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**MINUTES OF THE WORKING MEETING FOR
GCOS REFERENCE UPPER AIR NETWORK (GRUAN)**

Geneva, Switzerland

18 November 2015

GCOS-197

UNITED NATIONS
ENVIRONMENT
PROGRAMME

INTERNATIONAL COUNCIL
FOR SCIENCE

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Outcome of the GRUAN Science Day

It was agreed that the GRUAN Science Day was useful and should be repeated, at least biennially.

ACTION 1: GRUAN Science Meeting should be held on a regular basis (at least biennially), possibly based on a WMO Technical Commission meeting. (D/GCOS with AOPC chairs).

ACTION 2: GRUAN to submit an abstract to the GCOS Science Conference (Deadline 15 Dec).

GRUAN and WIGOS

The internal GRUAN communications work well. However, the linkages between GRUAN and various parts of WMO are not working as well as they could or should do if benefits of GRUAN are to be realised. It was agreed that, while it would be difficult to get representatives from the four relevant WMO Commissions (CBS, CIMO, CCI and CAS) to come to the ICM, meeting with them at their relevant meetings in Geneva (or elsewhere) may work well to build links.

It was further noted that GRUAN was a WIGOS pilot project and that many of the GRUAN activities should be used as working examples for WIGOS. It was agreed that GRUAN should be represented at meetings of the relevant WMO commissions (these happen every 4 years), with the aim to strengthen the external relations with the WMO community.

ACTION 3: GRUAN to be presented at the WMO Technical Commissions: try to organize a side event at the upcoming CIMO TECO in Madrid, 26-30 September 2016. (Tim to liaise with Roger / Isabelle).

The experiences of developing and operating GRUAN can contribute to the WIGOS guide that is being developed with its 1st edition due in mid 2016. Initially this would only refer to the GRUAN guidance but as the WIGOS guide is developed in the future, GRUAN material could be directly incorporated.

There is a need to incorporate the philosophy behind GRUAN into other WIGOS networks – the tiered system of systems approach with a reference network of high quality, traceable measurements, with a known uncertainty together with baseline and comprehensive networks of sites of lower quality. It was also noted that there is not a uniform usage, or understanding, of the network descriptions reference, baseline and comprehensive.

The EU Horizon 2020 project GAIA-CLIM has produced a document on tiered system of systems approach that can be used by AOPC/GCOS as basis of future plans around the tiered system of systems approach. (This document will be finalised at end of November 2015). It was agreed that this should be presented at the next ICG-WIGOS in January 2016, as the agenda for this meeting is still being finalized.

ACTION 4: GRUAN will prepare a paper on “Tiered System of Systems approach” to be submitted to WIGOS, as a GCOS contribution to WIGOS. (Peter – lead. Time: draft will be available by end of 2015).

ACTION 5: Concept of Tiered System of Systems approach to be discussed at ICG-WIGOS, using paper, see above. (submitted by GCOS to ICG-WIGOS, D/GCOS – lead, Luis to ensure that the paper is on the agenda of ICG-WIGOS).

As part of The EU Horizon 2020 project GAIA-CLIM, CNR(Italy) is also planning to generate metadata for all sites in the GRUAN, TCCON, NDACC networks (amongst others), which will comply with the WIGOS metadata standard. To make maximum use of this its needs to be incorporated into OSCAR.

ACTION 6: EU H2020 project Gaia-Clim is generating meta data (WIGOS standard) for tiered networks by Sept 2016. The project output should be considered as a contribution to WIGOS. (Tim to work with WIGOS (Luis) to incorporate the meta data into OSCAR, GCOS Document to ICG-WIGOS would report on this).

There are good links between GRUAN and AOPC: GRUAN is represented at AOPC and the GCOS Secretariat has represented AOPC at the GRUAN ICM. However, engagement from the wider WMO Secretariat has been somewhat ad-hoc in recent years.

ACTION 7: GCOS to facilitate WMO programme attendance at GRUAN ICM-8. Currently Carolin will be present for one day, but WMO representation will be required on a sustained base. (Carolin to discuss with D/OBS).

GRUAN would like to cooperate better with WMO and WIGOS. The possibility of GRUAN being recognised as a network by CBS was raised. This would raise the profile of GRUAN and may help NHMSs fund sites if they are part of an official WMO network.

ACTION 8: D/GCOS to discuss with WMO/OSD on CBS recognition of GRUAN as a network.

GRUAN can help WIGOS, especially with their experience in checking in near real-time the quality of all stations, both ground and upper air. GRUAN is developing tools to help countries assess their performance as a contributor to the reference network but it is possible that these tools can also be used to assess both the baseline (GUAN) and the comprehensive networks.

GRUAN should become a centre of knowledge of radiosondes systems, operations and measurement quality, as they have amassed a significant body of knowledge, methods and approaches that could be usefully disseminated more widely. These could also contribute to the CIMO guide, as this is recognised as the 'official' source of information by many NHMSs.

ACTION 9: Encourage the Lead Centre as part of the redesign of the GRUAN website at DWD to include all relevant documentation for public access. (GCOS and Lead Centre).

ACTION 10: GRUAN has developed a number of measurement and processing procedures which need to be recognized by CIMO and CBS and included into the relevant manuals. (GRUAN to inform D/GCOS, GCOS to forward this information to the CIMO editorial board; GRUAN to nominate to an expert to be included on the list of addressees if CIMO is updating the chapter of radiosondes).

GRUAN and other Networks

GRUAN is about both research and operations working together and it is an excellent example of this working successfully.

However, there are (potentially) reference quality networks that are not always talking to each other. It was agreed that there should be stronger links between the different high-quality networks dealing with upper air measurements (GRUAN, GUAN, GAW) using GRUAN as an example. The link

to GAW has not been well developed as the measurements are not GRUAN priority 1 but under priority 2 (ozonesondes) and 3 & 4 (GHGs). However, there are clear synergies between the 2 programmes. Presently there is no formal mechanism to encourage better collaboration of these networks (i.e. GRUAN, NDACC, TCCON etc.), but this is a key benefit from WIGOS as it can lead to reduction of duplication, efficiency gains, scientific improvements, and increase co-located measurements such that the column can be better characterised cross all ECVs. Potentially OSCAR/Surface could be used to identify suitable stations for collaboration. Focal points such as WMO PR, WIGOS FP, GCOS FP, GCOS Coordinator and GAW may be useful points of contact.

One action could be a paper to start a discussion on how to solve this. A second issue is how this should inform similar issues on comprehensive/ baseline networks through WIGOS.

ACTION 11: GRUAN and GAW working closer together (GAW (Geir) to work with GRUAN (Greg) on potential candidate sites, starting at the working level). Geir will investigate the possibility of GRUAN representation on GAW-Ozone SAG.

ACTION 12: Paper on collaboration of different networks, GRUAN, SHADOZ, NDACC, TCCON, and GAW, to be led by Peter and Greg, to stimulate discussions among the networks (submission deadline is Dec 2016). Proposed that this would be a future contribution to WIGOS.

GRUAN and Change Management

There was a discussion on how the GRUAN experience in changing radiosondes (from RS92 to another sonde (both RS41 and others)) and monitoring the change be used to inform GUAN. There will be intensive inter-comparison (for 2 years) at some GRUAN sites that will be used to inform nearby sites, but this leaves the southern hemisphere areas with no GRUAN sites (Africa and South America). A GRUAN strategy is being developed and GRUAN needs to consider how this can help GUAN.

It was agreed that drafting a two-page document on how to manage a change of equipment based around the replacement of RS92 radiosondes would help GUAN operators. This should include options in increasing complexity on doing practical and affordable inter-comparisons. Options could include alternating old and new equipment for a year, dual soundings for short periods of inter-comparisons, sampling all seasons, etc. Options should be scientifically justifiable. This advice needs to cover the range of potential replacement equipment and not be restricted to one type. The advice should include that if a nearby GRUAN site is doing this inter-comparison then there may well be no need for the local GUAN site to repeat the process. This would show how GCOS managing a global nested observing system – GRUAN and GUAN – adds value.

ACTION 13: Draft a two-page document on change management on the replacement of RS92. This should include options increasing complexity. GRUAN will draft a straw man proposal. Tim will consider this from a GUAN perspective and circulate it to a wider community. AOPC will be asked to endorse the proposal in April 2016.

GRUAN Support for Satellite Calibration and Validation

While there are clear links to the Satellite community they are not well understood or considered outside of this community. Benefits include funding and improved collaboration (i.e. co-located soundings & overpasses).

However, it is difficult to launch radiosondes close to satellite overpass time for operations and data continuity reasons. In most cases there would need to be funding for additional launches. Also validation plans for satellites are sometimes very ad hoc.

Identifying sites that can do extra flights for free, those that could do extra flights for a specified fee and those that cannot perform any extra flights would be very helpful. This information could go to CEOS as a GRUAN input into satellite cal/val.

ACTION 14: Greg to draft a paper on the possibility of stations providing extra flights when a satellite overpasses. Carolin to submit to CEOS WG Cal/Val.

GUAN Sites

There was a brief discussion on some issues arising from the ISPRA network meeting around what exactly a GUAN site is. If a site does not report for many years should it still be considered a GUAN site? Should GUAN site have to meet any requirements, annual reporting etc.?

ACTION 15: Tim to propose a list of stations to be removed from GUAN and to discuss the process at AOPC.

List of Participants

BODEKER Gregory, Alexandra, New Zealand – Co-chair of GRUAN Management Group

DIRKSEN Rudijeroen, Lindeberg, Germany – Head GRUAN Lead Centre

KLEIN TANK Albertus, Ae De Dilt, The Netherlands – Vice-chair, AOPC

THORNE Peter, Ireland – Co-chair of GRUAN Management Group

RICHTER Carolin, WMO – Director, GCOS Secretariat

OAKLEY Timothy, Exeter, United Kingdom – GCOS Network Manager

EGGLESTON Simon, WMO – GCOS Scientific Officer, Terrestrial Observation Panel for Climate

BRAATHEN Geir, WMO – Senior Scientific Officer, Atmospheric Environment Research Division

NUNES Luis, WMO – WIGOS Scientific Officer