High Level, Alta) to 73085 (High Level) - Change request received from Met Service Canada (MSC). Same site but measurement location approx. 1.08km difference. Six-month period of overlapping measurements. 71066 CLIMAT stopped in Jan 2021.
RA-V	151 Stations (0)	No Changes
RA-VI	139 Stations (+1) (Belarus) (Greece)	Add 26554 (Verkhnedvinsk) - Request from country to add station. Only one other GSN in Belarus (South). Station began observations in 1891 and is located in the North of the country. Providing monthly CLIMAT reports. ----- Delete 16734 (Methoni) - Automation in 2012. Stopped reporting CLIMAT. Confirmed by email with OSCAR/Surface contact Feb 2021. Add 16627 (Alexandroupoli) - Replacement station proposed by HNMS. Existing climate station with request to generate CLIMAT reports from April 2021.
ANTON	42 Stations (0)	No Changes
TOTAL	1023 Stations	

GCOS Upper Air Network (GUAN)

RA-I	23 Stations (0)	No Changes
RA-II	38 Stations (0)	No Changes
RA-III	18 Stations (0)	No Changes
RA-IV	24 Stations (0)	No Changes
RA-V	38 Stations (0)	No Changes
RA-VI	24 Stations (0) (Spain)	La Coruna 0-20000-0-8001 43.3658°N, 8.4214°W, 58m (Closed) Bens-A Coruna 0-724-0-0000000000008001 43.3633°N, 8.4417°W, 132m (Open) Station relocation due to change from manual to automated system.
ANTON	12 Stations (0)	No Changes
TOTAL	177 Stations (0)	

The above changes were submitted to AOPC Chairs (April 2021) for electronic approval.

Network Performance

GCOS Surface Network (GSN)

The following statistics are an annual summary of the monthly CLIMAT messages in the GCOS Climate Archive (National Climate Environmental Information, NCEI, US). According to the GCOS requirements, a fully compliant GSN/RBCN shall have 12 CLIMAT reports. The values represent the 2020 percentage of stations that are compliant and those that are partially or non-compliant. In brackets are the statistics for 2019, 2018, 2017, 2016, 2015, 2014, 2013, 2012 and 2011 respectively.

GCOS Surface Network (GSN)

Region	No.	12 Monthly CLIMAT	6 - 11 Monthly CLIMAT	1 - 5 Monthly CLIMAT	0 Monthly CLIMAT
RA-I	155	20% (26% 2019) (37, 31, 40, 29, 29, 32, 28, 23)	37% (33% 2019) (21, 34, 25, 31, 33, 33, 36, 39)	4% (6% 2019) (5, 3, 9, 15, 10, 10, 11, 14)	39% (35% 2019) (37, 32, 26, 25, 28, 25, 25, 24)
RA-II	258	77% (76% 2019) (74, 79, 83, 78, 71, 73, 73, 75)	14% (17% 2019) (14, 15, 10, 14, 21, 19, 19, 19)	2% (1% 2019) (5, 0, 2, 2, 3, 2, 2, 1)	7% (6% 2019) (7, 6, 5, 6, 5, 6, 6, 5)
RA-III	101	68% (72% 2019) (52, 63, 65, 61, 76, 89, 84, 69)	7% (5% 2019) (24, 15, 29, 35, 20, 6, 13, 28)	2% (9% 2019) (1, 6, 0, 0, 1, 0, 0, 0)	23% (14% 2019) (23, 16, 6, 4, 3, 5, 3, 3)
RA-IV	178	87% (82% 2019) (88, 86, 90, 88, 88, 88, 81, 80)	9% (16% 2019) (7, 12, 7, 9, 10, 11, 17, 18)	2% (1% 2019) (4, 1, 2, 2, 1, 1, 1, 1)	2% (1% 2019) (1, 1, 1, 1, 1, 0, 1, 1)
RA-V	151	72% (66% 2019) (62, 61, 67, 66, 70, 63, 58, 52)	11% (15% 2019) (21, 21, 15, 16, 17, 16, 23, 34)	3% (4% 2019) (1, 3, 3, 4, 1, 7, 7, 1)	14% (15% 2019) (16, 15, 15, 14, 13, 14, 12, 11)
RA-VI	138	79% (81% 2019) (75, 82, 84, 77, 80, 82, 78, 81)	7% (7% 2019) (15, 8, 7, 14, 9, 12, 17, 15)	4% (3% 2019) (1, 2, 2, 3, 5, 2, 1, 0)	10% (9% 2019) (9, 8, 7, 6, 6, 4, 4, 4)
ANTON	42	91% (88% 2019) (84, 83, 81, 77, 79, 60, 45, 50)	5% (10% 2019) (14, 12, 17, 19, 19, 36, 43, 33)	2% (2% 2019) (2, 5, 2, 2, 2, 2, 5, 12)	2% (0% 2019) (0, 0, 0, 2, 0, 2, 7, 5)

Regional Basic Climatological Network (RBCN, includes the GSN above)

Region	No.	12 Monthly CLIMAT	6 - 11 Monthly CLIMAT	1 - 5 Monthly CLIMAT	0 Monthly CLIMAT
RA-I	723	17% (17% 2019) (22, 18, 23, 16, 17, 19, 13, 12)	20% (19% 2019) (15, 22, 17, 22, 20, 20, 23, 22)	4% (6% 2019) (4, 5, 8, 11, 8, 7, 12, 13)	60% (58% 2019) (59, 55, 52, 51, 55, 54, 52, 53)
RA-II	664	73% (71% 2019) (67, 77, 80, 73, 71, 73, 67, 57)	15% (19% 2019) (17, 14, 12, 17, 18, 15, 22, 30)	3% (2% 2019) (7, 1, 1, 2, 4, 4, 1, 2)	9% (8% 2019) (9, 8, 8, 8, 7, 8, 10, 11)
RA-III	298	67% (74% 2019) (57, 60, 64, 63, 73, 81, 73, 65)	8% (3% 2019) (15, 13, 22, 25, 14, 6, 15, 23)	2% (5% 2019) (1, 8, 1, 0, 1, 1, 1, 0)	23% (18% 2019) (27, 19, 13, 12, 12, 12, 11, 12)
RA-IV	337	70% (71% 2019) (75, 77, 80, 78, 78, 72, 67, 66)	17% (18% 2019) (10, 10, 8, 10, 11, 18, 18, 18)	3% (3% 2019) (4, 2, 2, 3, 3, 2, 2, 3)	10% (8% 2019) (11, 11, 10, 9, 8, 8, 13, 13)
RA-V	247	60% (55% 2019) (57, 60, 64, 63, 64, 59, 56, 50)	9% (13% 2019) (23, 19, 16, 18, 21, 17, 24, 34)	3% (4% 2019) (2, 4, 4, 4, 1, 9, 6, 3)	28% (28% 2019) (18, 17, 16, 15, 14, 15, 14, 13)
RA-VI	594	79% (84% 2019) (79, 85, 85, 79, 81, 77, 77, 74)	9% (5% 2019) (10, 5, 5, 12, 8, 13, 15, 18)	2% (3% 2019) (1, 1, 1, 1, 3, 3, 1, 1)	10% (8% 2019) (10, 9, 9, 7, 7, 7, 7, 7)

RA-I is the poorest performing region, with only 20% of stations meeting the minimum requirement, and 39% not providing any CLIMAT messages, this has not significantly changed, neither better or worse, over the last 10 years. 2020 has the worst performance statistics over the 10 years but this is possibly because of the COVID pandemic, which is known to have impacted manual observing stations.

For the RBCN network, which includes the GSN, the situation is even worse in RA-I with only 17% of stations meeting the minimum requirement. All regions show an increase in the percentage of stations with zero reports (RBCN versus GSN), suggesting that not all countries are sending CLIMAT messages for their RBCN stations, in addition to the GSN stations, this is particular significant for RA-I.

GCOS Upper Air Network (GUAN)

The following table is the 2020 summary for the GCOS Upper-Air Network (GUAN) monitoring against the GCOS minimum requirements (25 daily soundings to 30hPa per month) for each region, according to the monthly statistics provided by ECMWF. In brackets are the same statistics for 2011 to 2019. For 2013 to 2018 these are based on availability according to NCEP, and for 2011 to 2012 to NCEI.

Region	Number of GUAN stations	% meeting minimum GCOS requirements in 2020 (% for 2019, 2018, 2017, 2016, 2015, 2014, 2013, 2012 and 2011)
RA-I	23	30% (22%, 22%, 30%, 39%, 35%, 39%, 46%, 48%, 57%)
RA-II	38	84% (87%, 87%, 89%, 87%, 87%, 87%, 87%, 87%, 87%)
RA-III	18	61% (72%, 72%, 61%, 61%, 67%, 72%, 67%, 89%, 78%)
RA-IV	24	96% (96%, 92%, 92%, 87%, 79%, 83%, 75%, 83%, 87%)
RA-V	38	79% (79%, 79%, 79%, 84%, 79%, 76%, 74%, 84%, 87%)
RA-VI	24	87% (92%, 87%, 87%, 87%, 87%, 87%, 83%, 92%, 87%)
Antarctica	12	50% (67%, 67%, 67%, 58%, 67%, 58%, 58%, 83%, 83%)

Twelve (12) of the GUAN stations (7%) were 'Silent' (zero reported TEMP observations) during 2020, same as in 2019, which is the highest since this monitoring was started in 2011. In 2018 and 2017 it was eleven (11), 2016 and 2015 it was seven (7), 2014 and 2013 it was three (3), four (4) in 2012 and five (5) in 2011.

The key points for each region are as follows:

In Region I, only 30% of the GUAN stations have met the minimum requirement for 2020, which was an improvement on the previous 2 years (22% in 2019 and 2018). This continues, by some margin, to be the worst performing region, with this very poor performance mainly associated with the necessary funding required to operate and maintain an upper-air station. Communication with the station at a technical level to establish the cause of the poor performance continues to be a challenge and often means that relatively simple issues can go unaddressed for long periods of time. In addition, there are an increasing number of stations that have problems and failures with their hydrogen generator systems which has resulted in a period of long-term inactivity. Five (5) stations were in-active during the period; Vacoas, Mauritius (Radiosonde consumables); Khartoum, Sudan (Hydrogen system); Addis Ababa, Ethiopia (Unknown); Dar es Salaam, Tanzania (Hydrogen system) and Harare, Zimbabwe (Unknown). A further ten (10) stations had at least 1 month with zero reported TEMP observations; 61052; 61641; 63741; 63985; 64910; 65578; 68110; 68592; 68906 and 68994.

The performance in Region II in 2020 was similar to that for the previous years, with six (6) stations not meeting the minimum requirement. No stations were completely in-active during the period, although the station in Pakistan (41780) is only launching PILOT balloons and with no TEMP soundings for 10 years, it is not meeting the GUAN requirements. One Russian station (20674 Ostrov Dikson) and one Thailand station (48453 Bangna) had lengthy periods of inactivity owing to radiosonde supply issues and the Maldives station at Gan (43599) had a lengthy outage of its hydrogen system.

The performance in Region III in 2020 (61%) has deteriorated when compared to the previous two years (72%). Two (2) stations were in-active during the period; 82397 Fortaleza, Brazil

(Unknown) and 84008 San Cristobal, Ecuador (Radiosonde supply and Hydrogen system). A further 5 stations did not meet the minimum requirement.

The performance in Region IV in 2020 was the same as in 2019, with only 1 station not meeting the minimum requirement (78762 Juan Santamaria, Costa Rica). No stations were completely in-active during the period but three (3) stations, 70026, 78988 and 8001, had at least 1 month with zero reported TEMP observations.

Region V was the same as for the previous 3 years, with 8 stations not meeting the minimum requirement. Five (5) stations were completely in-active during the period, Honiara, Solomon Islands; Vanuatu, Bauerfield; Rarotonga, Cook Islands; Port Moresby, PNG and Brunei, Brunei Darussalam, all due to having no radiosonde consumables. Four (4) stations, 91334; 91610; 94461 and 94995, had at least 1 month with zero reported TEMP observations.

The performance in Region VI in 2020 was a slight deterioration for 2019 but the same as the 5 years previous to 2019, with 3 stations not meeting the minimum requirement. Two (2) stations, 37789 and 40265, had at least 1 month with zero reported TEMP observations.

The performance in the Antarctica region in 2020 (50%) was a deterioration to that of the previous 3 years, with 7 stations not meeting the minimum requirement. One (1) station was completely in-active during the period; 89512 Novolazaravskaja (Russian Federation). Halley Bay (89022) had an extensive period of inactivity owing to the station needing relocating for safety reasons. Base Marambio (89055) has very few observations each month.

GUAN TEMP message reporting

Of the 164 GUAN stations which reported a TEMP message in 2020:

- 72% (118) reported either a low/high resolution BUFR message.
- 16% (26) not reporting BUFR (i.e. TAC only)
- 12% (19) only reporting BUFR

The GCM is the system improvement and resource mobilization activity of the GCOS programme. It has been established following a decision by the UNFCCC SBSTA in 2004 (UNFCCC Decision 5/CP.5) in order "to enable developing countries to collect, exchange, and utilize data on a continuing basis in pursuance of the UNFCCC". Since then, more than 3.5 million USD was raised to accomplish projects dedicated to improving climate observation systems. The following projects were completed in 2020, or are still on-going:

- Replacement stock of radiosondes and balloons have been delivered to Armenia and the Maldives during the period, along with emergency spare parts for the Hydrogen Generator at Gan (Maldives). Project work has been limited by the available funds in the GCOS Cooperation Mechanism (GCM) which in 2020 was only received from Japan in support of Gan and Yerevan.
- During 2020, and continuing in 2021, work has continued in support of the UAS in Kenya and Tanzania through the HIGHWAY project. Significant delays in the implementation of the UAS at Dar Es Salaam airport were encountered as a result of the COVID pandemic. Regular monthly meetings with the HIGHWAY project team and the country focal points to present progress and discuss any issues. Additional radiosondes and balloons to support the operations of Nairobi were successfully delivered to KMD in Nov 2020. All consignments for the Dar Es Salaam UAS were finally delivered to KMD in Jan & Feb 2021. Further work has been put on hold as engineers from France are not able to travel to Tanzania at the

moment due to COVID restrictions. Installation and training will take place as soon as it is possible, and safe, for engineers to travel. The HIGHWAY project will formally close at the end of March 2021 and all reporting/accounting from GCOS to the project has now been completed. Ongoing work is expected to be supported through the GCOS Cooperation Mechanism.

VI. GCOS Publications (Author or Co-author or contributor):

GCOS, 237. Report of the Twelfth GCOS Reference Upper Air Network Implementation Coordination Meeting (GRUAN ICM-12)
