WORLD METEOROLOGICAL ORGANIZATION

Distr.: RESTRICTED
CBS/OPAG-IOS (ODRRGOS-4)/ Doc. 10
(23.I.2002)

COMMISSION FOR BASIC SYSTEMS
OPEN PROGRAMME AREA GROUP
ON INTEGRATED OBSERVING SYSTEMS

ITEM: 10

EXPERT TEAM ON OBSERVATIONAL DATA REQUIREMENTS
AND REDESIGN OF THE GLOBAL OBSERVING SYSTEM

Original: ENGLISH

FOURTH SESSION

GENEVA, SWITZERLAND, 28 JANUARY-1 FEBRUARY 2002

CURRENT STATUS AND NEEDS FOR STRATEGIC ACTIONS TO IMPROVE OBSERVING NETWORKS IN AFRICA IN THE FRAMEWORK OF THE REDESIGN OF THE GOS

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Summary and Purpose of Document

This document contains some aspects of the issues regarding the GOS in Africa. The meeting is invited to take note of the current status and the ways to improve the implementation of the redesign of the GCOS in Africa through strategic actions to improve the regional observing networks (RBSN, RBCN, GCOS networks, Systematic Observation for Climatic Changes).

ACTION PROPOSED

The meeting is invited to take into consideration the information contained in this document when discussing regional aspects of redesign of the GOS.

CURRENT STATUS AND NEEDS FOR STRATEGIC ACTIONS TO IMPROVE OBSERVING NETWORKS IN AFRICA IN THE FRAMEWORK OF THE REDESIGN OF THE GOS

INTRODUCTION

The role of Africa in the global climate system is shown through the meridional exchanges carried within the African branch of the Hadley cell. The weather and climate manifestation of this branch have particularities at the sub-regional levels (West Africa, North Africa, East Africa and Southern Africa) in relation to the geographical features. Studies at the sub-regional levels show a significant linkage between sub-regional climate variability and the global ocean-atmosphere system.

Climate variability over Africa is strongly dependent on the space-time characteristics of the following weather/climate systems, which are the main component of the African Hadley cell:

The position and intensity of the Inter-tropical Convergence zone (ITCZ); the monsoon wind systems; the sub-tropical high pressure systems; the jet (African Easterly Jet, Tropical Easterly Jet and the sub-tropical jet) systems; the easterly and westerly wave systems.

In Africa the effects of climate variability are analysed by diagnosing the behaviour of the above weather/climate systems over the continent. The causes of African climate variability are controlled by the atmospheric processes induced as a result of the interactions taking place between the adjacent oceans and the atmosphere.

Rainfall variability over Africa is closely related to the temporal and spatial variation of the intensity of the convective activities, which are controlled by interactions between atmospheric circulations inherent to the weather/climate systems listed above. Other important controls are exerted on the climate system by the nature and characteristics of the ocean-atmosphere system. This variability is indicated through the intensity of induced signals, which affect the structural nature of a weather/climate system.

Studies of climate variability and climate dynamics as well as the monitoring of climate change in order to mitigate its negative impacts require a wide range of high quality data which should be collected and exchanged world-wide via appropriate mechanisms.

THE GLOBAL OBSERVING SYSTEM (GOS)

The global observing system (GOS) is one of the three essential components of the World Weather Watch (WWW) programmes. It consists of facilities and arrangements for making measurements and observations at stations on land, at sea and from aircraft, meteorological satellites and other platforms.

THE REGIONAL ASPECTS OF THE GOS IN AFRICA

The synoptic/climatological variables used for real time operation in NWPs and in GCMs are contained in the exchanged messages issued from the land stations comprising the Regional Basic Synoptic Network (RBSN), and from stations operated in the other networks (agromet, radiation, climatology). With regard to the variables measured over the sea and from aircraft, the messages are produced mainly by *in-situ* observing systems generally managed by international panels. Its is the same for variables produced by satellites which are managed by other satellite specialised panels. These last observing systems (*in-situ* and satellite) give regional and global coverage of observational data over oceans.

CURRENT OPERATIONAL STATUS OF THE RBSN (National component of the RBSN)

The results of a monitoring of CLIMAT reception, from all CLIMAT stations, at at least one GSN Monitoring Centre (GSNMC) from January to June 2001 are shown below.

Figure 1: Percentage of CLIMAT reports from all CLIMAT stations in Africa received at at least one GSNMC from January to June 2001

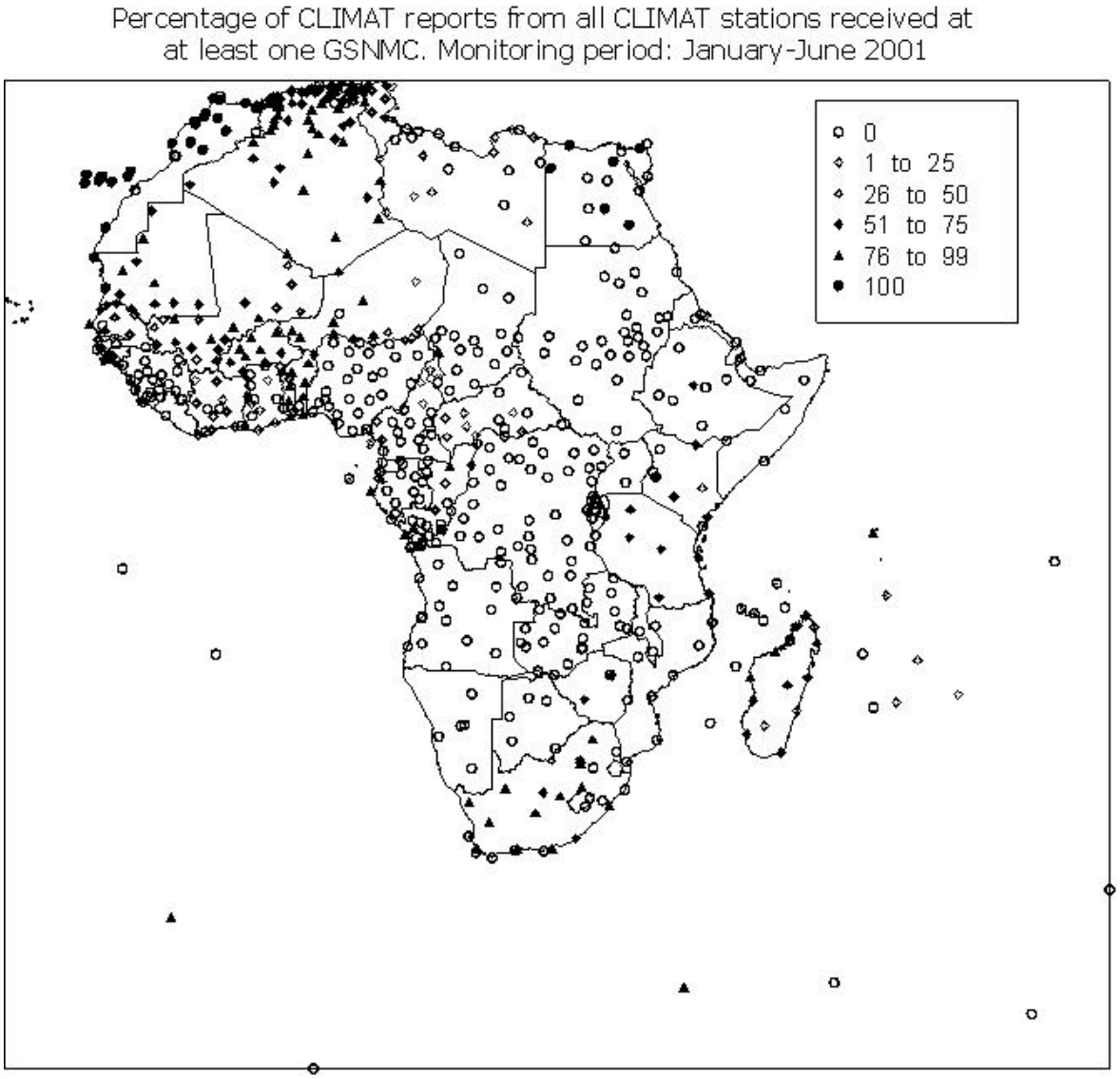


Table 1: Availability SYNOP reports from African stations at ACMAD in July 2001.

Percentage providing at least 90% of reports	Percentage providing from 50-89% of reports	Percentage providing from 1-49% of reports	Silent stations
12.2	24.3	29.9	38.5

It is seen that the reception rate of SYNOP and CLIMAT reports from African stations is very poor since only very few stations carry out a complete programme, while the reception of reports from the bulk of the station is unsatisfactory or completely absent (about 70% of the total number of stations).

It should be noted however, that the overall implementation of the surface stations in the RBSN has shown an increasing positive stability; for instance, the percentage of synoptic stations with a fairly complete programme is 32% (1999), 17% (1998), 18% (1997), 13% (1996) and 17% (1997). Also the 1999 global monitoring indicated that 56% of surface stations produced observations at the main synoptic hours (00,06, 12 and 18). While slightly surpassing the 1998 level, the overall results showed that all of the national components of the RBSN except in the countries of civil war or social unrest are implemented. However, the results showed that almost one quarter of expected reports are still missing in the international exchange. The main reasons for this data loss continued to be either the absence of observation (due to lack of qualified personnel and consumables) or telecommunication problems.

In view of the poor performance of the African Observing System, and in order to improve the availability of climatological data, the first session of the Open Area Group on Integrated Systems of the Commission for Basic Systems (CBS) held in Geneva from 11-15 September 2000 recommended several actions related to CBS area of responsibility. In addition, it reviewed the definition of the CLIMAT and CLIMAT TEMP networks and concluded that although the basic idea to have the CLIMAT networks identical to the RBSNs may have been defendable, practice showed that it did not work. More than 25% of the CLIMAT reporting stations are non-RBSN stations. Furthermore, more than 20% of the stations selected for the GSN were not RBSN and therefore cannot meet the requirements (consequently they are not monitored during the Annual Global Monitoring exercise).

The meeting felt that it seemed better to define the network of CLIMAT and CLIMAT TEMP reporting stations separately and call such a network a Regional Basic Climatological Network (RBCN). It also noted that the list of stations for RBCN could be prepared by the Rapporteur on Regional Aspects of GOS. The list should include GSN and GUAN stations within the Region and be supplemented by other CLIMAT and CLIMAT TEMP reporting stations needed for the description of regional climate features and selected through the same criteria that were used for the selection of GSN stations. Non-RBSN stations which are reporting CLIMAT messages should be taken into consideration, preferably the stations with a records as well as Reference Climatological Stations if possible.

The meeting strongly supported the concept of separate RBCNs and recommended that CBS invite other Regional Associations to consider establishing Regional Basic Climatological Networks in their Regions, based on the stations for which Members offer to provide monthly CLIMAT and CLIMAT TEMP reports.

THE GLOBAL CLIMATE OBSERVING SYSTEM (GCOS)

MISSION, GOALS AND REQUIREMENTS OF THE GCOS

Over the past decade, the meteorological community has witnessed an increasing demand for current and historical data related to climate, climate change, and extreme weather events. Such data are necessary for seasonal and interannual climate prediction as well as for climate research. The importance of these activities has been recognised on numerous occasions by Governments at various meetings, in particular by the Intergovernmental Panel on Climate Change (IPCC) and the Conference of the Parties to the United Nations Framework Convention on Climate Change. In response to these

requirements, from the climatological community, the Global Climate Observing System (GCOS) was established in 1992.

The mission of GCOS is to ensure the availability and quality of the atmospheric, oceanographic, and terrestrial data critical to a wide variety of climate users. Such data, obtained from both in situ and space measurements, are needed for:

- Detecting and attributing climate change;
- Monitoring the climate system;
- Modelling, understanding and predicting climate change and its impacts;
- Developing strategies to ameliorate potential harmful effects of climate variability (such as response to El Nino conditions) and to adopt human activities to climate change;
- Assessing the potential impacts on natural and man-made systems; and
- Advancing sustainable development.

GCOS is to provide for the “end-to-end” needs of climate users. Thus, at one end GCOS is concerned with improving the quality of observations; while at the other, its goal is to enhance the usefulness of climate data, products and information for such needs as national economic development. Its two highest priorities being to establish long-term systematic observations in support of global and regional climate and impact, and to provide the observations needed for climate prediction.

Drawing on the experiences of the IPCC in preparing its assessments, the GCOS has established the following goals that the observational programmes must meet to support of the specific issues facing the FCCC:

- Observe and characterise the current climate, including its inherent variability and extreme events;
- Obtain information useful to detect climate change, determine the rate of change and assist in attributing the causes of change;
- Provide observations to determine climate forcing resulting from changing concentrations of greenhouse gases and other anthropogegic causes;
- Provide observations to validate models and assist in prediction of the future climate;
- Contribute observations to understand and quantify impacts of climate change on human activities and natural systems.

To the fullest extent the GCOS data and information will rely upon existing national and international programmes taking into account the following criteria:

i) Responsiveness: the design is responsive to the needs of users;
ii) Adaptability: the design must accommodate changing, perspectives, objectives, user needs and increased knowledge;
iii) Flexibility: the protocols and design structures need to be flexible and capable of accommodating a wide variety of methods and space/time resolutions; and be able to incorporate existing international monitoring programmes;
iv) Simplicity: it must be understood by all and it must be implementable with varying degrees of sophistication; and
v) Rigor: quality assurance procedures need to be developed must be followed.

As integrated parts of the GCOS Initial Operational System, the GCOS Upper-Air Network and the GCOS Surface Network have been established to accommodate observed data from most land areas, including many mid-oceanic islands.

THE GCOS UPPER-AIR NETWORK (GUAN)

Composition of the GUAN

The GUAN is a subset of 150 stations in the upper air network of the WWW Global Observing System among which 25 are located in Africa. The GUAN was developed to address the requirement for a consistent baseline of homogeneous measurements for global climate. GUAN observations include measurements of pressure, wind, temperature and humidity from just above the ground to heights up to 30 km (using radiosonde attached to free rising balloons). Two soundings per day are highly desirable, although one sounding per day is considered acceptable.

The fundamental purpose of GUAN is to improve the quality and availability of data for climate purposes. It is specifically targeted at detecting temperature change and in providing a reference to other atmospheric data sets and model calculations. The GUAN is intended to serve as a standard for developing and improving the denser network of upper air stations that is needed for climate change studies at the national to regional scale. It provides a basis for detection of global atmospheric circulation changes and will allow a comparison between upper air and satellite observations to provide a stronger, more robust set of observations.

Monitoring the operation of GUAN stations

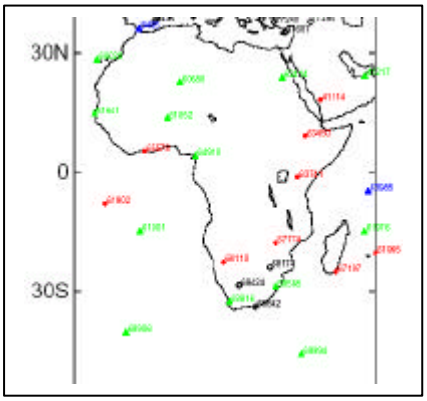
The European Centre for Medium-Range Weather Forecasting (ECMWF) monitors the availability and basic quality of the data submitted by GUAN stations and produces two reports per year. Further monitoring and quality assessment is done by the Hadley Centre of the UK Met Office. GUAN data are archived at the World Data Centre A for Meteorology at the U.S. National Climate Data Centre in Asheville, North Carolina. The data received are made available to all users.

Status of the GUAN implementation in Africa

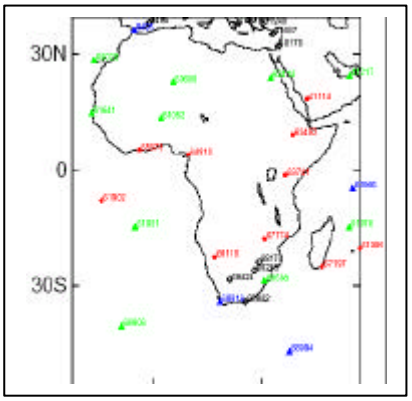
Analysis on the implementation of GUAN in Africa was based on the monitoring results from the GUAN Monitoring Centre over the period January to July 2001. The results of the analysis are presented below.

Figure 2 a: Availability of CLIMAT TEMP reports from the GUAN stations in Africa

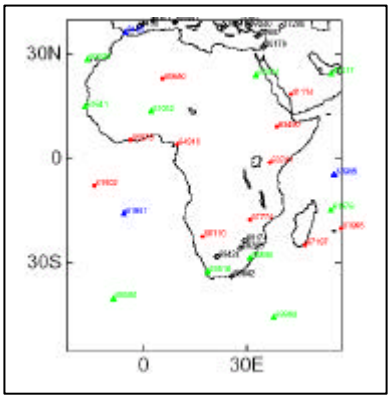
GUAN Performance : Jan 2001



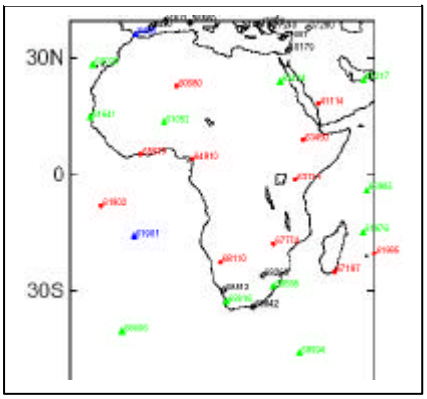
GUAN Performance : Feb



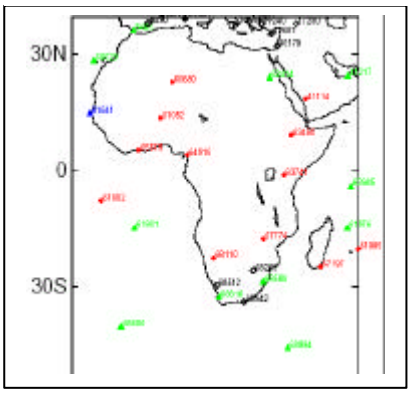
GUAN Performance : Mar



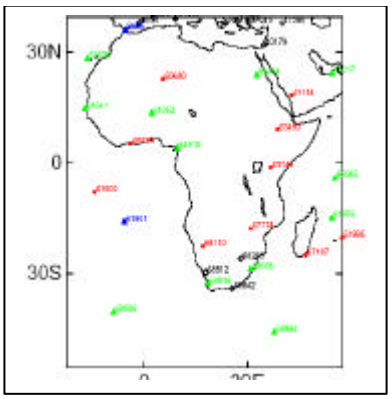
GUAN Performance : Apr 2001



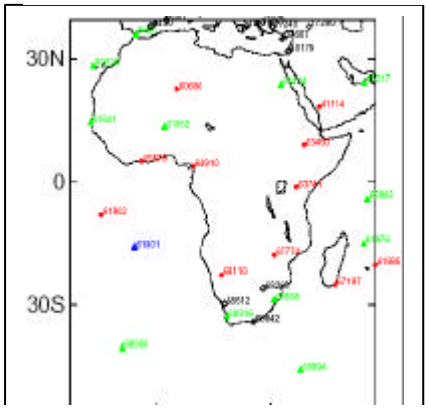
GUAN Performance : May 2001



GUAN Performance : Jun 2001



GUAN Performance : Jul 2001



▲ GUAN station, CLIMAT TEMP report received
▲ Reliable GUAN station, no report received
● Unreliable GUAN station, no report received
◇ Reliable non-GUAN station, CLIMAT TEMP report received

Table 2: Percentage of CLIMAT TEMP reports from RBSN and GUAN stations from Africa received at GUAN Monitoring Centre. Monitoring period: January-July 2001.

Type of stations	Percentage of stations from which reports are received	Percentage of stations from which reports are not (properly) received
GUAN stations	47	53
All CLIMAT TEMP STATIONS	17	83

The result show that the reception of CLILMAT TEMP reports from both GUAN and non-GUAN stations is very poor. The situation is worse for the RBSN stations where reports are properly received from only about 17% of the total number of stations. For the particular case of GUAN, reports are not received from more than half of the GUAN stations. It should be noted that the non-reception of reports from upper-air stations does not necessarily mean that all the stations were not operational; they may be making observations, but for one reason or the other their CLIMAT TEMP reports were not received.

THE GCOS SURFACE NETWORK (GSN)

Composition of the GSN

The GSN which was formalised in 1999 consists of 989 stations providing monthly data on averages and extreme values for several meteorological parameters, especially temperature and precipitation. Among the GSN stations, 155 are located in Africa. The fundamental purpose of the GSN is to improve the quality and availability of climate data and to encourage the preservation and exchange of data into the future. It should serve as a standard for developing and improving the denser reference climatological networks that are needed for regional climate applications. The GSN will also contribute to verification of satellite observations.

The basic GSN stations selection criteria include: i) performance of the station in producing high-quality observations; ii) length of time the station has submitted data; iii) distance from urban centres; and iv) adequate representation of the climate in regions where differences in elevation are significant by adding additional stations.

Monitoring the operation of GSN stations

Two monitoring Centres – one at the Deutscher Watterdienst (Offenbach, Germany) for precipitation and the other at the Japan Meteorological Agency (Tokyo, Japan) for temperature – have been established to provide information on the availability, timeliness and quality of the GSN data. Members concerned will be provided with regular reports on data receipt and data quality. GSN data will be archived at the World Data Centre A for Meteorology at the U.S. National Climate Data Centre. The data received will be available on CD-ROM and via FTP.

Status of implementation of the GSN in Africa.

As in the case of GUAN, analysis on the implementation of the GSN in Africa, which results are presented below, was based on the monitoring results from the GCOS monitoring centre over the period January-June 2001.

Table 3: Percentage of CLIMAT reports from all CLIMAT and GSN stations from Africa received at at least one GSN Monitoring Centre. Monitoring period: January-June 2001.

	100%	76-99%	75-51%	26-51%	1-25%	No record received
All CLIMAT stations	5	14	12	6	8	55
GSN stations	6	14	14	7	8	52

Figure 3: Availability of CLIMAT reports from GSN stations in Africa

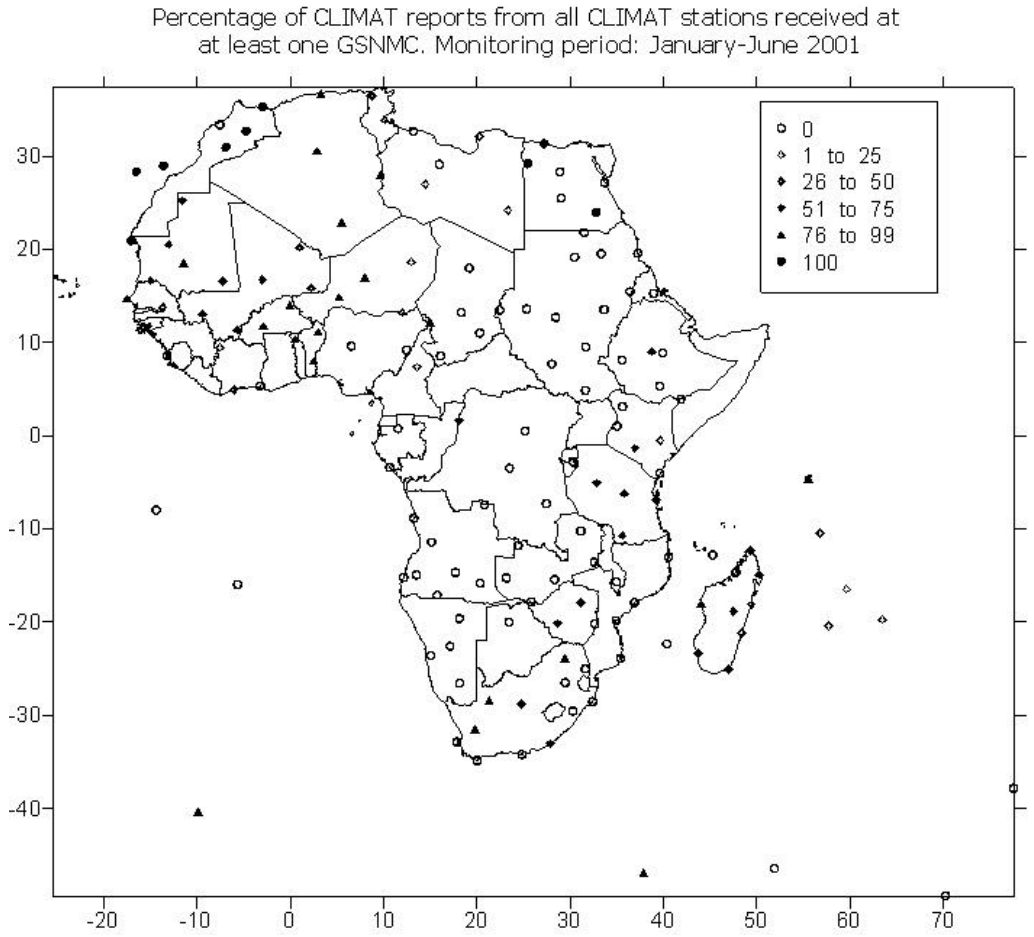
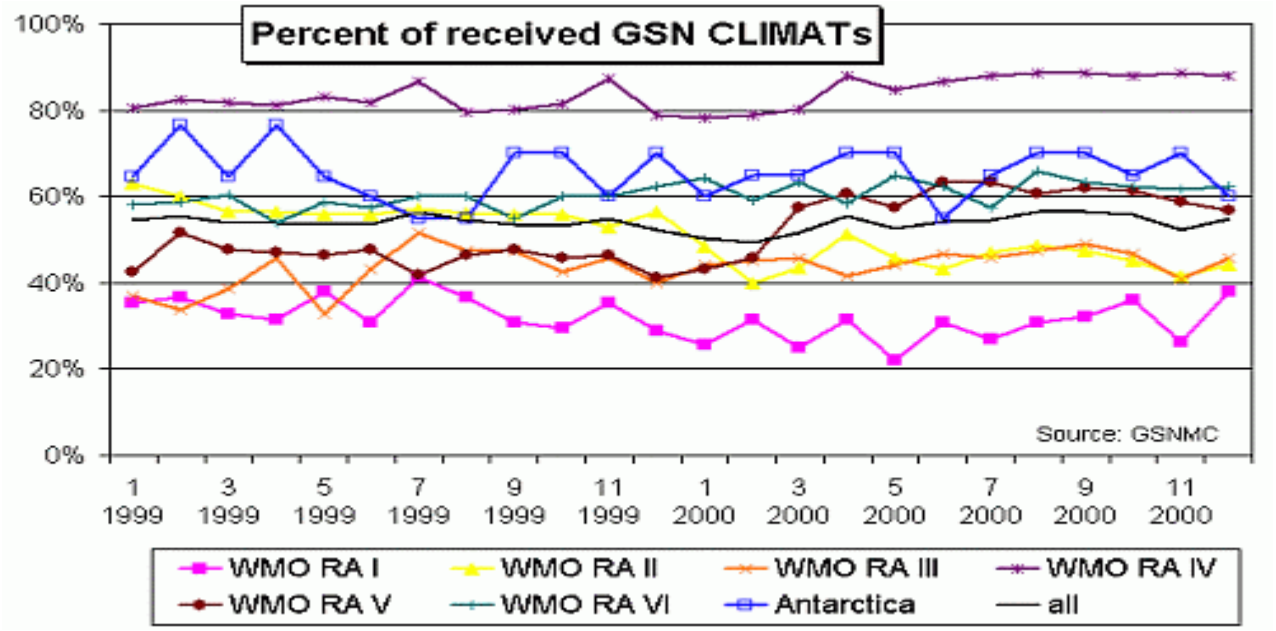


Figure 4: Availability of CLIMAT reports from all WMO Regional Associations GSN stations.



The results show that like in the case of CLIMAT TEMP, the reception of CLIMAT reports from both GNS and non-GSN stations is indeed very poor, since reports are received from only about 1/20 of the total number of stations, while reports are not received from more than half of both GNS and non-GSN stations. On a global basis, the operation of only about 39% of CLIMAT station could be considered satisfactory i.e. those for which the CLIMAT reception rate is above 50%. The non-availability of CLIMAT reports does not necessarily mean that all the stations were not operational; they may be making observations, but for one reason or the other their CLIMAT reports were not received. The results (Figure 4) also shows that the reception of CLIMAT reports from GSN stations from Africa is the poorest, compare to the reception rate from all other WMO Regional Associations.

In view of the poor performance of GCOS in Africa, a regional GCOS workshop on improving observing systems for climate was held for Eastern and Southern African countries in kisumu, kenya, from 3 to 5 October 2001. The workshop came out with the following resolution called the Kisumu Resolution

RESOLUTION CONCERNING THE IMPROVEMENT OF GLOBAL CLIMATE OBSERVING SYSTEMS IN EASTERN AND SOUTHERN AFRICA

The participants in the GCOS Regional Workshop for Eastern and Southern African Countries on Improving Global Climate Observing Systems,

***Welcome*:**

The opportunity provided by the GCOS Secretariat in partnership with the National Meteorological and Hydrological Services (NMHSs), the international climate change community, and Drought Monitoring Centres of Nairobi and Harare, and with the support of GEF/UNDP, UNEP, and WMO to identify ways to improve observing systems for climate in the region.

Recalling:

(1) That the Conference of the Parties (COP) to the UN Framework Convention on Climate Change (UNFCCC) has encouraged Parties to actively support capacity-building in developing countries to enable them to collect, exchange, and utilise data to meet local, national, regional, and international needs (Decision 14/CP.4), and has recognised the need to identify priority capacity-building needs related to participation in systematic observation (Decision 5/CP.5);

(2) That Decision 5/CP.5 urges Parties to address deficiencies in the climate observing networks and to bring forward specific proposals for that purpose and to identify the capacity-building needs and funding required in developing countries to enable them to collect, exchange, and utilize data on a continuing basis in pursuance of the UNFCCC; and

(3) The role and importance of GCOS to facilitate, with other stakeholders, systematic observation regionally.

Recognising:

(1) That Eastern and Southern African countries are considered among the most vulnerable to the impacts and consequences of human-induced climate change, in particular, global warming and the potential threats associated with extreme weather and climate events and sea level rise;

(2) That improved observations of climate will enable provision of information and forecasts which will greatly assist the governments and national communities of countries in the region to prepare for the season-to-season and year-to-year variations of climate

associated with sea surface temperatures, El Niño/Southern Oscillation, and other natural phenomenon, as well as to detect and better prepare for long-term, human-induced climate change;

(3) That Eastern and Southern African countries currently face significant challenges associated with natural climate variability, especially droughts, tropical cyclones, floods, snowfall, sea level variations, and changes in ocean temperature;

(4) That oceanic and atmospheric circulation patterns and ocean-atmosphere interactions in Eastern and Southern Africa play significant roles in determining global patterns of climate change and climate variability;

(5) That measurements of meteorological/atmospheric, oceanographic, and terrestrial variables in the region provide essential data for detecting and attributing climate change; for monitoring, understanding and predicting climate change and climate variability; for developing strategies to ameliorate the potential harmful effects of climate change and climate variability; and for advancing sustainable development regionally; and

(6) That the basic observation networks of NMHSs provide the foundation on which the strengthening of GCOS must be built.

(7) That enhanced co-operation among stakeholders with responsibilities to deal with climate change issues, including national climate change co-ordinators and national meteorological and hydrological services, is essential

(8) That the observations from the GCOS surface network and GCOS upper air network are currently inadequate and that these important networks have been deteriorating in recent years;

(9) That substantial historical data exists that has not been made available;

(10) That urban climate has significant impacts on the global climate;

(11) That the DMCs play an important role in climate monitoring and applications.

Urge:

(1) That a Regional Action Plan be prepared to illuminate priorities within the region and to form the basis for the preparation of a proposal(s) for funding improvements in observing systems for climate and in other activities related to climate observing systems in Eastern and Southern Africa;

(2) That the Action Plan be prepared in accordance with the following programme:

a) The DMCs, in collaboration with the NMHSs and the national climate change co-ordinators, will facilitate the development of a Regional Action Plan that will incorporate the priorities raised in the workshop and initial country reports. In order to take advantage of opportunities to report to the UNFCCC, this regional Action Plan should be completed no later than May 2002. To facilitate this process, the Workshop participants recommend the creation of a core drafting team comprised of 10 people from among the region, to include representatives from the 3 observing system domains and from the climate change coordinator group. The DMCs should seek support of agencies such as UNEP, WMO, ACMAD, and GEF/UNDP in this endeavour.

b) Once the Plan is developed, it will be circulated to the members of IGAD, SADC, and IOC for approval; and

c) The DMCs, in collaboration with the NMHSs, the national climate change co-ordinators, GCOS, concerned international agencies, and regional organisations in Africa should develop a strategy for implementing the actions within the report.

(3) The countries of the region to prepare national reports on observing systems for climate. These reports should be developed through co-ordination between NMHSs and climate change country teams. All countries should strive to develop these reports pursuant to the UNFCCC guidelines;

(4) That the African community should take advantage of both communication and observation facilities offered by Meteosat Second Generation (MSG) and other relevant technologies to enhance availability of data and information over Africa;

(5) That additional effort be made to provide historical data in line with the request by the WMO Secretary General;

(6) That closer interaction and co-ordination between NMHSs and national climate change co-ordinators be undertaken to define country observing system needs for vulnerability and adaptation;

(7) That the region address the need for capacity building in a number of areas, including awareness raising and specialised training needs;

(8) That Western Indian Ocean observations be enhanced and become an integral part of an Indian Ocean observation strategy;

(9) That hydrology observations become an integral part of the observational strategy in line with programmes discussed at the GCOS Regional Workshop;

(10) That carbon cycle observations, essential for the full participation by African countries in the UNFCCC, should be promoted by working at the national level with partners in the agriculture, forestry, land use, and ecological sectors and by co-locating carbon cycle observation sites with GSN sites;

(11) That because of the high cost of consumables for upper air measurements, the issue of cost and alternative methodologies needs to be seriously addressed by regional and international institutions; and

(12) That because of the growing population of urban areas in the region, a strategy for urban observations be developed.

Requests that:

(1) The NMHSs and the climate change co-ordinators, with the assistance of the DMCs ensure that this resolution is widely distributed within the region and with appropriate collaborating partners;

(2) DMCs, working with the countries of the region, and in consultation with other organisations, including NMHSs and climate change co-ordinators, use the information developed in the Action Plan to prepare one or more specific proposals to potential donors to fund improvements in observing systems for climate;

(3) Development partners consider financing appropriate elements of the Action Plan;

(4) Parties to the UNFCCC in the region and the GCOS Secretariat bring this resolution to the attention of COP and its Subsidiary Bodies; and

(5) NMHSs become actively involved in the preparation of their national reports on activities related to systematic observation, as invited by the parties to the UNFCCC in Decision 5/CP.5.

Resolve:

To work relentlessly on improving observing systems for climate to ensure enhanced availability of climate data and information over Africa, including meteorological*, atmospheric, oceanographic, and terrestrial (especially carbon and water) data that meets the regional climate needs and addresses the aims of the Convention.*

PROBLEMS OF OBSERVING SYSTEMS IN AFRICA

There are many problems associated to Observing Systems in Africa. The inadequacies of the present observing systems can, in part, be attributed to the lack of priority given to the gathering, processing and dissemination of climate data. This has led to a number of key deficiencies. The main problems reside in the following areas:

i) Satisfactory global coverage for many of the essential climate variables has not been archived;

ii) Regional coverage is not adequate in many areas. Surface and upper-air atmosphere observations from large parts of Africa are unavailable.

iii) Observations of selected variables often do not have adequate accuracy or precision to be reliably used as indicators of climate change; and

iv) Key data sets, although collected are often not effectively exchanged.

These problems are mainly associated to a lack of human and technical resources (lack or breakdown of telecommunications equipment, lack of or obsolete observation equipment, lack of consumables, lack of automation of the national Meteorological Centres, wrong application of procedures in the compilation, arrangement and transmission of reports to the Regional Telecom Centre, problems of formatting/coding of the CLIMAT and CLIMAT TEMP messages and incomplete observation programmes). The problem of coding and formatting of CLIMAT and CLIMAT TEMP reports and the incomplete observation programme is illustrated below.

Figure 5: Percentage of typical errors associated with CLIMAT reports.

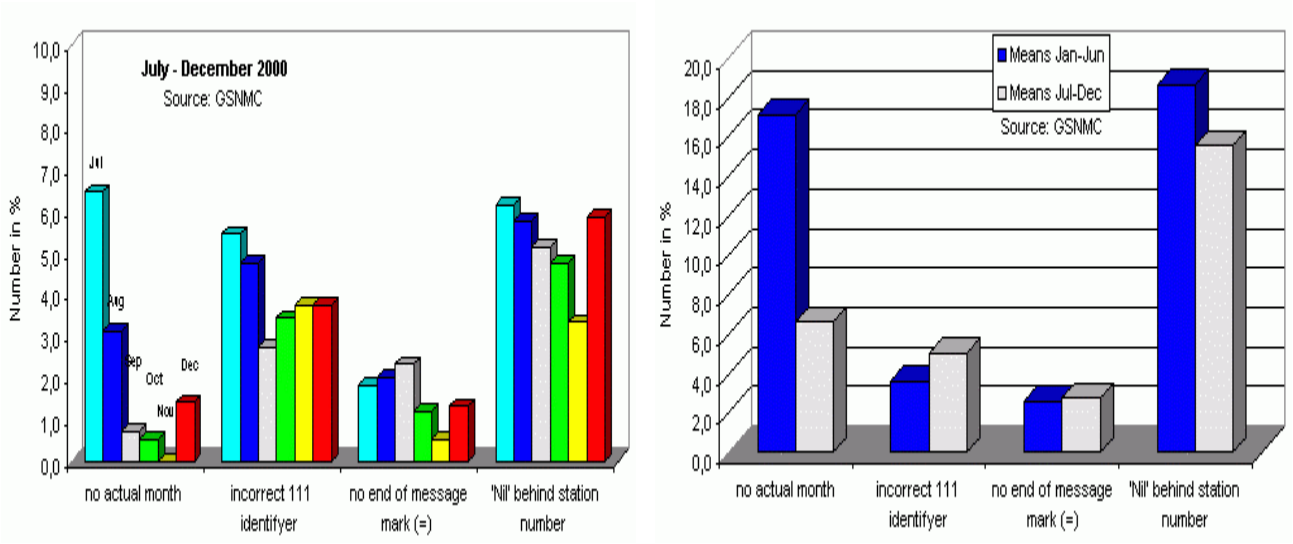


Figure 5 clearly shows that the problem of coding and formatting reports contribute highly to the non-availability of climate data. In order to solve this problem of coding and recognising that a problem had occurred concerning lack of awareness of some recent code changes, the CBS Management Group recommended, during its second meeting held in Sydney from 10 to 13 December 2001, that Members be invited to appoint focal points on code matters, who will be alerted to proposed changes in codes and code tables. The group also felt that the current procedures for approval of code and table changes, particularly fast-track procedures, were not satisfactory and suggested that alternative procedures be investigated.

Reasons for an insufficient level of GUAN and GSN implementation

There are several reasons for the low/non availability of CLIMAT and CLIMAT TEMP reports from GSN and GUAN stations from Africa. Many African stations have problems maintaining stations because of available funds are insufficient to buy new, modern equipment or to carry out day-to-day operations due to lack of consumables, spare parts and qualified staff. Other problems include reports that are generated but are not properly communicated to the related Regional Telecommunication Hub (RTH); reports that are communicated but not according to formatting and prescription; reports that are submitted too late in the month to be included and reports that are otherwise in good order but that are not properly transmitted between RTHs.

Needs for improving the GUAN and GSN programmes of observation

There is a critical need to develop and or improve the African climate observing system to better understand the role of Africa in the global climate system and the African climate variability and change. This will also enable a better climate monitoring in the continent and thus a better mitigation of the effects of extreme climate events.

The redesign of observing systems in Africa is essentially important because in many areas the system simply does not exist, whereas in other areas it is satisfactory or could be improved. The issues to be addressed have been identified; they essentially fall into three categories:

- Lack of public infrastructure (electricity, telecommunication, transport facilities, etc.);
- Lack of expertise (lack of staff, lack of training, etc.); and

- Lack of funding (equipment, consumables, spare parts, manpower, etc.).

To enable Africa's full participation in the Observing Programmes, due consideration must be given to these three issues. Attention must specially be given to improving current telecommunication facilities in those countries with poor telecommunication infrastructure. The needs for improvement may call for upgrading, restoring, substitution and capacity building, and therefore the following actions shall be considered.

The development and implementation of a regional strategy in the framework of the redesign of the GOS, taking into account the following:

i) Identification of observing systems that are less dependent of classical infrastructures that require expertise and cost: satellites, AMDAR, automatic stations;

ii) Reorganising observation networks by application fields;

iii) Restructuring the management of observation networks into sub-regional groupings and application field (e.g. ASECNA in synoptic and aeronautical meteorology;

Developing a strategy for improving observations through:

iv) Assisting African countries to acquire automatic stations;

v) Facilitating the participation of African airlines in the AMDAR Programme;

vi) Acquiring satellite ground stations;

vii) Promoting African participation in ocean observation projects;

viii) Developing regional institutions for promoting and maintaining new technologies in atmospheric observations;

The reactivation/rehabilitation of silent stations

ix) Replacing obsolete equipment;

x) The provision of spare parts and consumables;

xi) Reinforcing technical and human capacities;

xii) Regular examination and maintenance of the networks;

xiii) Providing sufficient budgets;

Improving telecommunication means through

xiv) The use of public transmission networks for data collection;

xv) Increasing the number of DCP channels;

xvi) Standardising the management of the whole observation network by a single national administration;

xvii) Installing performing message switching systems easily adaptable to technological advancement;

xviii) Replacing present data communication links by satellite and/or telephone links;

xix) Replacing obsolete AMSSs;

xx) Popularising the TCP/IP protocol;

xxi) Implementing PC based telecommunication systems (e.g. MESSIR);

xxii) Interconnecting the National Met. Centres to the SATCOM;

xxiii) Install MDD, SADIS and PDUS where not yet available;

xxiv) Secure Internet links;

xxv) Popularise the exploitation of (digital) specialised links and the use of "**frames relay**";

It is also expected that many of the problems associated to the GCOS stations will be overcome as feedback from network monitoring is provided to the stations concerned. The information received also makes it possible for some African countries to receive assistance to maintain their GUAN and GSN stations through appropriate channels, such as through the Voluntary Co-operation Programme.

Implementation of a national plan for systematic observation for climatic change

full implementation of the GCOS in Africa pass necessarily by the formulation and implementation of national programmes for:

- The reinforcement of the upper air network;
- The implementation of GUAN and GSN stations,
- The reception satellite and aircraft data;
- The measurement of mid-level temperature;
- The reinforcement of the network for cloud and precipitation observations;
- The creation of a national centre of climate analysis and prediction.