10 October 2000

ENGLISH ONLY

UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

SUBSIDARY BODY FOR SCIENTIFIC AND TECHNOLOGICAL ADVICE
Thirteenth session
The Hague, 13-18 November 2000
Agenda item 12

COOPERATION WITH RELEVANT INTERNATIONAL ORGANIZATIONS

Global Climate Observing System: progress report on developments in the global observing system and activities related to decision 5/CP.5.

Note by the secretariat

1. The Subsidiary Body for Scientific and Technological Advice (SBSTA), at its twelfth session, welcomed the information provided by the Global Climate Observing System (GCOS) secretariat in response to the invitation contained in decision 5/CP.5 to consider the need for an intergovernmental process for global observing systems. It noted the efforts already made to organize regional workshops to identify priority capacity-building needs of developing countries. The SBSTA invited the GCOS secretariat to report periodically on its activities related to decision 5/CP.5, as well as on developments in the global observing systems for climate at its further sessions (FCCC/SBSTA/2000/5, para. 59).

2. The GCOS secretariat submitted a report in response to the above request. In accordance with the procedure for miscellaneous documents, this submission* is attached and reproduced in the language in which it was received and without formal editing.

* In order to make this submission available on electronic systems, including the World Wide Web, it has been electronically scanned and/or retyped. The secretariat has made every effort to ensure the correct reproduction of the text as submitted.

GLOBAL CLIMATE OBSERVING SYSTEM (GCOS): REPORT TO THE THIRTEENTH SESSION OF THE SUBSIDIARY BODY FOR SCIENTIFIC AND TECHNOLOGICAL ADVICE OF THE CONFERENCE OF THE PARTIES TO THE UN FRAMEWORK CONVENTION ON CLIMATE CHANGE

(submission received on 20 August 2000)

INTRODUCTION

At its twelfth session, the Subsidiary Body for Scientific and Technological Advice (SBSTA) invited the GCOS secretariat, on behalf of the agencies participating in the Climate Agenda, to report periodically on recent developments in the global observing systems for climate and on progress in responding to decision 5/CP.5.

This document reports on:

- results from recent monitoring of some key components of the GCOS which suggest that the system has continued to deteriorate since the last report to SBSTA-11 and COP-5 and requires the urgent attention of Parties;
- significant developments in the global observing systems for climate for the oceans and for terrestrial carbon; and
- GCOS's responses to decision 5/CP.5 including holding of regional workshops, determining the adequacy of the GCOS and in regard to facilitating an intergovernmental process.

1 RECENT MONITORING OF SOME KEY COMPONENTS OF THE GCOS

The GCOS[1] was 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 including the UNFCCC. It addresses the total climate system including physical, chemical and biological properties, and atmospheric, oceanic, hydrologic, cryospheric and terrestrial processes.

GCOS builds upon, and works in partnership[2] with, other existing and developing observing systems and also draws upon proven networks established under research programs. GCOS integrates satellite observations provided by national agencies together with surface based observations through its participation in the Integrated Global Observing Strategy (IGOS[3]) partnership. The latter brings together all of the global observing systems, the satellite operators, research funding agencies, and the international research programmes to address major observing system requirements including the carbon and the water cycles in the most cost effective manner.

One of the major activities of GCOS is the establishment of operational performance standards for its contributing networks. These enable GCOS to assess and report upon the

actual effectiveness of those networks in meeting the needs of the users. As might be expected this activity is still in its infancy and the performance criteria for most of the networks are still under development. The following two sections outline performance information in two areas.

Atmospheric climate observations

The GCOS Surface and Upper Air Networks (GSN and GUAN) were established as sub-sets of the full World Weather Watch (WWW) networks of WMO's Global Observing System operated to GCOS standards. Monitoring of the performance of the GSN and GUAN and archiving of their data[4] are now fully operational and some recent results are presented in Table 1.

Table 1 Status of GCOS meteorological networks by WMO Region

	WMO Region	No of stations	Percentage providing at least 90% of reports	Percentage providing from 50- 89% of reports	Percentage providing from 1-49% of reports	Percentage of "silent" stations
GCOS Surface Network (GSN), Monitoring Period: July-December 1999	I - Africa	155	8	33	12	47
	II - Asia	262	37	26	2	35
	III - South America	120	33	16	8	43
	IV - North & Central America	157	72	9	10	9
	V - South-West Pacific	155	35	14	8	43
	VI - Europe	120	51	9	3	37
	Antarctica	20	50	20	0	30
	Global	989	39	19	6	36
GCOS Upper Air Network (GUAN), Monitoring Period: January-June,1999	II - Asia	26	62	11	0	27
	III - South America	17	24	35	6	35
	IV - North & Central America	20	40	10	5	45
	V - South-West Pacific	37	62	16	0	22
	VI - Europe	15	60	14	13	13
	Antarctica	12	75	8	0	17
	Global	150	47	22	6	25

They show, by WMO Region and globally: number of stations; the percentage of “good” stations (i.e. those from which at least 90 per cent of required reports were received at the relevant monitoring Centre); the percentage of “inadequate” stations (i.e. those from which between 50 and 89 percent were received); the percentage of “unsatisfactory” stations (i.e. those from which between 1 and 49 percent were received); and the percentage of “silent” stations (i.e. those from which no data were received. This does not mean that all of these stations are not operational; they may be making some daily observations but, for different reasons their climate reports have not been received.).

Table 1 shows that worst situation regarding the implementation of the GSN is in Africa, South America and the South-West Pacific where only about 50% of GSN stations have provided more that 50% of expected data. In addition about 45% of GSN stations in these regions are "silent". The worst implementation of the GUAN is in Africa, North & Central America, and South America, from where the relevant monitoring centres have received more than half the expected data from only about 60% of stations and about 40% of stations in these regions are "silent".

These data, based on performance of the GSN and GUAN, differ in detail from those presented to SBSTA-11 and COP-5 (FCCC/SBSTA/1999/10 paras 12 and 13 and Table 1) which indirectly inferred the performance of the GSN and GUAN from monitoring of the WWW and for a limited period only. But, as the GSN and GUAN stations were chosen, in part, on the basis of expected reliability, the data very strongly suggest that the situation has deteriorated over the last twelve months. Furthermore, analysis of the *quality* of those data which have been received indicates that they are not all to GCOS standards. It is apparent that these networks are completely inadequate for their intended purpose and that more focused resources are needed.

There are several reasons for the low reception rates and low quality. Some developing countries have problems maintaining stations because funds are inadequate for equipment, consumables, and ongoing operations. Other problems are caused by inadequate communications systems and lack of qualified staff. Some of these may be overcome as feedback from the monitoring centres is provided to the stations concerned. In addition to the need to improve transmission of current climate data, much useful historical data exist but have not yet been forwarded to the relevant archiving centres. Again, lack of funds for retrieving these data is a concern within some countries.

Ocean Climate Observations

Monitoring systems for the operational ocean observing system have yet to be established and so this report provides information in Table 2 on the basic atmospheric/ocean surface variables, by major ocean basin, similar to that provided to SBSTA-11 and COP-5 (FCCC/SBSTA/1999/10 paras 14 and Table 2). The data represent the range of daily average percentages of the World Weather Watch (WWW) requirements met for each variable for a recent period; for these data, GCOS requirements are not likely to be much different. Since most of the observations are derived from voluntary observing ships (VOS) and drifting or moored buoys, there is considerable variation even within each ocean basin, and the table reflects this. The apparent excessive coverage in the North Atlantic applies only in very

limited areas, usually close to coasts or in much-used shipping lanes, or where some ocean buoys are reporting every hour.

From an analysis of these and similar results, it is clear that the availability of data from the oceans is far from satisfactory at the present time: though performance is relatively consistent for most regions contained in the report to SBSTA-11, there are vast regions of the southern hemisphere's oceans - a key region for the global climate system - that remain almost completely void of data.

Table 2 Information on the status of selected oceanographic data by ocean basin. (Based on monitoring during May 2000.)

Ocean Basin	Surface air pressure (percent WWW requirements)	Surface air temperature (percent WWW requirements)	Surface wind (percent WWW requirements)	Sea surface temperature (percent WWW requirements)
North Atlantic	25-150	40-200	20-100	40-100
South Atlantic	10-50	0-25	0-20	15-70
North Pacific	5-50	20-60	20-70	40-100
South Pacific	$<10^5$	5-25	0-15	10-70
Indian	15-70	0-20	0-20	20-40
Southern	<10	<5	<5	<10

2 SIGNIFICANT RECENT DEVELOPMENTS IN GLOBAL OBSERVING SYSTEMS FOR CLIMATE

This section highlights two very important developments in components of the observing systems which are of particular interest to the Parties: in the Global Ocean Observing System (GOOS) and the Global Terrestrial Observing System (GTOS).

Ocean Climate Observations

There have been two significant events in this regard over the last year. First, an International Conference on the Ocean Observing System for Climate (OceanObs99), held in October 1999 in France, reached a consensus on an optimum mix of measurements needed for the ocean observing system for climate purposes. This has enabled the IGOS Partners to define, through an Oceans Theme, the way forward for the space-based component of the ocean observing system for climate.

OceanObs99

The Conference was bold in its vision and goals, successfully developing a broadly based and sound scientific rationale for the establishment of a sustained system. Practical El Niño

forecasts, research on climate variability, climate change, and ocean and marine forecasts were prominent.

The requirements of GCOS and of the UNFCCC, as expressed particularly through COP's Decision 5/CP.5 were important factors considered. The participants were charged, in part, with identifying robust, high-quality techniques that would withstand the rigorous analyses required for climate change studies. In addition to examining the strengths of existing and pilot systems, the Conference identified weaknesses and gaps and discussed methods for addressing these deficiencies.

The Conference was purposefully structured to encourage consideration of, and agreement on, the value of a multi-purpose, integrated system. This value was evident in many areas, for example in the wide application of altimeter and wind vector measurements and in the many considerations of complementary data streams.

Issues of cost and returns on investment were explicitly considered. Highest priority was attached to those elements that were perceived to be reliable, efficient and sustainable, from the perspective of delivering both short and long-term value for the given investment. Proven methodologies were preferred to emerging or potential techniques.

Remote sensing has become a mature technology for collecting regular, global observations. Measurements of sea surface temperature, surface wind vectors, surface wave height, sea-ice and surface topography are considered fundamental. Continuity was seen as a major issue. It is important that effective strategies for the transition of proven experimental techniques into a sustainable, operational mode be developed.

A multi-faceted, robust *in situ* network must also be implemented, in part as a complement to, and calibration for, remotely sensed data, but also for its own intrinsic value in various applications. The primary contributions include:

- The tropical Pacific ENSO Observing System and its Tropical Atmosphere-Ocean (TAO) mooring array;
- The global array of profiling floats, *Argo*, returning around 100,000 profiles of temperature and salinity annually;
- A global surface drifter array and surface and subsurface networks operated from voluntary observing vessels;
- Surface and subsurface reference sites, such as provided by sea level stations and fixed-point deep measurements;
- Hydrographic measurements targeting the carbon cycle and the deep ocean circulation; and
- Acoustic tomography in selected high latitude regions.

Many gaps are evident, in terms of global coverage and temporal sampling, in terms of quality and sophistication of processing, in terms of timely delivery, and in terms of missing information. The Conference agreed that strategies must be developed and supported to meet such needs. The GCOS provides an important mechanism for this purpose.

The development of a new paradigm for oceanography was one of the major achievements of the Conference. Free and wide availability of all data and products will now be the norm, not the exception. While the focus of the Conference was on measurement networks, all participants recognized the fundamental importance of models and data assimilation to the progress, prosperity and evolution of the observing system. The new paradigm is fashioned around the use of models to interpret and exploit data and to develop products that encourage wide adoption and value adding.

The degree of unanimity achieved by the Conference exceeded expectations, yet there is clearly much work remaining, both in terms of detail and in terms of implementation and sustained operation. However the ocean community can look forward with some confidence to an era of great prospect and opportunity, and also one of enhanced responsibility. And, in the longer term, the FCCC can expect a significant advance in meeting its requirements for ocean climate data from the situation described to in the report prepared by the GCOS secretariat for COP-4 (Comprehensive report on the development of the observational networks of the climate system; FCCC/CP/1998/MISC.2).

The IGOS Oceans Theme

The 'Oceans Theme' has, as overall goal, the creation of an observing system for the oceans that serves both the research and operational oceanographic communities. The Theme, the first of a series being developed under the IGOS Partnership, received preliminary endorsement at the IGOS Partner's meetings in early June 2000 and it is expected to be essentially complete by the end of this year.

A specific goal is to consider and study the full range of current and planned observations, while identifying potential gaps in future observations that might compromise ocean observational records. The Theme report presents a proposed set of long-term ocean observations and identifies a number of challenges for the improvement of knowledge about both the oceans and observing techniques. The set of observations is based on an evaluation of the range of requirements that have already been presented by GOOS, GCOS, and the Global Ocean Data Assimilation Experiment (GODAE).

The next five years will require development of institutional structures committed to:

- managing the total data flow (*in situ* as well as satellite);
- managing the production, distribution and quality assessment of relevant data products; and
- working with end-users to ensure that the evolving system is responsive to their needs.

It is also recognised that observation protocols evolve with time and, therefore, that the stated observational requirements will need to be reviewed. It is the recognised applications that ultimately drive the shape of the requirements for the ocean observing system. The focus has been on observations which are needed to address important issues in ocean science, and through combinations of measurements and models, to support the production of an extensive range of products for a broad community of users. The applications are directly linked to societal needs relating to issues including climate and climate change, weather prediction, and

seasonal-to- interannual forecasts. The data are needed for deriving fields of information about the ocean and for initialising and validating the models used to derive other products. In addition, there is also the need to improve how the data are assimilated into models.

In terms of the long-term continuity challenge, the Oceans Theme delineates observations, key issues, and objectives in the following areas: ocean topography, ocean vector winds, ocean biology, sea surface temperature, sea ice, precision gravity field or geoid, salinity, sea state and atmospheric pressure, and sea ice thickness.

In early 2000, space agencies made commitments to fill identified observation, data product and service requirements. The IGOS Oceans Theme Report will reflect these commitments, as well as identifying additional *in situ* observation requirements and commitments. At its June 2000 meeting, the IGOS Partners urged all Partners to accept the Ocean Theme Report as a strategy document for implementation and, as appropriate, to seek governing body approval at the earliest opportunity. GOOS was urged to take the lead in implementing the Oceans Theme and CEOS agencies and all Partners were encouraged to make supporting contributions.

Terrestrial Carbon

The IGOS Partners under the leadership of the Global Terrestrial Observing System (GTOS) have commenced the development of an integrated observing system to provide the information needed to document and understand the role of terrestrial carbon sources and sinks in the global carbon cycle. Key partners include IGBP, a number of national space agencies, WCRP, GCOS, FAO, UNEP and UNESCO and will build upon the assessment work currently underway in the IPCC

This has involved, as a first step, the need to agree on the observation and modelling requirements; to harmonise the existing projects and activities that can contribute to a global observing system; and to ways to fill key gaps. Some requirements for estimating terrestrial carbon are well understood although in certain cases the continuity of their measurement is of concern. For example: land cover and land use change, leaf area, biomass burning (fire scars), solar radiation, atmospheric composition, surface fluxes, and crop and forest production are among the key observations for which method of measurement and use of data are well established.

Other observations are less well understood and/or techniques for their measurement may be needed before global observations can be implemented. The important issues include: biomass and its changes, canopy structure, CO2 measurement from satellite platforms, atmospheric CO2 concentration at a micro-scale, plant biogeochemistry, and meteorological parameters with a fine spatial resolution.

Although carbon is at the heart of many UNFCCC and other global change discussions, more systematic observations are needed in order to estimate pools and fluxes (which tend to be more short-term) and use models to validate and highlight gaps in our current knowledge. There is also a need to move beyond the current approach whereby process models are tested on a very small scale and then extended to the global scale.

Emphasis is being placed on understanding the current spatial distribution of the sources and sinks in terrestrial systems and seasonal, annual, interannual, and decadal fluxes in carbon stocks. TCO encompasses the terrestrial and associated atmospheric parts of the carbon cycle. However, efforts are underway to integrate this with the ocean carbon observation requirements which are already partly developed. A global observation network will allow the development and testing of both process-based ecosystem models, their extrapolation to larger scales, and the assessment of sub-continental-scale flux variability.

Two scientific meetings have been held this year to develop consensus on the observation requirements. The IGOS partners will consider the development of an operational system at their next meeting in November 2000.

GTOS has also been developing a global system of terrestrial observing networks (GT-Net) to facilitate the collection and exchange of terrestrial observations data under its Terrestrial Ecosystems Monitoring Sites database. So far climate-related networks have been established for Glaciers and Permafrost while a Hydrology network is in the initial stages of development.

3 GCOS'S RESPONSES TO DECISION 5/CP.5

As the Parties will recall there were a number of components to decision 5/CP.5. The following sections will address how GCOS, its Sponsors and its Partners have responded to them.

Regional Workshops

In response to 5/CP.5 2, the GCOS secretariat has organised the first regional workshops to identify the capacity building needs of developing countries. With support from the WMO, UNEP, the USA and Australia, the first workshop covering the South Pacific region was held in Samoa in August 2000, in cooperation with the South Pacific Regional Environment Programme (SPREP). SPREP, as the principal regional entity concerned with climate variability and change, will take the lead in co-ordinating and implementing the actions specified in the workshop resolution. Participants included the Directors of National Meteorological and Hydrological Services (NMHSs) from nineteen Pacific Island countries and a number of national climate change co-ordinators from the Pacific Island countries.

The principal goals of the workshop were to assist participants in identifying regional deficiencies in climate observing systems, to assess priority observing system needs in the region, and to initiate the development of regional action plans and proposals to fund improvements in observing systems.

The Workshop's significant achievement was its approval of a draft Resolution Concerning the Improvement of Global Climate Observing Systems in the Pacific Region. The text of the Resolution is available at the GCOS web site[6].

The Resolution encourages the countries of the region to support their NMHSs in the preparation of national reports on activities related to systematic observation and urges the preparation of a regional Action Plan that would form the basis for the development of

proposals for funding improvements for observing systems for climate. Significantly, a series of actions was specified in the resolution, that if taken by SPREP and the Pacific Island countries, would result in completion of the Action Plan by June 2001.

Further workshops are under development building on offers of support from Canada, Japan, UNEP and EUMETSAT, including the holding of the second, probably in Africa, in the next six to nine months.

Analysis and Synthesis of Reports on Global Climate Observing Systems (5/CP.5 9)

Decision 5/CP.5 requested the GCOS secretariat to work with the Convention secretariat to develop a process for synthesising and analysing national reports on observations. There are four essential foundations for determining properly the adequacy of a global observing system for climate to meet the Convention's needs: the first, guidance to ensure adequate and consistent information from the Parties, was established at COP-5. The second is full reporting by all Parties; reporting from only Annex I Parties, no matter how detailed, will severely hamper adequate analysis of the global systems. Preliminary work has begun on the remaining two foundations: the analysis and synthesis of the reports, and the development of a report to the Parties on the adequacy of national contributions to a global climate observing system.

Intergovernmental Process

Decision 14/CP.4 requested "IACCA, through the GCOS Secretariat to initiate an intergovernmental process for addressing priorities for action to improve observing systems and for identifying immediate, medium-term and long-term options for financial support." while decision 5/CP.5 requested the GCOS secretariat to continue this activity and to report on it to SBSTA-12.

The GCOS Secretariat took advantage of an informal meeting of government and other experts convened by Canada in February 2000, to consider the most appropriate form of intergovernmental process for improving observational systems. The participants strongly urged GCOS to pursue a multi-pronged approach: given the nature and range of the observing systems involved, they concluded that the best solution would be to make effective use of all of the existing intergovernmental mechanisms potentially available to GCOS through its sponsors agencies and their appropriate subsidiary bodies; to continue to engage the UNFCCC and its bodies, particularly SBSTA in addressing the specific needs associated with climate change; to encourage national co-ordination of all aspects of climate observations across the various disciplines and domains; and to increase the proportion of representatives of the operational community on the GCOS Steering Committee. These conclusions were communicated to the GCOS sponsoring agencies and to SBSTA-12 on behalf of the participants.

The Fifty-second Session of the WMO Executive Council (May 2000) and the Thirty-third Session of the IOC Executive Council (June 2000) each adopted a wide-ranging resolution on GCOS, with emphasis on its interaction with the UNFCCC, particularly with regard to decisions 4/CP.5 and 5/CP.5. It is anticipated that the matters related to the implementation of the systematic observations required by the UNFCCC will be brought to the attention of a

number of intergovernmental meetings over the next year including sessions of the WMO's Regional Associations II, III and IV (respectively, Asia, South America, and North and Central America); of the WMO's Commissions for Hydrology, for Climatology and for Basic Systems; and of the Joint (WMO/IOC) Commission for Oceanography and Marine Meteorology). It is hoped that similar mechanisms can be developed involving both UNEP and the FAO. It should be noted that ICSU at its twenty-sixth General Assembly in September 1999 requested that their constituent bodies should become more actively engaged in the matter of systematic observations.

GCOS Implementation Strategy

One of the key messages that has become apparent over the past year, due to the large number of agencies involved as Partners with GCOS in the implementation of global observing systems for climate, is the requirement for a clearly articulated Implementation Strategy that clearly identifies how governments will be involved as well as how GCOS will work with its Partners in the implementation of global observing systems for climate. A formal strategy will be considered by the GCOS Steering Committee at its next session in China in September 2000. It will emphasise the need to foster ownership by national governments in implementing a multidisciplinary and multidomain global observing system for climate by stressing the cost effectiveness of building on existing national systems that in many cases have been implemented and operated for other purposes including basic research. The strategy will also emphasise the key role of the COP in supporting the work of GCOS and its partners to implement a Parties-based global observing system for climate responsive to the needs of the Convention.

Notes:

[1] GCOS is co-sponsored by the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC) of UNESCO, the United Nations Environment Programme (UNEP) and the International Council for Science (ICSU).

[2] The GCOS Partners include the World Weather Watch (WWW), the Global Atmosphere Watch (GAW), WMO's Hydrology and Water Resources Programme (HWRP), the Global Ocean Observing System (GOOS), the Global Terrestrial Observing System (GTOS), the Global Environmental Monitoring System (GEMS), the Global Resource Information Database (GRID), the World Climate Programme (WCP, including data and monitoring, applications and services, impacts and responses, and WCP-Water), the World Climate Research Programme (WCRP), the International Geosphere-Biosphere Programme (IGBP), the Intergovernmental Panel on Climate Change (IPCC), the Committee on Earth Observation Satellites (CEOS), the Integrated Global Observing Strategy-Partners (IGOS-P), and the United Nations Framework Convention on Climate Change (UNFCCC).

[3] GCOS is a Partner in the Integrated Global Observing Strategy, which takes a strategic view across all Earth observing requirements, i.e. it looks at observing requirements for climate, but also includes the needs of other multiple domains. IGOS evaluates the capabilities of current and planned satellite and surface-based observing systems to meet the user requirements, organised by theme or category. The IGOS Partners include:

The Committee on Earth Observation Satellites (CEOS), which coordinates national agencies launching satellites;
Integrated research programmes on global change within the World Climate Research Programme (WCRP) and the International Geosphere-Biosphere Programme (IGBP);
The International Group of Funding Agencies for Global Change Research (IGFA);
International agencies sponsoring global observations, including the Food and Agriculture Organization of the United Nations (FAO);
Intergovernmental Oceanographic Commission of UNESCO (IOC), International Council for Science (ICSU);

United Nations Educational, Scientific and Cultural Organization (UNESCO), United Nations Environment Programme (UNEP), and World Meteorological Organization (WMO);
The Global Ocean Observing System (GOOS) and the Global Terrestrial Observing System (GTOS) as well as GC, which organise global-scale operational observations of the climate, oceans and land surface.

[4] SNN and GUAN monitoring and archiving is undertaken through the collaborative efforts of the Deutscher Wetterdienst, the Japan Meteorological Agency, the UK Meteorological Office, the US National Climatic Data Center, and the European Centre for Medium-range Weather Forecasts

[5] Except in limited areas

[6] See http://www.wmo.ch/web/gcos/Pacific_workshop_Aug_2000_res_re_GCOS.htm

- - - - -