The Global Observing System for Climate

GCOS Upper Air Network (GUAN) Radiosonde Observations Past, Present and Future

CIMO-TECO-2018
Amsterdam, The Netherlands

GCOS Secretariat, WMO
Tim Oakley, GCOS Network Manager
The vision of GCOS is that all users have access to the climate observations, data records and information which they require to address pressing climate-related concerns. GCOS users include individuals, national and international organizations, institutions and agencies.

The role of GCOS is to work with partners to ensure the sustained provision of reliable physical, chemical and biological observations and data records for the total climate system – across the atmospheric, oceanic and terrestrial domains, including hydrological and carbon cycles and the cryosphere.
GCOS Progress: Improving global climate observations

Support Adaptation & Mitigation

Water, Energy and Carbon cycles

Additional Essential Climate Variables

More help for networks in developing countries

Climate Indicators

2015

2016

2017

United nations conference on climate change COP21/CMP11

ECV Inventory: The Architecture for Climate Monitoring from Space in Action

First Regional workshop held in Fiji for Pacific Island States

Working group in Lightning starts work

Working group on GCOS Reference Surface Network meets for first time

Weather radar data for climate

Review of ocean observing systems
The value of radiosonde measurements

- Most data providers and users still understand and value the radiosonde measurements.
- 800 + stations globally providing between 1 – 4 soundings per day.
  (NCEP monitoring: 1250 daily soundings; 460,000 per year; 60 million $usd consumables)
- GCOS Status Report 2015 – “To date, no new system has proved to be competitive with the radiosonde system with regards to accuracy, vertical resolution/range and consistency. They also provide main meteorological variables (temperature, wind and humidity) all together.”
- Global NWP - “Isolated radiosondes are individually much more valuable and bring much more benefit to forecast quality than observations in a dense network (benefit per station that is!)”
- Global Basic Observing Network (GBON) meeting (2018) documented the significant value of radiosonde observations for both Global NWP and Climate monitoring, and proposed text for WMO Congress 2019 reinforces the need for radiosonde measurements: - 500 km, 12-hourly
  - vertical resolution - 100 m or better
  - top - 30 hPa or better
Note the very significant effect of in-situ wind observations: Radiosondes and Commercial Aircraft

SOURCE: Langland et al.; from 5th WMO Impact Workshop, Sedona 2012
GCOS Upper-Air Network was designed and implemented more than 20 years ago.

The scope of the GUAN is a global network with the spacing set at 5 to 10 degrees latitude, sufficient to resolve synoptic-scale waves. The desired parameters are temperature, pressure (geopotential height), wind, and humidity (at least in the troposphere). The inclusion criteria are:
- Commitment by NMHSs with regard to continuity;
- Length and quality of historical time series;
- Current measurement quality.

The purposes of the GUAN are the following:
- To establish national commitments for the preservation of a minimum set of upper-air stations for the foreseeable future;
- To build a collection of validated data from these stations in standardized formats;
- To provide this information to the global climate community with no formal restrictions.
GCOS Upper-Air Network (GUAN) - 177
Performance Report of the GUAN

The following table is the 2017 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 NCEP. In brackets are the same statistics for 2016, 2015, 2014, 2013, 2012 and 2011. For 2012 and 2011 these are based on availability according to NCEI.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>RA-I</td>
<td>23</td>
<td>30% (39%, 35%, 39%, 46%, 48%, 57%)</td>
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<tr>
<td>RA-II</td>
<td>38</td>
<td>89% (87%, 87%, 87%, 87%, 87%, 87%)</td>
</tr>
<tr>
<td>RA-III</td>
<td>18</td>
<td>61% (61%, 67%, 72%, 67%, 89%, 78%)</td>
</tr>
<tr>
<td>RA-IV</td>
<td>24</td>
<td>92% (87%, 79%, 83%, 75%, 83%, 87%)</td>
</tr>
<tr>
<td>RA-V</td>
<td>38</td>
<td>79% (84%, 79%, 76%, 74%, 84%, 87%)</td>
</tr>
<tr>
<td>RA-VI</td>
<td>24</td>
<td>87% (87%, 87%, 87%, 83%, 92%, 87%)</td>
</tr>
<tr>
<td>ANTON</td>
<td>12</td>
<td>67% (58%, 67%, 58%, 58%, 83%, 83%)</td>
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Eleven (11) of the GUAN stations (6%) were ‘Silent’ (zero reported TEMP observations) during 2017, which is the highest since this monitoring was started in 2011. In 2016 and 2015 it was seven (7), 2014 and 2013 it was three, four (4) in 2012 and five (5) in 2011.
GUAN STATIONS Sep 2018
Frequency of Reception data at ECMWF
Level: 100 hPa Temperature SUMMARY 00/12 UTC

% of received data

170°W 160°W 150°W 140°W 130°W 120°W 110°W 100°W 90°W 80°W 60°W 40°W 30°W 20°W 10°W 0°W 10°E 20°E 30°E 40°E 50°E 60°E 70°E 80°E 90°E 100°E 110°E 120°E 130°E 140°E 150°E 160°E 170°E

0-0
1-15
15-25
25-100
Why do we need to review the GUAN?

• Network now 20+ years old
• Significant changes in both technology and data users
• GUAN often cited as being of little difference from the comprehensive network
• Requirements more explicit on the needs and benefit of high quality data, demanding a stronger governance on data availability, timeliness, accuracy
• Operators (Mainly WMO Members) have forgotten their commitment
• Increasing pressure on resources
• 2014 GCOS network review meeting recommended an updated, more proactively managed network
• Operational monitoring, Tiered networks and programmes such as GAIA-CLIM have highlighted the weaknesses in the current system
Membership

Chair (If no suitable candidate, agreed on a meeting by meeting basis)
AOPC Expert – Peter Thorne (peter.thorne@nuim.ie) – Maynooth University (Ireland)
GRUAN Expert – Richard Querel (Richard.Querel@niwa.co.nz) – NIWA (New Zealand)
NWP Expert – Bruce Ingleby (bruce.ingleby@ecmwf.int) – ECMWF (UK)
CBS/National Expert – Hiram Escabi (hiram.escabi@noaa.gov) – NWS (USA)
Satellite Expert – Marc Schroeder (Marc.Schroeder@dwd.de) – DWD (Germany)
National Expert – (Large GUAN contribution – China, Japan, Russia?)
GCOS Network Manager (Secretariat support) – Tim Oakley (toakley@wmo.int) (UK)
GCOS AOPC SO (Secretariat support) – Caterina Tassone (ctassone@wmo.int) (Switzerland)
CIMO expert team on upper air systems representative – Later meeting, if required
HMEI Observer – Later meeting, if required
### ANNEX 4: SWOT ANALYSIS FOR GUAN (SUMMARY FROM MEETING)

<table>
<thead>
<tr>
<th><strong>Strengths</strong></th>
<th><strong>Weaknesses</strong></th>
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<tr>
<td>GUAN is a well known brand. It is regarded as high-quality Radiosonde observations. (even if this is only a perception) Common practices and an underpinning standard. Has documented governance through WMO technical regulations and GCOS documents.</td>
<td>The aims, requirements and user needs of GUAN are not known and/or have just been forgotten. No NMHS ‘buy-in’. Passive not Active management (i.e. poor performance is not addressed) Little difference between GUAN and the Comprehensive network No auditing of GUAN and little outreach between GUAN operators Requirements and guidance has not been updated to reflect the change in technology and user needs</td>
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<th><strong>Opportunities</strong></th>
<th><strong>Threats</strong></th>
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<td>GUAN best practices and outreach can support the comprehensive network Utilised improved tools for Quality Management &amp; Visualisation Healthy competition in industry for the prestige of supplying GUAN stations Better alignment of GRAUAN and GUAN, for example GRUAN products from GUAN stations.</td>
<td>Budget cuts and resource priorities are often targeted at radiosonde system consumables The pollution aspect of radiosondes Lack of clarity on the difference between GRUAN and GUAN might cause competition for resources</td>
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Continuing under its current requirements is not the best option

- New focus on a guaranteed quality of observational data, according to updated requirements
- A subset of the comprehensive network based on quality assurance rather than a fixed network of stations. Adopting a tiered-network approach (Comprehensive-GUAN-GRUAN), as described by GAIA-CLIM
- Actively managed through a lead-centre, with a certification process, real-time monitoring and validated station list for the user community
- Process to identify gaps in global/regional networks, both in data sparse areas and least develop countries, to allow targeted support projects, using relevant cooperation and funding mechanisms (i.e. GCM, GCF, national bi-lateral programmes).
ECMWF monitoring of GUAN (coding)
• Radiosonde measurements still have a significant, and ‘cost effective’, benefit for most WMO applications, notably NWP and Climate Monitoring.
• The Radiosonde technology has continued to be updated/improved in-line with user requirements, also minimising costs and impact on the environment.
• Whilst GUAN is more a CBS governed process, there are several important links to the work of CIMO; (1) Instrument and Methods uncertainty; (2) Specification and procurement; (3) role of a Baseline network in a Tiered network.
• The WMO/CIMO radiosonde intercomparison is a significant contributor to much of that above and with China 2010 being the most recent, the community is looking for the next intercomparison. (will be discussed at the CIMO session)
The Global Observing System for Climate

Thank you

gcos.wmo.int