

## Revitalization of the GCOS Surface and Upper Air Network Stations

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### Abstract

This paper presents an overview and status report of recent initiatives to revitalize the GCOS upper air and surface networks and to improve the overall performance of these important baseline networks. Almost 20 of the roughly 150 GCOS Upper Air network stations have received some benefit from these activities so far. The paper will also address the results of the first complete analysis of the GCOS surface network and describe the regional technical support projects that have been implemented to support the operation of GCOS stations.

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### Introduction:

The GCOS Surface (GSN) and Upper air networks (GUAN) were defined in the late 1990's as baseline networks chosen from existing stations in the Global Observing System. They were selected based on a number of criteria which included good geographic location and a long history of good performance. Theoretically the Permanent Representative from the host Meteorological Service agreed that the stations would operate according to the identified criteria for climate observing stations. By 2002 almost 40% of the GSN was reported "silent" by the monitoring center at DWD and nearly the same number of GUAN stations were reported "silent" by the monitoring center in the UK Hadley Center.

The US announced its Climate Change Research Initiative and funds were made available through the US GCOS Program Office to begin actions to improve the performance of these networks. A project manager/network analyst, called the GCOS Implementation Manager/Officer was hired and the Atmospheric Observing Panel for Climate (AOPC), one of the GCOS scientific advisory panels, was asked to prioritize revitalization efforts. First priority was given to the GUAN and 5 existing stations were identified as highest priority and then 5 stations were identified as important "additional" stations.

The 5 high priority stations were:

Nairobi, Kenya  
Lima, Peru  
Galapagos Island, Ecuador  
Easter Island, Chile  
Honiara, Solomon Islands

The 5 "additional" stations were:

Gan, Maldives  
Kananga, Democratic Republic of Congo  
Christmas Island, Kiribati  
Pointe Noire, Congo  
Dar es Salaam, Tanzania

## **GUAN Revitalization Projects:**

The first step of course was to try to determine the reason the stations were not operating. Not surprisingly, a number of predictable reasons were encountered. Telecommunications including routing issue were found and corrected. Some stations were misidentified and this was corrected. Further the monitoring center at the Hadley Center bases its performance reports on the monthly summary report called CLIMAT TEMP and many GUAN stations operate regularly but do not prepare this format report. As a result of these first investigations, several stations were “restored” to operation and a wide variety of additional performance monitoring tools and reports were implemented. Just to illustrate, 4 of the 5 high priority stations were or are now operating to some degree without any remedial action at the site. Nairobi, Lima, and Galapagos were telecommunications problems while Chile simply did not realize that Easter Island was so important to GCOS. When contacted, they immediately began a 2- soundings- per- day operation. Honiara is indeed still silent as civil war there has prevented any remedial action.

A process was designed that took into account the technical expertise found in the WWW department, the technical and procurement expertise within the Technical Cooperation Department, the specific needs of the station, the priority of the donor as well as that of the AOPC, and whatever other cooperating WMO member countries we could enlist to assist. To illustrate, we engaged the UK Met Office to conduct the site survey for the possible activation of a new station at Gan, Maldives. The GCOS Implementation Manager conducted the site survey at Dar es Salaam, and the New Zealand Met Service was engaged to visit Honiara. Following the site surveys, detailed projects could be formulated. As a result, a WMO purchase order was issued to the UK Met Office for the implementation of the equipment at Gan. Competitive requests for tender were issued by the WMO for hydrogen generators and equipment for Dar es Salaam.

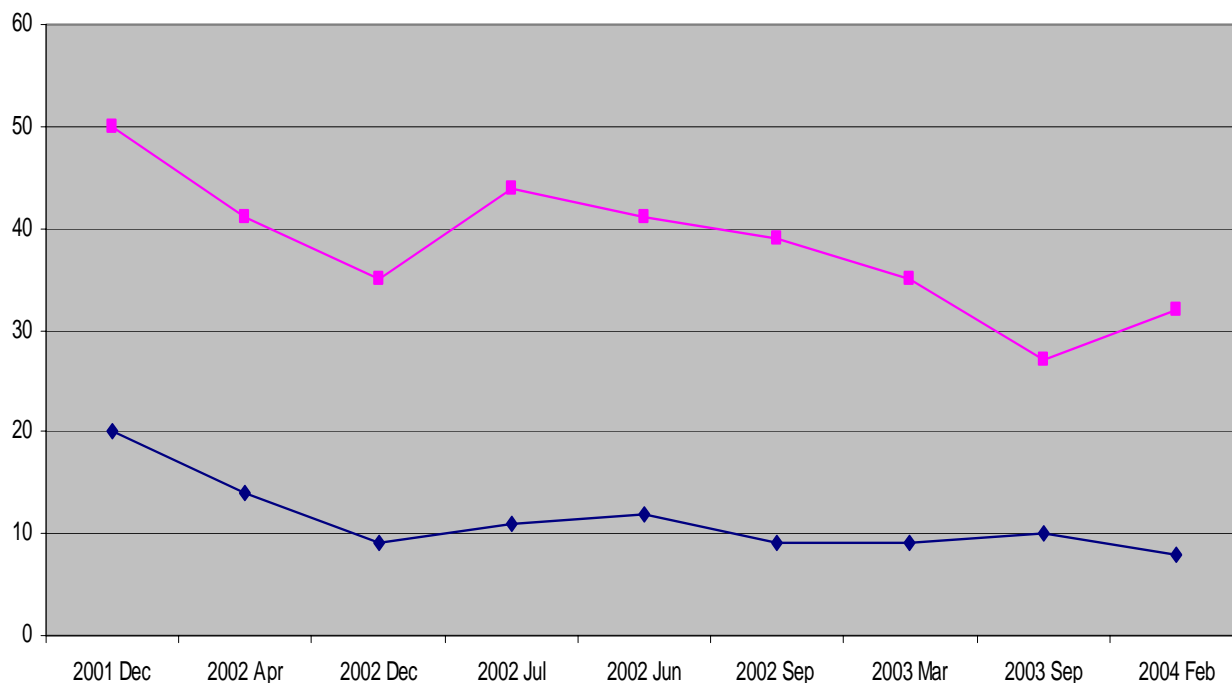
A major source of operational problems with GUAN stations is the high operating cost. Poorer countries simply cannot not afford expensive GPS radiosondes. We concluded that whenever possible we should implement radio direction finding (RDF) upper air systems. Further, as part of the initial remedial action projects, radiosondes were supplied to several stations. Several stations were found to be “silent” simply because they could not afford to purchase radiosondes. Our priorities were to get as many stations as possible up to minimum operational standards of one sounding per day. Five stations that needed nothing else were provided a year’s supply of radiosondes and balloons to restart their operation.

Another common problem was found to be the condition and age of the hydrogen generators. Many units are near the end of their useful life and are becoming difficult to maintain. Several stations were identified to receive new generators before their operation was effected.

In the first round of revitalizations, two new stations, Gan, Maldives and Dar es Salaam, Tanzania were activated and added to the GUAN. Five stations were restarted through the provision of radiosondes and balloons and two stations, Penrhyn Island and Galapagos Island received substantial equipment up-grades and renovations. Four other stations received replacement hydrogen generators. Through the analysis of station performance and direct interaction with operating staff, many other stations were returned to the “active” status.

In the second round, not yet completed, additional stations will receive generators and radiosondes while three stations, Windhoek, Namibia; Harare, Zimbabwe; and Yerevan, Armenia will receive major equipment replacements. Site surveys are also being done to prepare project plans for future years.

GUAN Poor and Silent  
 Silent=Blue  
 Poor=Red



As shown in the above chart the number of problem stations have been reduced. As this report is written, there were 7 truly silent stations at the end of 2004 and 21, including the 7 silent stations that were not meeting minimum performance specifications.

### GSN Revitalization Projects:

Thus far the priority of funding has been directed towards the upper air network (GUAN) but substantial effort has been devoted to the analysis of the surface network (GSN). The GSN is much larger with approximately 1000 stations and the problems are much different. Whereas the operating cost is a major factor with the GUAN, the GSN performance suffers for different reasons. The monthly CLIMAT report from GSN stations is considered a mandatory requirement and over 20% of the stations currently do not prepare and send these reports. Also a substantial number, more than 50% of the stations, have not provided the historical data to the world archive center. Both of these problems must be resolved before station specific revitalization can begin.

### Performance of the GSN

	<b>Number Stations</b>	<b>Number of Silent Stations</b>	<b>Number of No CLIMAT</b>	<b>Poor</b>	<b>CLIMAT Only</b>
Reg 1	155	16	48	13	1
Reg 2	248	14	63	0	6
Reg 3	119	18	20	0	15
Reg 4	156	4	21	0	0
Reg 5	153	8	29	2	3
Reg 6	118	3	21	1	9
Reg 7	32	2	12	2	0
<b>Total</b>	<b>981</b>	65 (6.6%)	214 (21.8%)	18 (1.8%)	34 (3.5%)

As illustrated in the above chart most GSN stations are actually operating. For this analysis “poor” was defined as fewer than 30 synoptic reports per month.

To address the CLIMAT reports, the GCOS Secretariat has worked closely with the World Weather Watch and the World Climate Program of the WMO to develop a handbook on the preparation of CLIMAT and CLIMAT TEMP reports and then a computer program that may be used to automatically prepare these reports. A series of workshops teaching both the handbook and the use of the software has already started with the first held in Russia in late 2004. Also an informal training session has been conducted in Australia and the next in the workshop series is scheduled for Cairo in the first quarter of 2005.

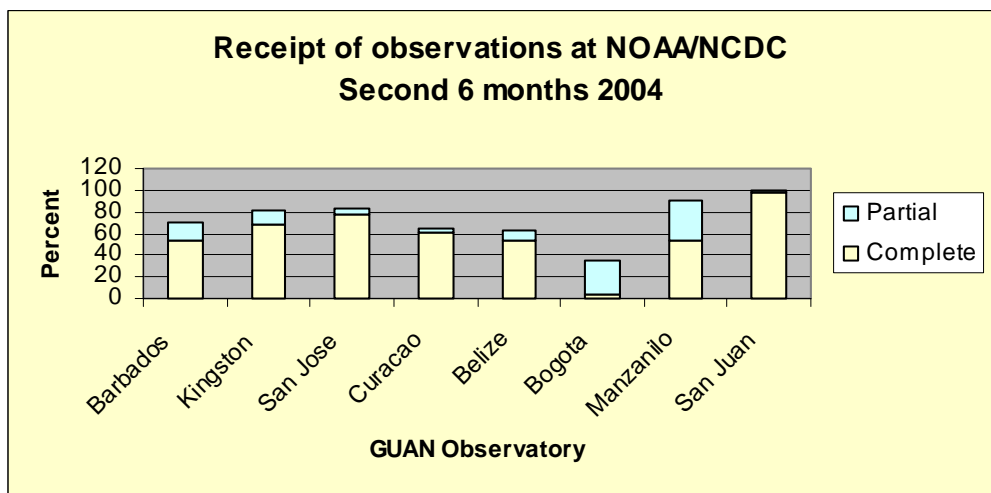
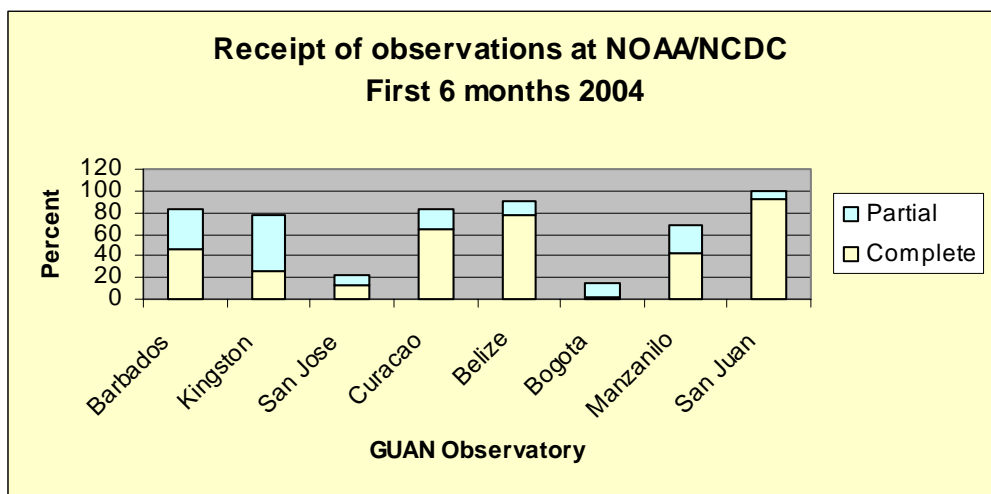
Despite being a criterion for inclusion into the GCOS baseline networks, many countries have not yet provided the historical data for inclusion into the world archive at National Climatic data Center (NCDC) in Asheville, USA. Historical data for less than half of the GSN is currently available. Substantial effort has been placed on direct contact with the member country by both the Archive center staff and the GCOS Implementation Manager. National GCOS focal points were requested by the Secretary-General of the WMO and almost all members have identified someone. These focal points provide at least a starting point for contacting someone in the country. Some progress has been made but it is not sufficient. In some cases the data must be rescued from its current state and in some cases the member country simply does not agree to share the data. It is likely that a greater emphasis through the WMO will be needed to resolve this dilemma.

#### **Regional Technical Support Projects (TSP):**

The GCOS Secretariat also received funding for the establishment of regional GCOS technical support projects in the Pacific, Caribbean, and in Africa. The support centers are to directly support the GUAN and GSN stations within their designated area. Site visits are required as is careful monitoring of the performance of stations. The site visits will include documentary photographs and station location information will be verified through the use of a GPS system. Countries within the region that need assistance will be addressed as a first priority.

The New Zealand Met Service was chosen to implement the project in the Pacific while a private company was selected for the Caribbean. The SADC part of Africa was identified as a reasonable sized area and a contract should be awarded soon. These initial projects are for one year’s duration

but certainly it is hoped that funding will be available to continue these and to add others. Initial results are an improvement in reporting frequency, an increase in the CLIMAT and CLIMAT TEMP reports, and a sharing of spare parts and technical expertise.



The above pair of charts shows the improvement in GUAN performance in the Caribbean during the first 6 months operation of the TSP there. Similar improvement is reported by the Pacific TSP. Note that San Juan is operated by the US and is not included in the scope of this TSP.

**GCOS Cooperation Mechanism:**

A GCOS Cooperation Mechanism (GCM) has been established to allow contributions from WMO members as well as any Non Government Organizations (NGO) to be applied to network revitalization. Initially several members, including the UK, Australia, US, China, and India attended the inaugural organization meeting and terms of reference have been drafted. A donor may contribute to a project of their choice or to a general fund which will be prioritized by the GCM. Donors may also contribute in non financial ways such as providing material or human resources. It is hoped that the GCM could provide the mechanism and means to address some of the more difficult data sparse areas of the globe where there is insufficient infrastructure at present to expect the host meteorological service to maintain operation.