

# IMPROVING CONDITIONS

## The Global Climate Observing System (GCOS)

The World Meteorological Organization is working in developing countries to improve atmospheric observations for climate change research

**U**nderstanding climate change, how it may impact natural and human systems, and what can be done to mitigate its effects and adapt to them is one of the great challenges of the 21<sup>st</sup> century. Underlying all efforts to meet this challenge is the need for high-quality observations of the climate system on global, regional, and national scales.

Gaps exist in the observing networks that measure the 50 atmospheric, oceanic, and terrestrial variables (known as the essential climate variables or ECVs) in the developed and developing worlds. However, in the developing world the gaps and deficiencies in these networks are typically much more significant. It is important that the gaps in these networks are closed. On a global scale, improved climate observations will lead to better understanding, modeling, and prediction of the climate system. At regional and national scales, such enhancements are required to help, among other things, improve early warning of extreme events and design effective adaptation strategies.

### The organizations for observation

The need for a global climate-observing system was recognized as critical at the Second World Climate Conference in 1990. The Global Climate Observing System (GCOS) was subsequently established in 1992 to ensure that the observations and information needed to address climate-related issues are obtained and made available to all potential users. The GCOS, led by the World Meteorological Organization (WMO), is co-sponsored by the Intergovernmental Oceanographic Commission of UNESCO, United Nations Environment Programme, and International Council for Science.



The first radiosonde launch at Gan, Maldives

One important focus of the small GCOS Secretariat is the facilitation of improvements in climate observing systems in developing countries. The secretariat does this in part through what is known as the GCOS Cooperation Mechanism (GCM), which was launched with initial funding from several nations.

The GCM provides one means by which interested developed countries can contribute to the climate-observing needs of developing countries. It directly contributes to fulfilling the repeated calls of the Conference of the Parties to the UN framework convention on climate change to provide financial and technical support to developing countries to improve their climate-observing systems. Several countries are now making contributions to the trust fund established by the GCM.

Contributors, which include the USA, UK, the Netherlands, Switzerland, Spain, Canada, and Germany, may designate funds for specific purposes or may allow the GCM Board to allocate the funds according to priority needs. The funds are used to renovate observing stations (which, in some cases, have been silent for years), to provide technical support and maintenance, and to organize technical training courses. Funds have been limited, so it has been necessary to concentrate on the highest-priority global-scale needs.

So far the GCM has addressed needs mainly in the atmospheric domain; however, in future the needs in the oceanic and terrestrial domains will also be considered.

An implementation manager has been hired who, among his other duties, maintains a prioritized list of scientifically

“Purchases are made through the international competitive procurement process of the WMO”



**Above: The remote Aragats Observatory**  
**Right: The hard way to Aragats High Mountain Station**



vetted projects that require funding. For atmospheric-domain projects the list is determined by the GCOS Atmospheric Observation Panel for Climate; however, a donor country can opt to support any project it chooses. The implementation manager provides feedback to the donor representative as the project progresses.

In the first few years after the creation of the GCM, the GCOS Secretariat focused its efforts on making needed improvements in developing countries to the GCOS Surface Network (GSN) and GCOS Upper Air Network (GUAN), both of which are subsets of the weather station networks operated by

national meteorological services. The stations in these networks were selected to meet GCOS climate-observing requirements based on their geographic spacing as well as on the length and quality of their long-term records.

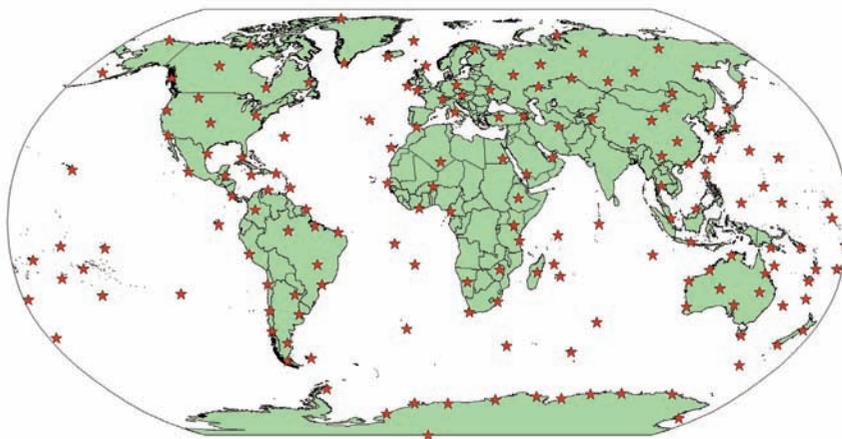
This focus was necessary partly because by early 2001 the GSN and GUAN were in need of performance improvements according to the annual reports prepared by WMO. In fact the performance of many stations had been deteriorating. At that time more than 25 of the 150 stations in the GUAN were silent, and nearly 30% of the stations in the GSN were not reporting according to WMO standards.

Early initiatives to correct this situation were a project to provide some initial funding that was sponsored by the US GCOS Program and a proposal by the GCOS Atmospheric Observation Panel for Climate to identify the five most important silent GUAN stations and the five locations where additional observations were needed.

**The GCOS upper-air network**

Initially the GUAN stations were given a higher priority by the Atmospheric Observation Panel for Climate. Many stations around the world had ceased operation, either due to the high cost of radiosondes (some were costing as much as US\$200 each) and/or because the hydrogen generators had failed. Hydrogen is often used as the inflation gas, and hydrogen generators at most stations were nearly 30 years old. The company that originally made them is out of business, and replacement parts are no longer available.

The typical renovation of an upper-air station is the replacement of the generator and usually of the upper-air system itself, along with a year's supply of radiosondes and balloons. Usually the supplying company is tasked with installing the equipment and providing the necessary training to local staff. Purchases are made through the international competitive procurement process of the WMO, following the regulations of the United Nations system. The first two station renovations took place at Gan, located in



**The GCOS Upper Air Network**



**Above: The 12Z upper-air launch at San Cristobal, Galapagos Islands, Ecuador**  
**Below: The implementation project manager with the observing staff**



**Right: To Bjelasnica by helicopter**  
**Above: Instrument screen at Bjelasnica**

the southernmost part of the Maldives, and at Dar es Salaam, Tanzania, both of which had been identified as important additions to the GUAN. These projects also established the methods used by GCOS to implement the projects. The UK Met Office agreed to manage the Gan project, and the Dar es Salaam project was managed by the GCOS Implementation Manager.

The purchases of hydrogen generators and balloons needed at both stations were undertaken through UN procurement procedures, and the upper-air equipment and radiosondes were installed by the UK Met Office for Gan and by the implementation manager for Dar es Salaam. The UK Met Office has continued to cooperate extensively with GCOS.

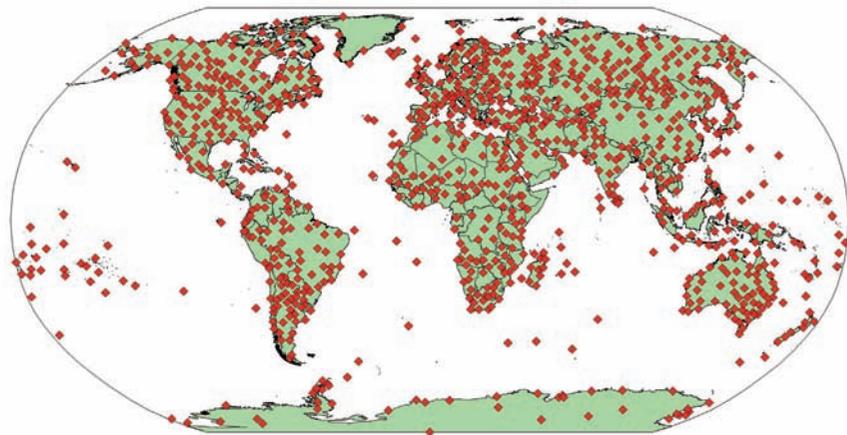
Another upper-air station that has received substantial support is the station at San Cristobal, Galapagos Islands, Ecuador, because of its important location and its long history of observations.

Since that beginning in 2001 when 20 of the GUAN stations were silent, almost all of them have been put back into operation. None are incapable of operating; some may be silent because they lack the ability to purchase expendables such as radiosondes. Given that a one-year supply of upper-air expendables can cost nearly US\$80,000, developed countries are hard pressed to contribute sufficient funding for operating these stations on a sustainable basis.



## The GCOS surface network

Surface observing stations also require attention in order to maintain operations. Following the initial higher priority placed on the upper-air stations, several important GSN stations were renovated. One of the first to be addressed was the mountain-top observatory at Bjelasnica, just outside Sarajevo in Bosnia-Herzegovina. This observatory sits atop a mountain that experiences extreme winter icing conditions. The building itself was severely damaged by artillery during the Bosnian



**The GCOS Surface Network**



conflict and again when it was occupied by UN peacekeeping troops.

In order to renovate this station local construction contracts were needed. Several local companies prepared bids, which were sent to WMO, and a contract was awarded for the repair of the exterior of the building. A similar contract was awarded for the renovation of the interior, including a water storage system. Because the observers must remain on station for several weeks at a time during the winter, it is important to have a safe facility. Most of the actual instruments had been stored by the meteorological service during the conflict, so the station was quickly returned to operation.

Since the renovation of the Bjelasnica Station, several more surface stations have been revitalized. Usually, classic instruments have been replaced, but sometimes automatic weather systems or replacement sensors are needed. Stations in Moldova, Georgia, Armenia, Angola, Paraguay, and El Salvador have received assistance so far, and recently a project to renovate 11 stations in Madagascar has been initiated. Another station that has just received assistance is the mountain-top observatory at Aragats, Armenia. The building itself is currently being repaired. ■

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## ADDITIONAL USES FOR GCM FUNDING

GCOS has used other methods to improve the operation of important but neglected station networks. Technical training courses have been organized to train the operators to prepare their reports properly. A training course was organized in Windhoek, Namibia, for operators of all 18 Global Upper Air Networks stations in Africa.

The operators were taught correct upper-air observing techniques and hydrogen safety by a team of experts from the UK Met Office. Several centers around the world contribute by preparing occasional performance reports. These reports enable us to better keep an eye on trouble areas and to resolve problems with a minimum of delay, such as when reports are not received because of telecommunications problems.

GCM funds have also helped GCOS establish technical support projects, which enable provision of direct assistance to stations. The technical support project in the Pacific, funded by the US GCOS Program Office, is still in operation. Other technical support projects were established for limited periods in the Caribbean, the Americas, and Africa. Those responsible for each project made site visits to stations within their region of responsibility. During the site visit, the precise location of the station is determined using the global positioning system. In addition, photographs of the instruments and the surrounding area are taken and subsequently added to the metadata archive.

More recently, a WMO Commission for 'basic systems lead centers' for GCOS

have been established to assist with regional and language differences. There are nine such lead centers, each of which is responsible for the stations within a given region. Using various performance reports, each lead center interacts directly with the stations in the region and with the appropriate national meteorological service.

The result of all this activity has been a substantial improvement in the operation of the GUAN and GSN. All the GUAN stations are now capable of operating. For the GSN, around 60% of the required monthly CLIMAT reports were received in 2001. In 2010 over 90% of such reports were received.

Of course there is much to do. Upper-air and surface observations are needed from some areas of the world from which we do not receive them today. Improvements are also needed in oceanic and terrestrial networks. More complete and better coverage is needed in many places: it would be desirable to have available higher-quality observations traceable to WMO standards. And it is important to complete the meta database with data from all stations.

Although the GCOS Secretariat is small and the budget of the GCM is limited, the GCM has managed to make some resources available to aid in promoting sustainable climate observations. GCOS is beginning to make a difference in developing countries. There are many stations operating today that would not be doing so had it not been for the GCM and its station renovation activities.

