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**INTERGOVERNMENTAL
OCEANOGRAPHIC COMMISSION**

**REPORT OF THE EIGHTH SESSION OF THE
WMO-IOC-UNEP-ICSU STEERING COMMITTEE
FOR GCOS**

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REPORT OF GCOS SC-VIII

1. OPENING OF THE MEETING

1.1 Welcome and Introduction

The Eighth Session of the Global Climate Observing System (GCOS) Steering Committee (SC) began at 09:30 on Tuesday 9 February 1999 at the Headquarters of the World Meteorological Organization (WMO) in Geneva, Switzerland. Prof. G.O.P. Obasi, Secretary-General of the WMO, formally opened the meeting by welcoming the participants to Geneva. He noted that this was the first meeting of the former GCOS Joint Scientific and Technical Committee (JSTC) under its new title of GCOS Steering Committee and expressed WMO's appreciation for the services provided by the two former Chairmen of the JSTC, Sir John Houghton and Prof. John Townshend. He welcomed Dr. Kirk Dawson as the new Chairman of the SC and also thanked the former Director of the GCOS Secretariat, Dr. Tom Spence, for his contributions to GCOS.

Prof. Obasi reminded participants of the need for GCOS to provide a tangible service to the bodies concerned with the issue of global climate change, and the considerable tasks placed upon GCOS, in conjunction with the agencies participating in the Climate Agenda, by the Fourth Session of the Conference of the Parties (COP-4) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Buenos Aires in November, 1998. He also stated that WMO, as a GCOS co-sponsor, would expect GCOS to identify specific actions required of member countries in support of the global observing systems for climate, and that the forthcoming Thirteenth WMO Congress would provide an opportunity to present those requirements to Members. Prof. Obasi closed his remarks by wishing the SC success in its work during this session and in all its future endeavours since its inauguration.

The Chairman, Dr. Dawson, thanked Prof. Obasi for his encouraging words and also welcomed participants to the meeting. He pointed out that this represented a watershed meeting for GCOS, in that he had recently taken on his responsibilities as Chairman of the SC, a new Director of the GCOS Secretariat was soon to be appointed¹, the mandate for GCOS had recently been modified with increased emphasis on implementation, and that governments, in the form of the Conference of the Parties (COP) to the UNFCCC, had presented GCOS with a great challenge to assist them in getting the systematic observations needed to implement the Convention. As a result, members would be challenged to provide direction for a new work programme for the GCOS Secretariat. He then invited participants to introduce themselves (see Annex 1 for list).

1.2 Outputs Required from this Meeting

Dr. Dawson presented an outline of his expectations of the meeting. He pointed out the need to identify the scientific and technical actions required to continue with the implementation of GCOS, including those to be taken by GCOS itself through the Secretariat, by GCOS in conjunction with the other observing systems partners, and by the national agencies and institutions which actually implement GCOS. In the latter context, actions would be needed to assist nations in developing workplans in support of GCOS and in their obtaining the resources required to carry them out. He also discussed the need for a set of actions which might be described as political, organizational and/or managerial to make the above scientific and technical actions effective,

¹ Dr. Alan Thomas was appointed as Director of the GCOS Secretariat on 11 July 1999.

including those addressing intergovernmental mechanisms to support GCOS and possible improvements to committee structures. Dr. Dawson referred specifically to the development of a workplan for the coming quadrennium which would be geared to the many immediate demands facing GCOS while recognizing current resource limitations, but which would nevertheless be capable of acceleration when additional resources became available. Such a workplan should contain actions which would lead to the preparation of performance measurement criteria against which progress in implementation (or lack thereof) could be broadly assessed and reported. He expected the elements of such a workplan to be presented for endorsement to the coming meeting of the Inter-Agency Committee on the Climate Agenda (IACCA), and that it would form the basis for a report to, and decision by, the WMO Congress in May. The workplan would also provide the basis for reporting to the meeting of the Subsidiary Body for Scientific and Technological Advice (SBSTA) of the Conference of the Parties (COP) to the UNFCCC in June, as well as providing a framework for the future work of the GCOS panels.

1.3 Adoption of the Agenda

The draft agenda (Annex II) was accepted as proposed, with the agreement that Item 3.8 would be discussed at the end of the meeting during an *in camera* session. The list of documents prepared for the meeting was reviewed and is presented as Annex III.

1.4 Conduct of the Meeting

Participants agreed on the detailed mechanisms of its conduct as proposed by the Chairman and the Secretariat.

1.5 Review of the Report of GCOS JSTC-VII

Dr. Michael Coughlan, Acting Director of the GCOS Secretariat, reviewed the action items from the previous two sessions of the committee. While all actions had been addressed, the following items still required additional attention through the Secretariat:

- (i) Investigate the possibility of holding an intergovernmental or national participants meeting to obtain commitments to the GCOS programme;
- (ii) Improve communications with national GCOS offices and/or points of contact, particularly regarding observing networks;
- (iii) Re-assess the role and functioning of the GCOS cross-cutting panels (the Global Observing Systems Space Panel (GOSSP), the Joint Data and Information Management Panel (JDIMP)), particularly in view of their supporting the other observing systems (the Global Ocean Observing System (GOOS), the Global Terrestrial Observing System (GTOS)) as well as GCOS;
- (iv) Prepare an annual status report on the state of the observing elements of GCOS;
- (v) Investigate the potential establishment of a GCOS 'Executive Panel' or similar structure to focus on the issue of obtaining the resources necessary to implement and sustain the GCOS networks.

The Chairman acknowledged the need to address these issues and pointed out that it was his intention that they would be considered under the appropriate agenda items at this meeting.

2. THE NEW MANDATE FOR GCOS

2.1 The New Memorandum of Understanding

Dr. Coughlan reviewed the main features of the revised Memorandum of Understanding (MOU) for GCOS (Annex IV), which had been formally signed by the Executive Heads of the four sponsors (WMO, IOC of UNESCO, UNEP and ICSU) and came into effect on 29 September 1998. The main revisions included:

- re-naming of the GCOS JSTC to the GCOS Steering Committee (SC) and the GCOS Joint Planning Office (JPO) to the GCOS Secretariat, to better reflect the shifting focus from planning to implementation and to be consistent with the nomenclature used for GOOS and GTOS;
- more direct reference to the needs and roles of the UNFCCC, Agenda 21, the UN Commission on Sustainable Development and the Climate Agenda, for systematic observations of the climate system;
- updated references to the component observing systems which together make up GCOS;
- revisions to the composition of the Steering Committee, including the addition of a Third Vice-Chairperson;
- revisions and updates to the financial arrangements and operation of the Climate Observing System Fund (COSF).

The Steering Committee expressed general satisfaction with the revised MOU, while noting concerns about the nature of some of the wording. Specifically, some members felt that the strengthening of some statements could be interpreted to mean that GCOS was intended to *make* the needed measurements itself, rather than facilitate the making of those measurements (to GCOS standards) through existing networks or new networks to be established by other agencies or organizations on behalf of GCOS. This could lead to confusion among funding agencies and even within national plans as to what is desired for GCOS itself and what the value added by GCOS to global observing of the climate system is actually intended to be. It was agreed that the facilitation role is unquestionably the desired one for GCOS and that this should be made clear at all times to all parties.

2.2 Expectations and Contributions of the Sponsors

2.2.1 WMO

Dr. Coughlan, in his substantive capacity as Director of the WMO World Climate Programme, indicated that WMO looked to GCOS to ensure the provision of observations in support of climate change detection, seasonal-to-interannual climate prediction, desertification and land degradation issues, and climate research. He saw GCOS as an integrator of the climate components of the various global and regional observation networks (the so-called GXOS's), ensuring that the needed observations were being obtained and facilitating the establishment of new networks or the enhancement of existing ones where current measurements were inadequate. This role included proper definition of the requirements for climate data, as had been the focus of much of the GCOS activity to date, as well as facilitating the 'institutionalization' of appropriate climate research networks into an operational framework. Dr. Coughlan noted the importance of the Integrated Global Observing Strategy (IGOS) initiative as an indication of the convergence of varied interests toward a coherent and comprehensive systems approach to environmental

observations. On the issue of support for GCOS, Dr. Coughlan indicated that this could be expected to remain at least at current levels² in the foreseeable future, but that this would be addressed in detail at the upcoming WMO Congress and Executive Council sessions in May³.

Mr. Peter Scholefield, Chief of the WMO World Climate Data and Monitoring Programme (WCDMP) Division, provided some specific expectations of GCOS on behalf of the WMO Commission for Climatology (CCI) and the WCDMP. These were addressed at various points during the meeting and included support in maintaining existing climate observing networks; filling gaps in the climate observation system in space, time and parameter domains; integrating climate data from new observation systems into the existing climate record; and emphasizing the importance of the historical climate record to the climate-monitoring-and-prediction process as well as encouraging steps to remove the deficiencies and inadequacies therein.

2.2.2 ICSU

The Executive Director of the International Council for Science (ICSU), Mr. Jean-François Stuyck-Taillandier, expressed the desire of ICSU, as a sponsor of all three Global Observing Systems (GCOS, GOOS and GTOS, the so-called G3OS's), to see them working very closely together in obtaining the observations needed for the many applications for which they were designed, including climate. He emphasized the importance of the IGOS initiative in providing an integrating framework in this regard, and was pleased to see GCOS taking an active role in its development. On the resource issue, he indicated that ICSU would continue to support GCOS at the current funding level (US\$20K per year) and suggested that GCOS should also consider the ICSU 'large grant' programme for potential additional support. In response to a query on the status of the ICSU review of the GCOS programme, Mr. Stuyck-Taillandier indicated that a preliminary report from the ICSU Advisory Committee on Environment (ACE) would be presented to the upcoming meeting of IACCA and a full report was expected to be available later in 1999.

2.2.3 UNEP

The United Nations Environment Programme (UNEP) representative, Dr. Arthur Dahl, informed the meeting that UNEP had recently reaffirmed the high priority of environment, observations, assessment and early warning in its programme objectives. This thrust included the collection of data through the assessment process and the delivery of results to users, including policy-makers. A new, coherent environmental observation and assessment strategy was to be completed by June and would set UNEP's relations with the G3OS's in context. The Executive Director of UNEP had expressed his commitment to supporting the G3OS's in a catalytic role. Although no support for GCOS was available for 1999, GCOS and the other G3OS's could, according to current plans, expect support of US\$20K per year beginning in 2000.

2.2.4 IOC

Dr. Colin Summerhayes, Director of the GOOS Secretariat, spoke on behalf of the Intergovernmental Oceanographic Commission (IOC) of UNESCO. He noted that the IOC was pleased to be a sponsor of GCOS and would continue to highlight the importance of GCOS in reporting to Member States. He invited GCOS to make a presentation to the upcoming IOC Assembly in July⁴. He noted the intimate link between GCOS and GOOS in that the ocean component of GCOS is the climate component of GOOS. IOC expected GCOS to continue to

² (Roughly US\$375K per year including the positions of Director and Administrative Assistant in the GCOS Secretariat).

³ WMO Thirteenth Congress (Cg-XIII), 4-26 May 1999, and Fifty-first Session of the Executive Council (EC-LI), 27-29 May 1999; Geneva, Switzerland.

⁴ Twentieth Session of the IOC Assembly, 29 June - 9 July 1999, Paris, France.

assist GOOS with design, implementation and resources for an ocean observing system. Under design, this meant working jointly through the Ocean Observations Panel for Climate (OOPC), JDIMP and GOSSP. Under implementation, this meant (a) assisting in the development of the Global Ocean Data Assimilation Experiment (GODAE) and its Argo initiative; (b) helping to expand the GOOS Initial Observing System and to gain commitments from nations to make their sustained systems part of GOOS; (c) working with GOOS to successfully establish the new Joint Technical Commission for Oceanography and Marine Meteorology (J-COMM); (d) jointly supporting the proposed International Conference on the Ocean Observing System for Climate planned for later in 1999⁵ (see also Section 3.4.2); and (e) providing strong links between the observing systems on the one hand and the Intergovernmental Panel on Climate Change (IPCC) and the UNFCCC on the other. Under resources, this meant working together to find new sources of funding for the G3OS's and to ensure that no opportunities were being overlooked. Dr. Summerhayes confirmed that IOC would continue to provide an annual contribution of US\$20K to the GCOS Climate Observing System Fund (COSF), as well as providing in-kind assistance through support for GOOS to take the lead role in meetings of the OOPC, the Tropical Atmosphere-Ocean (TAO) Array Implementation Panel and GODAE.

Dr. Jeff Tschirley, Director of the GTOS Secretariat, spoke on behalf of GTOS, as well as the Food and Agriculture Organization of the United Nations (FAO) as a potential future sponsor of GCOS. FAO had programme elements which included support for global change issues and associated observing systems for terrestrial, coastal and climate measurements. FAO was particularly interested in the possibility of co-sponsoring GCOS through the carrying out of joint activities as opposed to direct contributions to a particular operating fund. Regarding GTOS, he pointed out that it is aimed particularly at sustainable development issues and is funded to provide information to support this in five key areas, as outlined in the recently-published GTOS Implementation Plan⁶. GTOS had established GT-Net (GTOS Network), a framework for cooperation among 12 (currently) operational terrestrial observation networks, as a major step in its implementation. GTOS was focussing strongly on its users including the scientific and technical bodies of the various international conventions, the national entities which actually made the observations, and the research and scientific community which had been the primary driver for GTOS to date.

2.3 Expectations of the IPCC

Dr. Narasimhan Sundararaman, Secretary of the IPCC, outlined the work programme for the IPCC Third Assessment Report (TAR) and the five policy-relevant scientific/technical questions on which it is focussed, namely:

- (1) How has the earth's climate changed over the last 100 years at the regional/global scale, and can the observed changes be fully or partly attributed to human influences?
- (2) What do we know about the frequency and magnitude of natural climate variability, including daily and seasonal variability, the El Niño-Southern Oscillation (ENSO) phenomenon and the North Atlantic Oscillation, and what is the influence of the projected human-induced change in climate on them?
- (3) What do we know about the duration, location, frequency and magnitude of extreme events such as heat waves, droughts, floods, storms, tornadoes and tropical cyclones, and what is the influence of the projected human-induced change in climate on them?

⁵ International Conference on the Ocean Observing System for Climate (OCEANOBS 99), 18-22 October 1999, St.-Raphaël, France.

⁶ GTOS Implementation Plan, Version 2.0, GTOS Publication 17, December 1998.

- (4) Will increases in the atmospheric concentrations of greenhouse gases alter the risk of abrupt/non-linear changes in climate and, if so, can the risk be quantified?
- (5) What do we know about the potential for positive and negative feedbacks from the projected human-induced changes in climate to alter greenhouse gas concentrations and climate?

The IPCC looked toward GCOS, in cooperation with the other global observing systems, to provide the climate observations which were vital to answering these questions and to carrying out the overall assessments. He particularly highlighted the requirement for targeted observations to address particular issues (e.g. rapid non-linear climate change), as well as the need to address the problem of the decline in existing observational networks. He stated candidly that without the global observing systems for climate, and the research programmes such as the World Climate Research Programme (WCRP) and the International Geosphere-Biosphere Programme (IGBP), there could indeed be no IPCC assessments.

2.4 Expectations of the UNFCCC

Mr. Dennis Tirpak of the UNFCCC Secretariat reviewed the decisions of the Fourth Session of the Conference of the Parties (COP-4⁷) relating to research and systematic observations in support of the needs of the FCCC. Decision 14/CP.4 (see Annex V) was taken in response to the report⁸ on the adequacy of the global observing systems for climate, which had been requested by COP-3⁹ and prepared by GCOS on behalf of the G3OS's. It called *inter alia* for actions: to undertake programmes of systematic observation of the climate system, including the preparation of national plans; to support and strengthen existing national and international observing networks for climate and to reverse their decline, especially in developing countries; to submit information on national plans and programmes for climate observation in the context of reporting on research and systematic observation as an element of national communications to COP; to identify options and mechanisms for financial support; and to initiate an intergovernmental process to address the priorities for action. In a separate decision (2/CP.4, see Annex VI), COP-4 decided that the Global Environment Facility (GEF) should provide funding to developing-country Parties to build capacity for participation in systematic observational networks supporting convention objectives and for facilitating national and regional access to information and information services relating to climate. Mr. Tirpak reminded the meeting of the upcoming workshop¹⁰ on guidelines for the preparation of national communications by Parties to the UNFCCC and reiterated the invitation for GCOS to participate fully. He also emphasized the opportunity presented by the decision concerning the GEF in that this funding had heretofore not been available in support of taking observations, and he encouraged GCOS to take full advantage of this opportunity.

2.5 Expectations for Seasonal-to-Interannual Climate Prediction

Dr. Coughlan presented the perspective of the WMO Climate Information and Prediction Service (CLIPS), which looked to GCOS to ensure that the observing system needed for seasonal-to-interannual climate prediction was indeed in place. A major challenge in this regard was to stimulate the transition of appropriate research efforts into an operational mode. Dr. Coughlan reminded the meeting of the UN General Assembly Resolution 52/200 regarding international cooperation to reduce the impact of the El Niño phenomenon, and the Declaration of Guayaquil

⁷ Fourth Session of the Conference of the Parties to the UNFCCC, 2-13 November 1998, Buenos Aires, Argentina.

⁸ Report on the Adequacy of the Global Climate Observing Systems, GCOS Publication 48, October 1998.

⁹ Third Session of the Conference of the Parties to the UNFCCC, 1-10 December 1997, Kyoto, Japan (Decision 8/CP.3).

¹⁰ UNFCCC Workshop on generic issues related to Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, 17-19 March 1999, Bonn, Germany.

which resulted from the meeting of experts¹¹ held as one response to that resolution. The Declaration called for improved monitoring of the climate system and emphasized that commitment of new funding for multi-purpose space-based systems and *in situ* observing networks of the GCOS is needed toward this end. An El Niño retrospective was being carried out as part of the response to Resolution 52/200 and represented an effort where GCOS could make a significant contribution, for example in assessing the adequacy of the observing system for this particular event.

2.6 Expectations of the Research Community (WCRP)

Mr. Roger Newson of the WCRP Joint Planning Staff (JPS) outlined the needs of WCRP from GCOS. WCRP would depend on GCOS to provide the data needed to identify climate change over the coming decades, to explain the changes that occur, to separate natural from anthropogenic changes and to evaluate the validity of model predictions. Mr. Newson emphasized the importance of carefully calibrated, continuous, systematic measurements of fundamental climate variables and indicated that details of those requirements for WCRP had been provided to GCOS and IGOS through the AOPC and OOPC, which were jointly sponsored by WCRP. An outstanding need was for the establishment of an operational global ocean observing system drawing on the experience gained from the World Ocean Circulation Experiment (WOCE) and the Tropical Ocean and Global Atmosphere (TOGA) programmes, including comprehensive delivery of as much of the data as possible in near-real-time for quasi-operational assimilation into seasonal-to-interannual climate prediction models. Mr. Newson cited the specific requirements of the Climate Variability and Predictability (CLIVAR) programme as presented in its initial implementation plan¹² and also referred to the pressing need for cryospheric and hydrological data. He emphasized the importance of suitable data quality-control and management procedures and suggested that improvements in this regard could enhance the value of many existing observing systems within current funding levels. He noted that much stronger cooperation was needed between the world's meteorological services and the climate community in this regard. Mr. Newson also emphasized the importance of maintaining the basic observational infrastructure on which much research activity is strongly dependent, noting that research using operational data often results in new applications with major socio-economic and practical benefits.

Mr. Newson briefly reviewed some of the WCRP *in situ* observational research networks and highlighted the need to merge the data from these with remotely-sensed data to produce new and more comprehensive data sets. New data assimilation techniques permitted much more effective exploitation of the data and were likely to lead to changing views on the value of different observing systems for climate studies, and perhaps even moreso for the numerical weather prediction (NWP). This would likely affect the requirements for and availability of observational data, at least for the atmosphere. Mr. Newson also discussed the issue of transitioning research networks into operational or quasi-operational systems under the leadership of GCOS and described some of the basic characteristics of each type of system. The TOGA TAO array was the prime example of a research system which had made the transition and was now a pillar for operational ENSO predictions. Several other WCRP networks were candidates for such a transition, although identifying the operational funding to support them might be a difficult challenge.

Finally, Mr. Newson emphasized that WCRP saw GCOS as an essential complement to its work. WCRP needed and depended on GCOS for a wide range of systematic, long-term reference climate data and would cooperate fully with GCOS for their mutual benefit. He suggested that the role of GCOS needed to be more clearly defined for the broad user, especially with the proliferation

¹¹ International Seminar on the 1997-1998 El Niño Phenomenon: Evaluation and Projections, 9-13 November 1998, Guayaquil, Ecuador.

¹² CLIVAR Initial Implementation Plan, WCRP No. 103 and WMO/TD No. 869, June 1998.

of various systems and their acronyms, so that whenever a need was seen for new or refined climate data sets it would be GCOS that immediately sprang to mind.

2.7 Overall Big Picture: Where Do We Stand?

The Chairman, Dr. Dawson, summarized his interpretation of the various presentations as a step toward the drafting of specific actions and decisions which the SC could take in response to the needs expressed. He noted the wide range of expectations and the need, in view of the very limited resources available, for the SC to make the difficult decisions which would allow the GCOS Secretariat to focus on what was feasible while making a substantive contribution to the user communities. He also noted the opportunity presented by the COP decisions and the need for GCOS to take advantage of this opportunity in working more closely with governments. Dr. Dawson observed that the very small number of existing national plans for GCOS was indicative of the weakness of the approaches used to date. During the past eight years, GCOS, through its planning activities, had established what was needed in the way of observations; now the SC must focus on ensuring that those observations would be obtained and exchanged. In that regard, performance measures were needed for GCOS to be able to demonstrate the progress of success (or failure) in its implementation actions. The strengthened focus on implementation meant that GCOS would need to clarify what was meant by 'being part of GCOS', and to update its plans for the broad range of users of the data, for its sponsors, for policy-makers and for other relevant and interested parties. Finally, Dr. Dawson noted the need to address the issue of resources, both fiscal and human, since without them none of the users' expectations could be met. In view of the upcoming meetings of the WMO Congress and the IOC Assembly, early action on the need for resources was required.

DECISION

- (1) The SC, recognizing the changing nature of GCOS as a result of recent developments, requested the Chairman to lead the development of an updated and refined statement of the roles and responsibilities of GCOS and how the programme relates to the various other components of the global environmental observing system.**

3. THE WAY FORWARD

3.1 National Programmes for GCOS

Dr. Dawson introduced this item by reiterating the fact that GCOS is in fact the sum of the national contributions to it, with the details of and plans for such national contributions being embodied in the so-called 'national plans' or 'national programmes' for GCOS. He noted that there had been to date a disappointingly small number of these national plans, and that it was a high priority for GCOS to stimulate and assist nations in the development and implementation of such plans.

Prof. Paul Mason introduced the report¹³ of a study recently carried out in the UK to consider the potential UK contribution to GCOS, which could lead to a formal UK national plan for GCOS. He noted that this was the most recent of several attempts that had been made in the preceding several years to develop a UK national plan for GCOS, and was optimistic that it would lead to a continuation and augmentation of the current UK contributions to GCOS. He emphasized that national plans for GCOS must demonstrate an obvious connection to end users and a clear benefit to the mandate of each relevant department or organization in order to generate an

¹³ Final Report to the UK Met. Office: A UK Contribution to the Global Climate Observing System, P. Ryder, September 1998.

adequate level of support within the country involved. They needed to define carefully where current activities must be refined or augmented in both the short and long term, and to ensure continuity and reliability of the data collected. He was pleased that the UK science community had received the current document with considerable enthusiasm and that it had identified clear areas where a UK contribution would be feasible and highly beneficial. Prof. Mason strongly emphasized that in order for national activities to receive strong internal support, it must be very clear that they were not being done in isolation but rather as an important component of a much larger whole, as evidenced by the corresponding plans and programmes of other nations. Thus it was very important that GCOS ensure the development of a realistic number of such plans.

Mr. Volker Vent-Schmidt of the Deutscher Wetterdienst gave an update of GCOS activities in Germany. The German GCOS Secretariat had organized a national GCOS meeting (Hohenpeissenberg, 20-21 August 1998) at which all German representatives to GCOS panels had met to discuss various GCOS activities, including the then-pending GCOS report on the adequacy of global climate observing systems (GCOS-48) and plans for the Global Surface Network (GSN) Monitoring Centres (MC's), one of which Germany (Deutscher Wetterdienst (DWD)) had offered to host (the other being hosted by the Japan Meteorological Agency (JMA)). The MC's would monitor the availability and quality of the CLIMAT messages distributed on the WMO Global Telecommunication System (GTS), beginning in February 1999 for January 1999 data, and make the results available as soon as possible via a dedicated Web site (<http://www.dwd.de/research/klis>). An implementation meeting for the MC's had been held in Offenbach, Germany on 19-20 January 1999 to further the plans for these MC's (see also Section 3.4.1). Germany was also in the process of finalizing its national contribution to the GOOS Initial Observing System, with a plan to be submitted to the IOC Assembly in June/July. Regarding the Global Atmosphere Watch (GAW), operations were continuing at the Hohenpeissenberg GAW station and measurements would soon begin at the Ultra-high Observatory on the Zugspitze. Mr. Vent-Schmidt also reported on recent activities of the Global Precipitation Climatology Centre (GPCC), the Arctic Precipitation Data Archive (APDA), the Global Runoff Data Centre (GRDC) and the recently-established Satellite Application Facility (SAF) on Climate Monitoring, which was located at the DWD and jointly funded by EUMETSAT and other partners. More details on these and related activities could be obtained from the DWD Web site (see above).

Mr. Vent-Schmidt noted the difficulties experienced in gaining national support for GCOS activities due to the many and varied climate issues which were often seeking attention at any given time. The number of different players involved frequently led to confusion and competing demands on potential funding agencies. The problem could be mitigated by development of some form of unifying guidelines for nations in preparing national plans. He also mentioned a particular difficulty in Germany in including GTOS-related activities in a national programme, since these were generally handled at the state level and thus required additional effort to incorporate them into a federal or combined national plan.

Dr. Josef Cihlar spoke on behalf of GCOS national activities in Canada, where development of a second iteration of a GCOS national plan was underway. A workshop on the issue was to be held in late February leading to an updated plan later in the year. In the case of China, Prof. Yunqi Ni reviewed activities of the China Commission for GCOS (CCGCOS), which has been in operation since 1996. Prof. Ni reiterated the common difficulty encountered by national GCOS efforts where different and often very independent departments are responsible for the measurement of climate-related parameters.

Dr. Mike Manton, Chairman of the GCOS Expert Sub-group of the Australian GCOS/GOOS Secretariat, reviewed GCOS-related activities in Australia. An Australian plan for GCOS ("The Australian Climate Observing System") had been completed and many parts had been, or were

being, implemented. Australian GCOS activities were very closely linked with those identified in the WCRP/CLIVAR implementation plan. Although no new resources had been obtained for GCOS activities, continuation of current activities was assured. Dr. Manton emphasized the need for strong leadership from GCOS in the UNFCCC process, and that this process would be extremely important as a mechanism for entraining nations into participation in GCOS.

Following discussion on the issue of national plans for GCOS, the SC approved the following:

DECISIONS

- (2) The SC requested the Secretariat to develop guidelines for use by Parties to the UNFCCC in submitting information on national plans and programmes relating to their participation in global observing systems for climate as an element of their national communications to the COP. It urged the preparation of an initial draft for presentation at the SBSTA Workshop in Bonn on 17-19 March 1999 and an updated version for consideration by the SBSTA at its tenth session in May-June 1999.**
- (3) The SC recognized that there is limited experience in the preparation of national plans and programmes for global observing systems for climate, and that their development presents a number of unique problems. It noted in addition that development of responses by nations to guidelines for national communications would likely generate a range of questions and issues. The SC therefore requested that the Secretariat identify, assemble and develop, as needed, the information resources that would be required to address those questions, building on the experience of those nations that had prepared, or are in the process of preparing, national plans and programmes for GCOS. The SC expected that these information resources would include an update of the 1995 GCOS Plan and its Initial Operational System.**
- (4) The SC noted that there is a requirement to integrate national plans and programmes into a global programme and to assess how well the needs stated by GCOS are being met. It requested the Secretariat to develop a range of options for consideration by the SC on how such integration could be carried out. It also requested the Secretariat to prepare a progress report on actions taken to address the adequacy of global observing systems for climate for presentation to the next meeting of the COP in October 1999.**

3.2 Funding and Partnerships

Dr. Tom Spence led a discussion of this issue from the perspective of the experience he had gained as the former Director of the GCOS Secretariat since its inception in 1992. He noted that support for GCOS could be broadly separated into two categories: support for the GCOS Secretariat itself for coordination activities such as facilitating the GCOS planning process, organizing panel meetings, publications, communications, etc.; and support for implementation activities to actually establish the networks defined as the GCOS Initial Operational System (IOS). Funding for secretariat activities came primarily from two sources: the WMO and the other sponsors provided about US\$400-450K as a basic contribution, while an additional total in the area of perhaps US\$1.5 million had been provided by various agencies over the preceding six years in support of a range of specific projects. This funding arrangement had been reasonably adequate in the early years of the programme, but was well short of current requirements as the implementation phase of GCOS was gaining momentum and particularly in view of the many new demands of responding to the requests of the UNFCCC.

Implementation of GCOS systems was primarily in the hands of national entities with international coordination involving the many GCOS partners with observational capabilities, such as the Global Observing System (GOS) of the WMO World Weather Watch (WWW) and the WMO Global Atmosphere Watch (GAW) in the atmospheric domain, as well as various ocean and terrestrial observation networks falling under the umbrella of GOOS and GTOS. In addition, many important observing components were the responsibility of international research programmes such as WCRP and IGBP. This led to a very diffuse arrangement with a wide range of funding agencies and mechanisms which were often difficult to motivate toward addressing long-term climate concerns

As part of the discussion of potential sources of funding for GCOS, Mr. Alan Cross of the European Commission noted the recent approval of the European Union Fifth Framework Programme for Research, Technological development and Demonstration (RTD) for the years 1998-2002. A substantial amount of funding had been targeted to key actions in the area of global change, climate and biodiversity, including support for the development of a European component of the global observing systems for climate as well as research to understand, detect, assess and predict global change processes.

It was also noted during the discussion that GCOS had in the past not focussed on obtaining support from individual countries for network implementation, working instead through intergovernmental and international organizations to generate support, and that a change in this approach might now be appropriate. The well-understood difficulty of securing the needed long-term support for operational, continuing observations and processing of data was reiterated. The possibility of seeking support from agencies such as the World Bank, the Inter-American Development Bank, the UN Foundation and the Asian Development Bank was discussed. It was acknowledged that the solicitation of funding from such sources would require substantial and possibly specialist or professional effort, and the possibility of engaging such assistance was raised. These discussions led to the following decision being approved by the SC (see also Section 3.5):

DECISION

- (5) The SC requested that the Secretariat, in consultation with GOOS and GTOS: investigate and report on the funding difficulties being experienced by both nations and international agencies that are associated with implementing, operating and coordinating the global observing systems for climate; assess any barriers in making use of national and international assistance programmes, such as the GEF, for these purposes; and make recommendations on appropriate actions which could be taken to address such barriers. The SC noted that it would need to provide an initial identification of some of the possible immediate, medium- and long-term options for financial support to the SBSTA at its upcoming session in May-June, 1999.**

3.3 Intergovernmental Mechanisms

One of the specific requests of the COP-4 decision (Annex V, Paragraph 10) was that the agencies participating in the Climate Agenda, through the GCOS Secretariat, initiate an intergovernmental process for addressing the priorities for action to improve global observing systems for climate in relation to the needs of the convention and for identifying immediate, medium-term and long-term options for financial support. Discussion on this issue was led by Mr. Bob Winokur, who reviewed some of the possible mechanisms including an intergovernmental meeting or perhaps a series of such, a targeted GCOS commitments meeting, and establishment of an intergovernmental climate agency or possibly some form of intergovernmental implementation

panel. Participants were reminded that an intergovernmental meeting on climate had been held some years ago (1993) with very limited success in the long term, and that what was really needed was a continuing mechanism or process rather than a single event. The possibility of establishing an intergovernmental board was discussed by several participants, possibly focussing on climate research as well as on monitoring and hence being concerned with the interests of WCRP as well as GCOS and the other global observing systems. The current existence of an intergovernmental committee for GOOS (I-GOOS) was acknowledged, as was the need for the G3OS's to present an integrated front to nations when encouraging them to contribute to global monitoring.

DECISION

(6) The SC noted the invitation of COP-4 for IACCA, through the GCOS Secretariat, to initiate an intergovernmental process for addressing the priorities for action to improve global observing systems for climate and noted that the GCOS-JSTC had explored this question on a number of occasions in the past. It requested that the Secretariat explore and report on the various options suggested at this meeting and at the previous meeting of the JSTC, especially the concept of establishing an intergovernmental board for GCOS. It further requested that such exploration include consultation with WCRP, and others as appropriate, on the possibility of such a board being focussed on both research and monitoring needs. The SC urged the Secretariat to seek advice on such mechanisms at the upcoming meetings of IACCA (March), the WMO Congress (May) and the G3OS Sponsors (June), noting the need to be in a position to address this matter at the meeting of COP-5 in October of 1999.

3.4 Implementation of GCOS

3.4.1 Atmosphere (AOPC)

Dr. Mike Manton, Chairman of the GCOS/WCRP Atmospheric Observation Panel for Climate (AOPC), reported on activities of the Panel and related developments since the previous meeting of the Steering Committee.

In March 1998, the AOPC Chairman had represented the Panel at the 19th Session of the WCRP Joint Scientific Committee (JSC) in Capetown, South Africa. The JSC welcomed the progress in establishing the GSN and GUAN and endorsed plans for further developments. It urged close liaison between AOPC activities and WCRP projects in order that support could be provided for specific WCRP needs such as observations of stratospheric water vapour and the monsoon system. The JSC recognized the merits of implementing a climate observing system as an independent programme, drawing on and fundamentally complementing the operational activities of the WMO, IOC and other bodies.

In April 1998, the Fourth Session of the AOPC had been held jointly with the Fourth Session of the JDIMP in Honolulu, USA and a full report had been published¹⁴. Dr. Manton highlighted some of the activities and decisions taken at that meeting, with details being available in the report. Dr. Manton also reported on the Extraordinary Session of the WMO Commission for Basic Systems held in Karlsruhe, Germany in October 1998. That meeting had endorsed the proposed 'best practices' for GCOS networks and had encouraged strong liaison between AOPC and the newly-created CBS Open Programme Area Group (OPAG) on Integrated Observing Systems, most logically through one of its expert sub-groups.

¹⁴ Report of the Joint Meeting of the GCOS/WCRP Atmospheric Observation Panel for Climate and the GCOS/GOOS/GTOS Joint Data and Information Management Panel, Fourth Session (GCOS-45).

The AOPC had also been involved in a number of very productive workshops in the preceding several months. An AOPC-OOPC Workshop on Global SST Data Sets had been held at the International Research Institute (IRI) for Climate Prediction (Columbia University, Palisades, USA, 2-4 November 1998) to address the problem of inconsistencies in SST analyses from various agencies, and had recommended criteria to be satisfied by GCOS SST analyses to minimize or eliminate such problems. It had also recommended the establishment of an international working group under the AOPC and/or OOPC to continue sea-surface temperature (SST) intercomparisons and to develop improved standards for such comparisons¹⁵. A full report with recommendations would be published in due course in the GCOS report series. A workshop had also been held in Melbourne, Australia in December of 1998 on the issue of climate extremes¹⁶. This had been a follow-up to an earlier meeting in Asheville, USA, held to encourage the development of climate data sets and analysis techniques aimed at determining whether extreme climate events are becoming more extreme or variable. The Asia Pacific region had not been well represented in Asheville and hence the Melbourne workshop had been held to encourage regional participation in this activity. Participants had recognized the value of maintaining and enhancing the national infrastructure needed to monitor climate extremes, including the nurturing of GSN sites in each country with the collection and analysis of daily observations being a high priority. It had been agreed to hold a follow-on workshop in late 1999 to prepare a regional report on trends in climate extremes as a contribution to the IPCC Third Assessment Report (TAR).

In January 1999, a workshop had been held in Offenbach, Germany to advance the implementation of real-time monitoring and quality control of GSN precipitation and temperature data. This monitoring would be carried out by the Deutscher Wetterdienst (Germany) and the Japan Meteorological Agency and would be crucial to ensuring the availability and quality of the GSN data in the long term. Mr. Vent-Schmidt of the DWD, in a later presentation to the SC, elaborated on some of the details of this workshop and its conclusions. He noted that in 1998 less than 50% of the then-current total of 980 stations were reporting the expected data, with a downward trend toward the end of the year. A prime objective of the monitoring centres would be to provide the data which would lead to action to reverse this trend and ultimately to ensure the timely availability of high-quality observations from the GSN. The full report of the workshop would be available in the near future¹⁷.

Dr. Manton highlighted some of the future plans for AOPC, including completion of the initial AOPC plan; solidifying the GSN data stream; establishing feedback from GCOS to GSN and GUAN observing agencies regarding the observations being obtained; identifying key satellite data to complement GSN and GUAN data; supporting IPCC TAR work on climate extremes; resolving SST and sea ice issues; identifying key GCOS precipitation products and atmospheric constituents as well as radiation budget observations (including clouds and aerosols); supporting OOPC activity on surface observations and products; monitoring emerging technologies, especially GPS-met; and promoting capacity-building for GCOS.

Following Dr. Manton's presentation and subsequent committee discussions, a number of decisions were approved concerning the AOPC:

¹⁵ Working group subsequently established, under the chairmanship of R. Reynolds of the NOAA National Climatic Data Centre.

¹⁶ Asia Pacific Network Workshop on Climate Extremes, December 1998, Melbourne, Australia.

¹⁷ Report of the GCOS Surface Network (GSN) Monitoring Centre Implementation Meeting (GCOS-53).

DECISIONS

- (7) The SC requested the Secretariat to seek a formal link between AOPC and the WMO/CBS Expert Team on Observational Data Requirements and Redesign of the GOS.
- (8) The SC noted the recommendations from the recent AOPC-OOPC Workshop on Global SST Data Sets (Palisades, USA, 2-4 November 1998) and expressed its appreciation to the IRI for hosting the meeting.
- (9) The SC endorsed the need for an AOPC-OOPC project on SST/Sea-Ice Analysis aimed at identifying and systematically minimizing differences in the analyses produced by the main centres. It requested the AOPC to develop terms of reference for the project, including a specific duration for the activities involved.
- (10) The SC noted the outcome of the Asia-Pacific Network (APN) Workshop on Climate Extremes (Melbourne, Australia, December 1998) and endorsed the value of a follow-on workshop to produce a regional report for the IPCC Third Assessment Report.
- (11) The SC noted the results of the recent workshop on Implementation of the GSN Monitoring Centre (Offenbach, Germany, 19-20 January 1999) and expressed its appreciation to the DWD for hosting it. It also recognized with appreciation the ongoing contributions of DWD and JMA (Japan) in carrying out near-real-time monitoring of GSN data.
- (12) The SC noted with appreciation the continuing efforts of ECMWF and the WMO/CBS in support of the GUAN.
- (13) The SC endorsed the proposal that the provision of historical GSN data be extended to include precipitation, pressure and winds as well as temperature, and daily as well as monthly data.
- (14) The SC requested the Secretariat to facilitate, as a matter of some urgency, the formal request from WMO to NMHSs seeking historic daily GSN data and associated metadata.
- (15) The SC recognized the need to establish direct feedback to the operators of GSN and GUAN stations as an integral part of the operation of the GSN and GUAN.
- (16) The SC endorsed the overall data system planned for GSN and GUAN.
- (17) The SC noted the improving state of the GUAN and encouraged the AOPC to pursue the steps needed toward its completion.
- (18) The SC requested the Secretariat to work with AOPC towards establishment of a project office for GSN and GUAN, building synergistically on existing efforts being carried out by the WMO Secretariat.
- (19) The SC endorsed the proposed actions by AOPC-GOSSP to secure the satellite measurements needed to complement GUAN data and to determine the broad-based global top-of-atmosphere radiation budget.

- (20) The SC endorsed the proposed action by AOPC to investigate the needed links between GCOS and the WCRP/Global Energy and Water Cycle Experiment (GEWEX) Global Precipitation Climatology Project, with respect to global precipitation measurements complementing those of the GSN.
- (21) The SC noted and endorsed the potential role for GCOS in adding value to GAW measurements through international calibration activities.

3.4.2 Oceans (OOPC)

Dr. Neville Smith, Chairman of the GCOS/GOOS/WCRP Ocean Observations Panel for Climate (OOPC), reported on the activities of the Panel since the previous meeting of the SC and plans for the future. Significant activities included the Third Session of the OOPC¹⁸ in Grasse, France (6-8 April, 1998) and associated meetings such as the first and second meetings of the GODAE International Steering Team (January and July, 1998), the 'Sydney Implementation Workshop'¹⁹ (March 1998), the Argo workshop (Tokyo, Japan, 7-8 July 1998), the AOPC/OOPC SST Workshop (November 1998) which had also been referred to by Dr. Manton, and the Second Meeting on the Implementation of Global Ocean Observations for GOOS/GCOS (Paris, France, 30 November 1998).

From a phenomenological point of view, the OOPC had several drivers: seasonal-to-interannual climate prediction (e.g. ENSO forecasting); monitoring and prediction of climate change; other climate issues such as contributing to a basic service for climate; and short-range ocean forecasting. The OOPC strategy for responding to these drivers included contributing to the establishment of an effective body whose prime mission was the implementation of operational ocean observations for climate (the new WMO/IOC Joint Technical Commission for Oceanography and Marine Meteorology, or J-COMM, had resulted from such efforts and was expected to be approved by the WMO and IOC governing bodies during 1999); facilitating an integrating, 'frontier' pilot project aimed at demonstrating the feasibility and practicality of real-time global-ocean-data modelling and assimilation systems (the GODAE initiative²⁰, which had now reached its pre-operational phase); carrying out specific focussed activities and projects (workshops, the Argo initiative to establish a global array of autonomous profiling floats, various joint projects); and exploiting relevant international activities and events such as the occurrence of the 1997/98 El Niño and the UNFCCC/COP process.

Dr. Smith also elaborated on plans for the International Conference on the Ocean Observing System for Climate ('OCEANOBS99'), aimed primarily at obtaining broad input from the ocean research and operational community to develop a consensus on the ideal mix of elements and methods needed for an efficient and cost-effective ocean observing system. This conference was to be held in St.-Raphaël, France in October 1999 under the auspices of the WCRP, GCOS and GOOS, through the OOPC and the CLIVAR Upper Ocean Panel. It promised to be a watershed event in the design and establishment of an ocean observing system for climate and Dr. Smith invited the GCOS SC to support it to the maximum extent possible.

Following discussion on Dr. Smith's presentation and related issues, the committee approved the following:

¹⁸ Report of the Third Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (GCOS-44).

¹⁹ (First) Workshop on the Implementation of Global Ocean Observations for GOOS/GCOS, 4-7 March 1998, Sydney, Australia.

²⁰ Details available on the GODAE homepage at <http://WWW.BoM.GOV.AU/bmrc/mrlr/nrs/oopc/godae/homepage.html>

DECISIONS

- (22) The SC welcomed the initiative of the OOPC in convening the first International Conference on the Ocean Observing System for Climate (OCEANOBS99), to be held in St.-Raphaël, France from 18-22 October 1999. It recognized the important role of this conference in implementation of the GCOS Initial Operational System (IOS) and in beginning the process of enhancement with CLIVAR activities, and agreed that GCOS would act as a co-sponsor of the conference. The SC noted that preparation activities for OCEANOBS99 would provide an important input for COP-5 with respect to ocean observations for climate, and asked that the Scientific Organizing Committee ensure that this aspect be taken into account. It also asked that committee to identify issues which would impact on other components of GCOS and to report to the next meeting of the SC on these outstanding issues.
- (23) The SC endorsed the pilot project GODAE and associated activities such as Argo, and encouraged the OOPC to continue its work on these initiatives. In particular, it supported the strengthening of GODAE activities in the area of data assimilation and modelling.
- (24) The SC commended the actions taken by the OOPC through various workshops and studies. In particular, it endorsed the need for a commissioned study on the upper ocean thermal network, including data-processing activities. These networks were a critical element of the GCOS IOS and it is timely to revisit the design and provide a plan for future operation.
- (25) The SC supported the high priority being given by the OOPC to the integration of remotely-sensed and *in situ* data and noted that the GOSSP would also play an important role in this regard, as would the OCEANOBS99 conference.
- (26) The SC noted and welcomed the progress made in the establishment of a WMO/IOC Joint Technical Commission for Oceanography and Marine Meteorology (J-COMM). It recognized that this initiative, *inter alia*, would provide a permanent mechanism for implementing, monitoring and maintaining the ocean observing system for climate.
- (27) The SC recognized the importance of the climate component of GOOS in characterizing the global climate system and noted with appreciation the support of OOPC meetings by GOOS. It urged the G3OS sponsors to ensure continuing financial support and priority for GOOS among their programmes.

3.4.3 Terrestrial (TOPC)

Dr. Josef Cihlar, Chairman of the GCOS/GTOS Terrestrial Observation Panel for Climate (TOPC), reviewed activities of the TOPC and discussed the Panel's plans for the future. He reminded the meeting of the main issues and drivers for the Panel, namely: the terrestrial carbon cycle and its importance in light of the requirements of the Kyoto Protocol (carbon sinks, land use and land-cover changes); the hydrological cycle and its relation to land productivity and the supply of usable water; and the needs of the conventions (biodiversity, desertification and especially the UNFCCC). Progress had been made in the establishment of GCOS Terrestrial Networks (GTN's), albeit it limited progress in some cases. For the glacier monitoring network (GTN-G), foundation letters had been sent to potential participants (November 1998) and a number of positive responses had already been received. Current issues included the sparse and variable global coverage of glacier monitoring, the absence of Tier 5 coverage (i.e. repeated complete coverage by

satellite remote sensing, in the terminology of the Global Hierarchical Observing Strategy²¹ defined by GCOS/GTOS), and a lack of coordination of reporting needs with other groups (e.g. ICSU). Regarding the permafrost network (GTN-P), Dr. Cihlar highlighted some resolutions and recommendations taken at a meeting of the International Permafrost Association (IPA) in Yellowknife, Canada (June, 1998) with respect to the monitoring and reporting of annual active-layer depth and permafrost temperatures; encouragement for establishing a circum-Antarctic Permafrost Monitoring Network; and establishment of a Standing Committee for Data, Information and Communication. The TOPC sought endorsement of TOPC efforts in cooperation with the IPA for developing a GTN-P, as well as support from the GCOS Secretariat in distributing invitations to participate. With respect to a hydrology network, different groups had undertaken various initiatives in recent years (e.g. WMO/WHYCOS, GRDC, WCRP/GEWEX) for which the goals and requirements overlapped but which had not yet added up to consistent, robust global coverage and uniform access to data. It was proposed to organize in the near future a meeting of groups interested in global hydrology to address G3OS needs and prepare a plan of action among the stakeholders. The DWD (Germany) had kindly offered to host such a meeting.

With regard to terrestrial data management, Dr. Cihlar pointed out that TOPC had identified some 40 data sets and metadata for which relevant information had been forwarded to the Global Observing Systems Information Centre (GOSIC). GOSIC itself had adopted the NASA Global Change Master Directory (GCMD) and established a database on their server using these fields, as well as adding a number of hyperlinks to centres which had the data and building a search capability to find them (see <http://www.gos.udel.edu>).

Dr. Cihlar also reported briefly on progress in the Global Observation of Forest Cover (GOFC) and Net Primary Productivity (NPP) pilot projects in which TOPC was involved. GOFC was one of the six projects originally selected by the Committee on Earth Observation Satellites (CEOS) Strategic Implementation Team (SIT) to test the IGOS concept, and TOPC members had worked closely with its leaders in furthering this initiative. Regarding the NPP project, its objectives were to distribute a global standard NPP product to regional networks for evaluation and translation into regionally-specific crop-, rangeland- and forest-yield maps for land management applications, and to use the FLUXNET global network of eddy-covariance flux towers to translate NPP into Net Ecosystem Productivity (NEP, the difference between NPP and the loss in terrestrial carbon resulting from the decay of organic matter) for use in global climate and carbon cycle models. It was possible that efforts in both of these projects could eventually be combined in a terrestrial carbon cycle study under the IGOS thematic approach (see 3.4.4.2 below). This would be addressed by TOPC at its next meeting in July of 1999.

Discussion on the information presented by Dr. Cihlar included acknowledgement of the many difficulties involved in establishing rigorous global terrestrial observational networks, and encouragement from the SC for the TOPC to continue along the paths it was following. Suggestions were made regarding the potential benefits of closer cooperation with the global research programmes such as WCRP and IGBP. The following decisions concerning the TOPC were approved:

DECISIONS

(28) The SC noted with appreciation the progress achieved on the establishment of glacier, permafrost and ecology networks through the efforts of the TOPC.

²¹ Global Hierarchical Observing Strategy (GHOST), GCOS-33.

- (29) The SC encouraged the enhancement and further development of the glacier observation network (GTN-G), for example by incorporating satellite data (as Tier 5) through new initiatives such as the proposed Global Land Ice Monitoring System (GLIMS), by establishing new sites in data-sparse regions, and by revitalizing existing sites where measurements have been discontinued. It endorsed efforts aimed at developing common reporting, performance-measurement and review procedures with ICSU and other appropriate groups.
- (30) The SC endorsed the establishment of a permafrost network (GTN-P) based on the guidelines and observation-strategy documents developed by TOPC, and requested that the GCOS Secretariat, in cooperation with the GTOS Secretariat, send out invitations to participate in GTN-P.
- (31) The SC considered the establishment of a GCOS hydrology network an important step toward meeting the climate observation needs for hydrological information. It recognized the wide range of activities at both national and international levels in this area and encouraged the TOPC, in consultation with other appropriate groups and programmes and with support from the GCOS Secretariat, to work toward organizing an expert meeting on the subject. The SC acknowledged with appreciation the offer of the DWD to host such a meeting.
- (32) The SC welcomed and endorsed the suggestion that GTOS and GCOS increase collaboration in the establishment of GT-Net and GSN, respectively, to maximize the potential benefits for both systems.
- (33) The SC recognized the importance of the Global Observation of Forest Cover (GOFC) and Net Primary Productivity (NPP) pilot projects toward establishing an initial terrestrial observation system for climate purposes. It also recognized the relevance of these projects to an understanding of the global carbon cycle and recommended further consideration of the role they can play in quantifying the components of this cycle. Toward this end, the SC encouraged the TOPC to pursue further discussions, both within the projects and as part of the analysis initiated in the framework of IGOS.
- (34) The SC acknowledged the importance of the initial steps taken in the establishment of terrestrial observation networks for climate, while recognizing that many of these networks have serious gaps in coverage, and that in many cases the sites involved lack the funding or institutional support necessary to reliably and effectively participate in a long-term global observing system. The SC recommended that these issues be brought to the attention of nations as part of the response to COP-4, along with suggested remedial actions.
- (35) The SC recognized the fundamental importance of effective interaction with research programmes such as IGBP and WCRP in establishing a global observing system for climate, as well as the importance to those programmes of long-term systematic observations for climate. It acknowledged with appreciation the co-sponsorship by WCRP of the AOPC and OOPC, while noting that enhanced collaboration with research programmes is desirable in the terrestrial domain. The SC therefore invited the IGBP and WCRP to increase their participation in the work of TOPC through ensuring effective representation at its meetings and through co-sponsorship of the Panel.
- (36) The SC recognized the importance of the climate component of GTOS in characterizing the global climate system and noted with appreciation the support by GTOS for TOPC

meetings. It urged the G3OS sponsors to ensure continuing financial support and priority for GTOS among their programmes.

3.4.4 Cross-Cutting Activities

3.4.4.1 Data and Information Management (JDIMP)

Mr. Ken Davidson, representing Mr. Tom Karl, Chairman of the GCOS/GOOS/GTOS Joint Data and Information Management Panel (JDIMP), updated the meeting on recent activities and plans of the Panel. Mr. Davidson focussed in particular on the latest version of the G3OS Data and Information Management Plan (January 1999), which had been produced following discussions at the April/May 1998 session of the JDIMP in Hawaii, USA¹⁴. He highlighted the Terms of Reference for JDIMP as outlined in the plan, as well as the data and information management model for the G3OS's and the role envisaged for JDIMP in implementing such a model. This role focussed on oversight and monitoring to ensure that the G3OS data and information systems were meeting stated needs, including adhering to the G3OS data policy principles and conforming to the 'principles of environmental monitoring' which had been accepted by the JDIMP and which were detailed in the plan. He reiterated the need for full and open sharing of G3OS-relevant data and products for all users and reminded the group of difficulties that had been encountered in some instances in this regard. Mr. Davidson also discussed the need for JDIMP to develop the performance measures for G3OS networks and the data-management chain which would allow such oversight and monitoring to be carried out. He outlined an ambitious schedule for the development and testing of such performance measures over the coming year, although it was not clear at this stage that such a schedule could be adhered to, particularly in view of the fact that the current Chairman of JDIMP was unlikely to be able to continue in that role.

During discussion on this issue, it became evident that the optimum future role for JDIMP in the G3OS structure was not totally clear. The JDIMP draft data and information plan was seen as an umbrella document for individual plans being developed by the G3OS's. There was clearly a need for the expertise of JDIMP members in each of the science panels. There was also an obvious need for a broad range of expertise in JDIMP membership, including research scientists who use and understand global data sets and data and information management experts responsible for significant components of existing operational and research-oriented global information management systems. With regard to the data exchange policy issue, it was agreed that concrete examples of the impact of existing principles and resolutions on the exchange of climate data were needed before approaches should be made to external organizations. As a result of these discussions, the SC approved the following:

DECISIONS

- (37) The SC agreed to review the draft G3OS Data & Information Management Plan and provide comments to the SC Chairman by the end of March 1999.**
- (38) The SC expressed its appreciation for the efforts of JDIMP in preparing the draft information management plan and in carrying out its other activities. It encouraged the Panel to continue with its GOSIC and other pilot projects.**
- (39) The SC requested JDIMP to increase its activities in the area of data exchange policy, taking into account the ongoing activities of the WMO in this regard, including the work of the WMO Technical Commission for Climatology. In particular, it requested the Panel to document concrete examples of data-policy-driven problems in the international exchange of GCOS data, including any impacts of WMO Resolution 40 on**

the collection and exchange of global climate data. The SC requested that such information be available for presentation to COP-6 in 2000.

3.4.4.2 Space-Based Measurements (GOSSP)

Prof. Francis Bretherton, Chairman of the GCOS/GOOS/GTOS Global Observing Systems Space Panel (GOSSP), reported on his participation in a meeting of the CEOS/SIT held in January 1999 in La Jolla, USA. In collaboration with Dr. David Williams of EUMETSAT, representing CEOS, he discussed the strengthening of cooperation between CEOS and GOSSP under the umbrella of the IGOS initiative. GOSSP would take a major role in carrying out the analysis of gaps and overlaps in a number of areas, between the needs for space-based observations in a number of areas on the one hand and the current programmes and plans of the CEOS agencies for fulfilling those needs on the other hand. A group of six demonstration or 'pilot' projects had been established by CEOS/SIT to assess the feasibility and demonstrate the potential benefits of the IGOS approach for coordinating environmental observation activities among the agencies and nations involved. The individual-project approach had been expanded to a broader 'theme' structure under IGOS, and the GOSSP Chairman had been invited to identify a set of themes for potential future analysis which could be presented for consideration to the June 1999 meeting of the IGOS Partnership. Prof. Bretherton had identified the following themes or categories in this regard: Oceans, Terrestrial, Atmospheric Chemistry and Climate, Weather Prediction, Coastal Areas, Disaster Management, Carbon Storage and Cycling, Climate Variability and Change, and Climate Impacts. The CEOS/SIT meeting had proposed that the Oceans theme be addressed immediately by an 'Oceans Theme Team' which had been established under the leadership of NASA, in collaboration with GOSSP.

Prof. Bretherton also reported on the Fourth Session of the GOSSP, which had been held in the USA in October 1998 and of which a draft report²² had been distributed for this meeting. This had been an abbreviated first meeting of the Panel under Prof. Bretherton as its new Chairman. Prof. John Townshend, outgoing Chairman of the GCOS JSTC, had briefed the members present, some of whom were attending for the first time, on the invitation from CEOS and the IGOS Partnership for GOSSP to provide support to them in carrying out gap analyses and related activities in the process of coordinated planning for future observation activities. Especially important was the role of GOSSP in ensuring that the needs of the G3OS for space-based observations, as defined by their various science panels, were kept reliably up-to-date and were appropriately incorporated in the analysis process. Prof. Townshend had also presented proposed new terms of reference and structure for GOSSP which had been approved by the GOOS and GTOS Steering Committees and which would be considered by GCOS at the next session of the GCOS SC (i.e. at this meeting). GOSSP would consist of the Chairman and two members from each of the G3OS's, with appropriate experts from other organizations such as WCRP and IGBP, including up to three from CEOS, being invited to participate in each meeting. The basic strategy of GOSSP would be to facilitate communication between the space agencies and the users of long-term global observations; to establish clarity and transparency on needs and plans for space-based earth observations; to identify major issues requiring decision and/or specific action; to build on the existing CEOS/WMO database of requirements and capabilities by examining ways of making the database more widely accessible and by extending existing statements of requirements to include information on intermediate products and end users; and to liaise with other IGOS user groups such as the Numerical Weather Prediction, WCRP and IGBP communities. Some major current issues included continuity of ocean surface measurements (vector winds, sea-surface height, temperature, colour and salinity), land surface measurements (global vegetation index, high-

²² Report subsequently published as GCOS-47, Report of the Global Observing Systems Space Panel, Fourth Session, 22-23 October 1998, College Park, Maryland, USA.

resolution land surface data), various atmospheric issues and general issues such as instrument calibration and validation. Following discussion, the SC approved the following:

DECISIONS

- (40) The SC endorsed the themes proposed by GOSSP for classifying areas of interest under the IGOS initiative including the explicit identification of an atmospheric chemistry and climate component. It also strongly supported the proposal to focus on the 'Oceans' theme for an initial, fast-track gap/overlap analysis. It noted that results of this analysis are to be available for 30 April 1999 if possible.**
- (41) The SC requested the GCOS science panels, in consultation with GOSSP, to review the latest information on GCOS data requirements in the WMO/CEOS database to confirm its validity and provide updates as appropriate.**
- (42) The SC endorsed the terms of reference for GOSSP as presented in Annex V of the draft report of the preliminary GOSSP-4 meeting (Washington, USA, 22-23 October 1998).**

3.5 Recommendations and Reports to Other Bodies

Dr. Coughlan presented a list of upcoming meetings of major importance to GCOS and for which direct input from the SC and/or the GCOS Secretariat would be required, as indicated below:

- Third Session of the Inter-Agency Committee on the Climate Agenda; to be held on 11-12 March in Paris, France. A report would be required on the GCOS response to the decisions of COP-4 and SBSTA-9;
- SBSTA Workshop on generic issues related to Guidelines for the preparation of national communications by Parties included in Annex I to the Convention; to be held on 17-19 March in Bonn, Germany. GCOS was expected to provide input on draft guidelines for reporting by Parties on their participation in global observing systems for climate;
- Thirteenth Congress of the WMO; to be held from 4 to 26 May in Geneva, Switzerland. GCOS needed to report to the Congress on the results of SC-VIII and other GCOS activities and to present a resolution for continuing WMO support for GCOS;
- SBSTA-10; to be held in Bonn, Germany from 31 May to 11 June. GCOS would need to provide an interim report on the proposed response to COP-4 and SBSTA-9 decisions;
- Fourth Meeting of the G3OS Sponsors; to be held in Rome, Italy on 7 June, followed by the Third Meeting of the IGOS-Partnership on 8 June. GCOS would be reporting on the results of the present session of the SC and the proposed response to COP-4 and SBSTA-9;
- Twentieth Assembly of the IOC; to be held from 29 June to 9 July in Paris, France. GCOS would be reporting to the Assembly as one of the GCOS sponsors;
- COP-5; to be held in Bonn, Germany from 25 October to 5 November, preceded by the Eleventh Session of SBSTA. GCOS would have to report on the status of the response to COP-4 and SBSTA decisions.

In addition to the reporting indicated above, it was urgent that action begin to actually carry out the responses being reported on. The SC recognized the very large load that was being placed on the GCOS Secretariat by these requirements and the extremely limited resources currently available to the Secretariat to deal with this load. Following discussion on various aspects of this and related problems, and in light of the presentations made earlier in the meeting by the GCOS sponsors and clients, the SC approved the following:

DECISIONS

- (43) The SC expressed its appreciation for the commitments by its sponsors to continue to provide resources to support the planning operations of the GCOS Secretariat. The SC nevertheless concluded that this level of resources is totally inadequate for coordinating the implementation of GCOS as expected by both the sponsors and clients. Addressing the priority actions identified at this meeting would urgently require additional financial and human resources. It therefore requested the Secretariat to identify this requirement for specific project resources as a matter of great urgency at upcoming meetings of the IACCA, the WMO Congress and related events.**
- (44) The SC also requested that this urgent need for additional resources be drawn to the attention of potentially interested nations who might be willing to provide either personnel and/or financial support for GCOS at this critical time. It noted with appreciation the willingness expressed by one country to provide immediate financial resources for one of the urgent projects (specifically, the development of guidelines for national communications on participation in global observing systems for climate and for encouraging and assisting the development of national plans and programmes for GCOS). The SC urged other nations to consider providing support for specific priority activities.**
- (45) The SC requested the Secretariat to prepare a report on the proposed GCOS response to the decisions of SBSTA-9 and COP-4, for presentation at the upcoming meeting of IACCA on 11–12 March in Paris. The report would be on behalf of all the global observing systems for climate including the climate components of GOOS and GTOS.**
- (46) The SC requested the Secretariat to prepare appropriate documentation for the WMO Congress in May 1999 and the IOC Assembly in June-July 1999, taking particular account of the results of this meeting and the resource requirements identified.**

3.6 Organizational Structure and Coordination with Other Programmes

The committee considered the GCOS relationship with the various observing systems and programmes which can and do contribute to a global observing system for climate, including GTOS, GOOS, the GOS of WWW and its CBS, GAW, WCDMP, WCRP and IGBP. It also discussed the current structure of the science and cross-cutting panels and whether this structure remained appropriate under the modified remit for GCOS in the revised MOU. One issue upon which clear agreement was reached was the need to strengthen ties with the major global research programmes such as WCRP and IGBP. This need had been embodied in the decision to invite their stronger participation in TOPC (Decision 35) and was reiterated during this discussion. Regarding the existing panel structure, there was consensus that no formal changes should be made at this time, but that changes might be needed in some areas in the foreseeable future, particularly for the cross-cutting panels. The SC wished to obtain the opinions and advice of the panels in this regard, and therefore approved the following:

DECISION

- (47) **The SC requested the GCOS science panels (AOPC, OOPC, TOPC) and JDIMP to review their Terms of Reference and membership with a view to identifying possible modifications or updates, noting that such review had just been completed for GOSSP, and to report results to the next meeting of the SC.**

It was noted during the discussion that the specific role of GCOS had come up many times during the meeting. Prof. Worth Nowlin, Chairman of the GOOS SC, commented that this had been a concern at earlier meetings of the SC and suggested that in developing the way forward, GCOS should consider in an iterative manner the following questions, and proposed some initial responses:

- Who are the users of GCOS and what do they need? These questions impact the design of GCOS and can be met by identifying the users and assembling their requirements for climate data and information.
- What sustained observations are required? This question also affects design and can be met by translating user needs into requirements for long-term, systematic observations.
- Who will implement the actions needed to meet the requirements? This questions involves facilitation and can be met by transmitting requirements to the organizations coordinating the implementation.
- What analyses and products are needed? This question also affects design and can be met by specifying the products and analyses needed to add value to data for the users.
- Are users getting what they need? This question relates to monitoring and oversight and can be met by monitoring the performance of the elements of the observing system and the system as a whole.
- How can the existing system be improved? This is a question of re-design and can be met by considering potential system changes and recommending those that would improve performance.
- What additions to the system are needed? This question affects implementation and can be met by devising other paths to implementation, as necessary.

The Chairmen agreed that greater clarity was required in specifying the role of GCOS and suggested that this was clearly a matter which would require the attention of the incoming Director of the Secretariat.

3.7 Membership of Steering Committee

The revised Memorandum of Understanding for GCOS had increased the total number of SC members to 16, including the addition of a Third Vice-Chairperson. The current roster of members including changes since the previous meeting of the SC, consisted of 13 individuals, including the Chairman and one Vice-Chairman. As agreed at the opening of the meeting, the filling of vacant positions and other matters related to the committee membership was discussed at an *in camera* session of the SC members, which was held on the morning of 12 February.

4. OTHER BUSINESS

The China Meteorological Administration (CMA) kindly invited the SC to hold its next meeting in Beijing, China, for which Dr. Dawson expressed the committee's gratitude. It was decided, however, with the agreement of the CMA, to defer a final decision on the location and timing of this session until after the results of the many presentations to the upcoming meetings of GCOS sponsors and other organizations were known. The Chairman would keep the committee informed of developments in this regard.

5. CLOSURE

The Chairman thanked the members of the SC and the other participants in the meeting for their input and advice. He also expressed his appreciation to the WMO for hosting the meeting and the GCOS Secretariat for its support in its organization. He formally adjourned the Eighth Session of the GCOS Steering Committee at 13:30 on 12 February 1999.

ANNEX I

LIST OF PARTICIPANTS

Members of the GCOS Steering Committee

Dr Kirk DAWSON (**Chairman**)

RR No. 1, S84A C1
OKANAGAN FALLS,
B.C. V0H 1R0
Canada

Tel: +1 250 497 8621
Fax: : +1 250 497 8621
Email: kdawson@vip.net

Mr Robert S. WINOKUR
(**Vice-Chairman**)

Satellite & Information Services
National Oceanic and Atmospheric
Administration (NOAA)
5200 Auth Road
Federal Building 4, Room 2069
SUITLAND, MD 20746-4304
USA

Tel: +1 301 457 5115
Fax: +1 301 457 5276
Email: rwinokur@nesdis.noaa.gov

Mr Yukio HARUYAMA
Earth Observations Planning
Department (EOPD), NASDA
World Trade Center Bldg.
2-4-1 Hamamatsu-cho, Minato-ku
TOKYO 105-8060
Japan

Tel: +81 3 3438 6331
Fax: +81 3 5401 8702
Email: haruyama.yukio@nasda.go.jp

Prof. Zdzislaw KACZMAREK
Institute of Geophysics
64 Ks Janusza str.
01 452 WARSAW
Poland

Tel: +48 (22) 6 915-851
Fax: +48 (22) 6 915 915
Email: kaczmar@igf.edu.pl

Prof. Paul J. MASON
Meteorological Office
London Road
BRACKNELL RG12 2SZ
UK

Tel: +44 1344 854 604
Fax: +44 1344 856 909
Email: pjmason@meto.gov.uk

Dr Valentin MELESHKO
Voeikov Main Geophysical
Observatory
7, Karbyshev Str.
194021 ST PETERSBURG
Russian Federation

Tel: +7 812 247 4390
Fax: +7 812 247 8661
Email: meleshko@main.mgo.rssi.ru

Prof. Yunqi NI (attending
in place of Dr X. ZHOU)
Chinese Academy of
Meteorological Sciences (CAMS)
46, Baishiqiao Road, Haidian
District
BEIJING 100081
P.R.China

Tel: +86 10 6680 0672
Fax: +86 10 6217 5931
Email: cams@public.bta.net.cn or
niyunqi@public.east.net.cn

Dr Christopher READINGS
Earth Sciences Division
Directorate of Observation of the
Earth and its Environment, ESTEC
Postbus 299 AG NOORDWIJK
Netherlands

Tel:+31 7156 55673
Fax: +31 7156 55675
Email:creading@estec.esa.nl

Ex-officio members of GCOS SC

Dr Francis BRETHERTON
University of Wisconsin-Madison
Space Science and Engineering
Center
1225 West Dayton Str.
MADISON, WI 53706
USA

Tel: +1 608 262 7497
Fax: +1 608 262 5974
Email: francisb@ssec.wisc.edu

Dr Josef CIHLAR
Canada Centre for Remote
Sensing
588 Booth Street
OTTAWA
Ontario K1A 0Y7
Canada

Tel: +1 613 947 1265
Fax: +1 613 947 1406
Email: josef.cihlar@geocan.nrcan.gc.ca

Mr Kenneth DAVIDSON
(attending in place of Tom KARL)
National Climatic Data Center
Federal Building Room 557
151 Patton Avenue
ASHEVILLE, NC 28801-5001
USA

Tel: +1 704 271 4848
Fax: +1 704 271 4246
Email: kdavidson@ncdc.noaa.gov

Dr Michael MANTON
Bureau of Meteorology Research
Centre
GPO Box 1289K
MELBOURNE, Vic. 3001
Australia

Tel: +61 3 9669 4444
Fax: +61 3 9669 4660
Email: m.manton@bom.gov.au

Dr Neville SMITH
Bureau of Meteorology Research
Centre
GPO Box 1289K
MELBOURNE, Vic. 3001
Australia

Tel: +61 3 9669 4434
Fax: +61 3 9669 4660
Email: n.smith@bom.gov.au

Representatives of Sponsoring Organizations – G3OS

ICSU

Mr Jean-François STUYCK-
TAILLANDIER
International Council for Science
51, Boulevard de Montmorency
F – 75016 PARIS
France

Tel: +33 1 4525 0329
Fax: +33 1 4288 9431
Email: secretariat@icsu.org

IOC / GOOS

Dr Colin SUMMERHAYES
GOOS Secretariat
Intergovernmental Oceanographic
Commission (IOC) – UNESCO
1, Rue Mollis
F – 75732 PARIS CEDEX 15
France

Tel: +33 1 4568 4042
Fax: +33 1 4568 5812
Email: c.summerhayes@unesco.org

FAO / GTOS

Mr Jeff TSCHIRLEY
GTOS Secretariat
C/o Food & Agriculture Organization
(FAO), SDRN
Viale delle Terme di Caracalla
I-ROME 00100
Italy

Tel: +39 6 5705 3450
Fax: +39 6 5705 3369
Email: jeff.tschirley@fao.org

UNEP /Earthwatch

Dr Arthur Lyon DAHL
Division of Environmental
Information, Assessment & Early
Warning
UNEP GEC, 15 Chemin des
Anemones
1219 CHATELAINE/GENEVA
Switzerland

Tel: +41 22 917 8207
Fax: +41 22 797 3471
Email: Arthur.Dahl@unep.ch or
dahla@unep.ch

WMO

Dr Mike COUGHLAN
World Meteorological Organization
P.O. Box 2300
1211 GENEVA 2
Switzerland

Tel: +41 22 730 8401
Fax: +41 22 740 1439
Email: coughlan_m@gateway.wmo.ch

Representatives from other Organizations**EC**

Mr Alan CROSS
European Commission
Directorate General XII
Science, Research &
Development DG XII/D 1-1
Rue de la Loi 200 B-1049
BRUXELLES
Belgium

Tel: +32 2 296 4961
Fax: +32 2 296 0588
Email: alan.cross@dg12.cec.be

EUMETSAT

Dr David WILLIAMS
EUMETSAT
Am Kavalleriesand 31
D-64295 DARMSTADT
Germany

Tel.: +49 6151 807 603
Fax: +49 6151 807 830
Email: dwilliams@eumetsat.de

IGFA

Dr Tom SPENCE
National Science Foundation
4201 Wilson Blvd
ARLINGTON VA 22230
USA

Tel: +1 703 306 0891
Fax: +1 703 306 0372
Email: tspence@nsf.gov

IPCC

Dr Narasimhan SUNDARARAMAN
Office of IPCC
C/o World Meteorological
Organization
P.O. Box 2300
1211 GENEVA 2
Switzerland

Tel: +41 22 730 8288
Fax: +41 22 733 1270
Email:
sundararaman_n@gateway.wmo.ch

NOAA/NESDIS

Dr P. Krishna RAO
NOAA/NESDIS
5200 Auth Road, Room 0204, FB-
4 SUITLAND, MD 20746-4304
USA

Tel: +1 301 457 5113
Fax: +1 301 457 5276
Email: krao@nesdis.noaa.gov

NOAA/NESDIS

Ms Linda V. MOODIE
NOAA/NESDIS
1315 East-West Highway
SSMC3, Room 3620
SILVER SPRING, MD 20920-3282
USA

Tel: +1 301 713 2024 x.111
Fax: +1 301 713 2032
Email: lmoodie@nesdis.noaa.gov

UNFCCC

Mr Dennis TIRPAK
UNFCCC Secretariat
P. O. Box 260 124
D-53153 BONN
Germany

Tel: +49 228 815 1424
Fax: +49 228 815 1999
Email: dtirpak@unfccc.de

WCRP

Mr Roger NEWSON
World Climate Research
Programme
c/o World Meteorological
Organization
P.O. Box 2300
1211 GENEVA 2
Switzerland

Tel: +41 22 730 8418
Fax: +41 22 730 8036
Email: newson_r@gateway.wmo.ch

Other Attendees

Dr Claudio CAPONI
Hydrology and Water Resources
Department
World Meteorological Organization
P.O. Box 2300
1211 GENEVA 2
Switzerland

Tel: +41 22 730 8407
Fax: +41 22 730 2326
Email: caponi_c@gateway.wmo.ch

Mr Johan KUYLENSTIERNA
Hydrology and Water Resources
Department
World Meteorological Organization
P.O. Box 2300
1211 GENEVA 2
Switzerland

Tel: +41 22 730 8358
Fax: +41 22 730 2326
Email: kulyenstierna_j@gateway.wmo.ch

Mr Robert LANDIS
World Weather Watch Department
World Meteorological Organization
P.O. Box 2300
1211 GENEVA 2
Switzerland

Tel: +41 22 730 8221
Fax: +41 22 730 0242
Email: landis_r@gateway.wmo.ch

Dr Norman McFARLANE
Canada Centre for Climate
Modelling and Analysis
University of Victoria
P.O. Box 1700
VICTORIA BC V8W 2Y2
Canada

Tel: +1 250 363 8227
Fax: +1 250 363 8247
Email: Norm.McFarlane@ec.gc.ca

Prof. Worth NOWLIN, Jr.
Department of Oceanography
Texas A&M University
COLLEGE STATION,
TX 77843-3146
USA

Tel: +1 409 845 3900
Fax: +1 409 847 8879
Email: wnowlin@tamu.edu

Mr Dieter SCHIESSL
WWW/BAS
World Meteorological Organization
P.O. Box 2300
1211 GENEVA 2
Switzerland

Tel: +41 22 730 8221
Fax: +41 22 730 0242
Email: schiessl_d@gateway.wmo.ch

Mr Peter Scholefield
World Climate Data and
Monitoring Programme
World Meteorological Organization
P.O. Box 2300
1211 GENEVA 2
Switzerland

Tel: +41 22 730 8377
Fax: +41 22 730 8042
Email: scholefield_p@gateway.wmo

Dr Alan THOMAS
National Oceanic Atmospheric
Administration (NOAA)
Office of Global Programs
1100 Wayne Avenue # 1225
SILVER SPRING, MD 20810
USA

Tel: +1 301 427 2089 x171
Fax: +1 301 427 2082
Email: alan.thomas@noaa.gov

Mr Volker VENT-SCHMIDT
Deutscher Wetterdienst
Department Climate &
Environment
Frankfurter Strasse 135
D-63067 OFFENBACH MAIN
Germany

Tel: +49 69 8062 2758
Fax: +49 69 8236 1493
Email: vvent@dwd.d400.de

GCOS Secretariat

Dr Mike COUGHLAN
Acting Director
Global Climate Observing System
Secretariat
c/o World Meteorological
Organization
P.O. Box 2300
1211 GENEVA 2
Switzerland

Tel: +41 22 730 8401
Fax: +41 22 730 8042
Email: coughlan_m@gateway.wmo.ch

Dr Hans TEUNISSEN
GCOS Secretariat
c/o World Meteorological
Organization
P.O. Box 2300
1211 GENEVA 2
Switzerland

Tel: +41 22 730 8086
Fax: +41 22 730 8052
Email: teunissen_h@gateway.wmo.ch

MEMBERS / EX-OFFICIO MEMBERS / EXPERTS UNABLE TO ATTEND

Dr Philippe COURTIER
Météo-France
1 Quai Branly
F – 75340 PARIS Cedex 07
France

Tel: +33 1 4556 7006
Fax: +33 1 4556 7005
Email:

Dr Jim GOSZ
Biology Department University of
New Mexico
ALBUQUERQUE, NM 87131
USA

Tel: +1 505 277 2265
Fax: +1 505 277 5355
Email: jgosz@sevilleta.unm.edu

Mr Thomas KARL (being
represented by K. DAVIDSON)
National Climatic Data Center
151 Patton Avenue
ASHEVILLE, NC 28801-5001
USA

Tel: +1 828 271 4476
Fax: +1 828 217 4246
Email: tkarl@ncdc.noaa.gov

Dr Angus McEWAN
Bureau of Meteorology
P.O. Box 727G
HOBART, Tasmania 7001
Australia

Tel: +61 3 6221 2090
Fax: +61 3 6221 2089
Email: mcewan@bom.gov.au

MEMBERS / EX-OFFICIO MEMBERS / EXPERTS UNABLE TO ATTEND

Mr Stefan MILDNER
Technical Department
Deutscher Wetterdienst
Postfach 100465
D – 63004 OFFENBACH
Germany

Tel: +49 69 8062 2846
Fax: +49 69 800 4201
Email: smildner@dwd.d400.de

Mr Koichi NAGASAKA
Planning Division
Japan Meteorological Agency
1-3-4 Otemachi, Chiyoda-ku
TOKYO 100-8122
Japan

Tel:+81 3 3211 4966
Fax: +81 3 3211 2032
Email:inad-jma@hq.kishou.go.jp

Prof. Laban A. OGALLO
Department of Meteorology
University of Nairobi
P.O. Box 30197
NAIROBI - Kenya

Tel: +254 2 567 864
Fax: +254 2 567 888 or 567 889
Email: logallo@lion.meteo.go.ke

Dr Will STEFFEN
IGBP Sweden
Royal Swedish Academy of
Sciences
Box 50005
S-104 05 STOCKHOLM
Sweden

Tel: +46 8 166 448
Fax: +46 8 166 405
Email: will@igbp.kva.se

Dr Douglas M. WHELPDALE
Climate Research Branch
Atmospheric Environment Service
4905 Dufferin Street
DOWNSVIEW,
Ontario M3H 5T4
Canada

Tel: +1 416 739 4869
Fax: + 1 416 739 5700
Email:douglas.whelpdale@ec.gc.ca

Dr Xiuji ZHOU (being represented
by Prof. Y. NI)
Chinese Academy of
Meteorological Sciences (CAMS)
46, Baishiqiao Road, Haidian
District
BEIJING 100081
P.R. China

Tel: +86 10 6217 5931
Fax: +86 10 6217 5931
Email: cams@public.bta.net.cn

ANNEX II

AGENDA

1. Opening of the Meeting
 - 1.1. Welcome and Introduction }
 - 1.2. Outputs required for this meeting }
 - The GCOS SC Chair will outline specific* }
 - outputs needed from the Committee.* }
 - 1.3. Adoption of the Agenda }
 - 1.4. Conduct of the Meeting }
 - 1.5. Nomination of Minute Taker }
 - 1.6. Review of Report of GCOS-VII (including any matters arising) Coughlan
2. The New Mandate for GCOS (A focus on expectations for the next 3 years)
 - 2.1. The New Memorandum of Understanding. Coughlan
The Committee should review the key changes and responsibilities.
 - 2.2. Expectations and contributions of the Sponsors. Coughlan
WMO, UNEP, IOC AND ICSU representatives will outline what is Dahl
now expected of the GCOS and what resources will be available Summerhayes
to administer the programme. Stuyck-Taillandier
Tschirley
 - 2.3. Expectations of the IPCC. Sundararaman
IPCC representative will outline what is needed from GCOS for the
Third Assessment Report.
 - 2.4. Expectations of the UNFCCC Tirpak
UNFCCC representative will outline the needs arising from relevant
decisions of the UNFCCC COP-4.
 - 2.5. Expectations for Seasonal and Inter-annual Climate Predictions Coughlan
Representative of the WCP Directorate in WMO will outline the needs
for operational activities in this area.
 - 2.6. Expectations of the Research Community Newson

Representative(s) of WCRP and IGBP will outline priority needs
for future climate-related research programmes.
 - 2.7. Overall Big Picture, Where do we stand? Dawson
As a basis for discussion, the Chair GCOS SC will provide an
overview of where GCOS stands and will review the key issues.
3. The Way Forward
 - 3.1. National Programmes for GCOS Mason
The Committee should explore how it can assist nations in their
planning and implementation activities and the most effective

mechanisms for getting information on GCOS plans and priorities into the hands of nations and experts.

- | | | |
|------|---|------------|
| 3.2. | Funding and Partnerships
<i>The Committee should assess what is needed to respond to the UNFCCC decision and other requirements for global climate observing systems, and how best to tap the necessary programme funds.</i> | Spence |
| 3.3. | Intergovernmental Mechanisms
<i>The Committee should examine how GCOS relates to governments and explore how, for example, GCOS might best respond to the UNFCCC COP-4 decision.</i> | Winokur |
| 3.4. | Implementation of GCOS
<i>The Committee should, in the light of the expressed needs and priorities, determine the next steps and decide on what performance measures are needed to assess progress?</i> | |
| | 3.4.1. Atmosphere | Manton |
| | 3.4.2. Oceans | Smith |
| | 3.4.3. Terrestrial | Cihlar |
| | 3.4.4. Cross-cutting activities | |
| | 3.4.4.1 Data and Information | Davidson |
| | 3.4.4.2 Space-based Systems | Bretherton |
| 3.5. | Recommendations and Reports to other Bodies
<i>The Committee should decide how it should report on its activities to the IACCA, WMO Congress, GXOS Sponsors, etc.</i> | Coughlan |
| 3.6. | Co-ordination with GXOS and other Programmes
<i>The Committee should discuss its relationship with (GTOS, GOOS, WWW/CBS, GAW, WCDMP, WCRP, IGBP) and determine what actions it should take.</i> | Dawson |
| 3.7. | Organizational Structure
<i>The Committee should assess the need for changes to its sub-committees and panels in the light of proposed programme activities.</i> | Dawson |
| 3.8. | Membership | Dawson |
| | 3.8.1. Election of Vice-Chairpersons | |
| | 3.8.2. New Members | |
| 4. | Immediate Priorities
<i>The Committee should identify the priority activities for GCOS in the light of the expected resource constraints.</i> | Coughlan |
| 5. | Other Business (including time and place of next meeting). | Dawson |
| 6. | Review of Recommendations and Actions for the Future
<i>The Committee may wish to review its recommendations and actions against the expected outputs and responsibilities.</i> | Dawson |
| 7. | Closure | |

ANNEX III

LIST OF DOCUMENTS

Document No.	Agenda Item	Title
1	1.3	Provisional Agenda
2	1.3	Explanatory Memorandum
3	2.5	Executive Summary - TAO Implementation Panel, Seventh Session (Tip-7)
4	2.6	International CLIVAR Conference, Paris, December 2-4, 1998 - Conference Statement
5	3.4.1	Report on participation in CBS session and Technical Conference (Karlsruhe, 28 Sept-2 October 1998), submitted by M Manton
6	3.4.1	GSN Monitoring Centre Implementation Meeting, Offenbach, Germany
7	---	Withdrawn
8	2.4	Report on the Adequacy of the Global Observing Systems: Executive Summary
9	2.4	UNFCCC COP-4, Report on the Adequacy of the Global Climate Observing Systems: Full Report
10	2.4, 3.1, 3.3	Review of the implementation of commitments and of other provisions of the Convention ; other matters related to implementation research and systematic observation (Articles 4.1(g) and 5 of the convention)
11	2.5	Declaration of Guayaquil (Guayaquil, Ecuador, 13 November 1998)
12	1.6	Summary of Recommendations made at JSTC-VI
13	1.6	Summary of actions and recommendations made at JSTC-VII
14	2.1	The revised Memorandum of Understanding
15	2.5	International Seminar on the 1997-98 El Niño Event: Evaluation and Projections (Guayaquil, Ecuador; 9-13 November 1998)

Document No.	Agenda Item	Title
16	2.4, 3.1	UNFCCC COP-4, Report on the Adequacy of the Global Climate Observing Systems: Letter to Minister of Foreign Affairs
17	3.4.2	Proposal for a Conference on Ocean Observations for Climate
18	3.4.3	Letter to Establish the GTN Glacier Network
19	3.4.4.2	Report of the 2nd IGOS Partners Meeting - Revised draft 12/12/98 (Bangalore, 10 November 1998)
20	3.4.4.2	GOSSP Meeting Report
21	3.5	Summary of Climate Meetings important to GCOS
22	3.5	GCOS Congress document 1999
23	3.7	The G3OS (GCOS, GOOS, GTOS)
24	3.4.4.1	G3OS Data and Information Management Plan prepared by JDIMP (draft Plan revised Jan. 99)
25	3.5	Global Climate Observing System (GCOS) - Report to (WMO Congress XII) plenary on item 3.2.5
26	2.2	Global Climate Observing System (GCOS) - Report to (WMO EC-L) plenary on item 4.6
27	3.1	Final report to The Met.Office - A UK contribution to the Global Climate Observing System (September 1998) by P. Ryder
28	3.4.2	Report from OOPC to the 8th Session of the GCOS SC
29	3.4.4.2	IGOS Themes – A Position Paper

LIST OF INFORMATION DOCUMENTS

INF.1	List of participants
INF. 2	List of documents

ANNEX IV

GCOS MEMORANDUM OF UNDERSTANDING

**MEMORANDUM OF UNDERSTANDING BETWEEN
THE WORLD METEOROLOGICAL ORGANIZATION
THE INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION OF THE
UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION
THE UNITED NATIONS ENVIRONMENT PROGRAMME AND
THE INTERNATIONAL COUNCIL FOR SCIENCE**

The WMO, the IOC of UNESCO, the UNEP, and the ICSU,

NOTING:

- (1) The recommendation of the Second World Climate Conference concerning the creation of a Global Climate Observing System;
- (2) Resolution XVI-8 of the sixteenth session of the IOC Assembly, to undertake the development of a Global Ocean Observing System and participate in the Global Climate Observing System;
- (3) Resolution 10 (Cg-XII) of the twelfth World Meteorological Congress, to continue the Global Climate Observing System;
- (4) Resolution 21 (Cg-XI) on the relationship between the Global Ocean Observing System and the Global Climate Observing System;
- (5) The decision of the sixtieth meeting of the ICSU Executive Board that ICSU should join WMO and IOC of UNESCO in the formation of the Global Climate Observing System;
- (6) The decision of the sixteenth session of the UNEP Governing Council that UNEP should support, within available resources, the creation of a Global Climate Observing System and assist in ensuring that its development and implementation are pursued with urgency;
- (7) Agenda 21 which calls for systematic observations in support of sustainable development;
- (8) The UN Framework Convention on Climate Change with Articles 4 and 5 committing parties to promote and cooperate in systematic observation;
- (9) Recommendations made by the Commission on Sustainable Development toward the development of global environmental observing systems;
- (10) The Climate Agenda, which supports, in Thrust 4, the Dedicated Observations of the Climate System;

RECOGNIZING the need to acquire comprehensive information on the properties and evolution of the earth's climate system, for detecting climate change, observing climate variability including its impact, supporting climatological applications for economic development, and developing climate system science and predictions,

CONSIDERING that the required information will encompass data from operational meteorological, hydrological, oceanographic and other relevant programmes, as well as observations from research programmes conducted by scientific institutions and space agencies.

AGREE:

(1) To cooperate in organizing and supporting a Global Climate Observing System (GCOS) based on the coordination of existing or planned operational and research programmes for observing the global climate system, and the further development of these programmes as required to ensure continuity of observations;

(2) That the GCOS shall, as its long-range objectives, support all aspects of the World Climate Programme and relevant aspects of other climate-related global programmes. Specifically the GCOS will ensure the data needs are met for climate system monitoring, for assessing the impacts of climate variability and change and for applications to national economic development, as well as research leading to improved understanding, modelling and prediction of the climate system;

(3) To consult and call upon other relevant national and international agencies, institutions and organizations, to collaborate in the organization and participate in the implementation of the GCOS;

(4) To establish a GCOS Steering Committee, to provide scientific and technical guidance for the organization and further development of the GCOS, and a GCOS Secretariat;

(5) To support, through appropriate administrative and financial arrangements, the activities of the Steering Committee and Secretariat for GCOS.

AGREE FURTHER that the GCOS Steering Committee shall be regarded by the sponsoring organizations as the main scientific and technical body for formulating the overall concept and scope of the GCOS, and advising on the further development of the GCOS.

APPROVE the procedures to be followed in implementing this Memorandum of Understanding which are specified in the following Annexes:

ANNEX A: Concept of the Global Climate Observing System;

ANNEX B: Terms of reference, structure and functions of the GCOS Steering Committee and supporting staff;

ANNEX C: Financial arrangements.

AGREE: that this Memorandum of Understanding shall be reviewed every four years by the sponsoring organizations, and may be called for review at any time by one of the sponsoring organizations.

AGREE: that other organizations and agencies, which contribute to the implementation of the GCOS and wish to join in the sponsorship of the GCOS, may become a party to this Memorandum of Understanding, including its appropriate administrative and financial arrangements.

AGREE that this Memorandum of Understanding shall come into force on signature by all four parties.

Secretary-General
WMO

Executive Secretary
IOC

Secretary-General
ICSU

Executive Director
UNEP

Place
Date

Place
Date

Place
Date

Place
Date

ANNEX A

CONCEPT OF THE GLOBAL CLIMATE OBSERVING SYSTEM

1. The goal of the Global Climate Observing System (GCOS) is to provide comprehensive information on the total climate system, involving a multi-disciplinary range of physical, chemical and biological properties, and atmospheric, oceanic, hydrologic, cryospheric and terrestrial processes.
2. The GCOS is intended to meet the needs for:
 - (a) Climate system monitoring, climate change detection and monitoring the impacts of and the response to climate change, especially in terrestrial ecosystems and mean sea-level;
 - (b) Data for application to national economic development;
 - (c) Research toward improved understanding, modelling and prediction of the climate system.
3. The GCOS will build, as far as possible, on existing operational and scientific observing, data management and information distribution systems, and further enhancements of these systems. The GCOS will be based upon, *inter alia* :
 - (a) Improved World Weather Watch systems and the Integrated Global Ocean Services System;
 - (b) The Global Atmosphere Watch and related atmospheric constituent observing systems;
 - (c) The Global Ocean Observing System for physical, chemical and biological measurements;
 - (d) The Global Terrestrial Observing System for land surface ecosystem, hydrosphere, and cryosphere measurements;
 - (e) The maintenance and enhancement of programmes monitoring other key components of the climate system, such as terrestrial ecosystems (including the International Geosphere-Biosphere Programme), as well as clouds and the hydrological cycle, the earth's radiation budget, ice sheets and precipitation over the oceans (including the World Climate Research Programme);
 - (f) Programmes to monitor the key physical, chemical and biological aspects of the impacts of climate change (including the World Climate Impact Assessment and Response Strategies Programme);
 - (g) Data communication and other infrastructures necessary to support operational climate forecasting (including the World Climate Data and Monitoring Programme and the Climate Information and Prediction Services).

ANNEX B

TERMS OF REFERENCE, STRUCTURE AND FUNCTIONS OF THE GCOS STEERING COMMITTEE AND GCOS SECRETARIAT

1. Terms of reference

1.1 The functions of the GCOS Steering Committee are to formulate the overall concept and scope of the GCOS, and to provide scientific and technical guidance to sponsoring and participating organizations, and agencies for the planning, implementation and further development of the GCOS.

1.2 Specifically, the Steering Committee will be called upon:

- (a) To identify observational requirements, define design objectives and recommend coordinated actions by sponsoring and participating organizations and agencies, in order to optimize the system's performance and coherence, taking cognizance of the responsibilities, working arrangements and recommendations of established scientific and technical bodies of such organizations and agencies;
- (b) To review and assess the development and implementation of the components of the GCOS, and report to the sponsoring organizations, and to the participating agencies as required;
- (c) To facilitate the exchanges of information among sponsoring and participating organizations and agencies, and in general make the objectives, resource requirements capabilities and outputs of GCOS known to relevant national and international bodies.

2. Membership

2.1 The Steering Committee shall be appointed jointly by the Executive Heads of the sponsoring organizations by mutual consent.

2.2 The Steering Committee shall consist of up to sixteen scientific and technical experts selected on the basis of their personal expertise. The Chairs of standing panels will be members *ex officio*.

2.3 The membership of the Steering Committee shall aim to include a balanced geographical representation of major operational and research observing programmes contributing to the GCOS, as well as an appropriate mix of disciplines in atmospheric, oceanic, hydrological, cryospheric and biospheric sciences. Experts in both *in situ* and remote sensing techniques will be included.

2.4 The members will be appointed for an initial term of appointment of two years. The membership shall be reviewed regularly by the Executive Heads of the sponsoring organizations, bearing in mind the need to ensure reasonable continuity and influx of new members. Members shall not normally serve more than six years.

3. Officers

3.1 The officers of the Steering Committee shall consist of a Chair, and First, Second, and Third Vice-Chairs selected by the Executive Heads of the sponsoring organizations and appointed for two-year terms.

3.2 The duties of the Chair of the Steering Committee shall be:

- (a) To preside over the sessions of the Committee and respond to its decisions;
- (b) To act on behalf of the Committee between meetings;

(c) To guide the activities of the GCOS Secretariat, with respect to the fulfilment of GCOS plans and tasks;

(d) To conduct, either directly or through appropriate sponsoring organizations, correspondence on matters related to the organization, planning and implementation of GCOS;

(e) To carry out specific duties as prescribed by decisions taken in agreement by the sponsoring organizations;

(f) To ensure that the activities and recommendations of the Steering Committee are in accordance with the joint objectives of the sponsoring organizations, as recorded in this Memorandum of Understanding;

(g) To arrange for the views of the Steering Committee to be presented to the sponsoring organizations;

(h) To prepare annually, with the GCOS Secretariat, a report of GCOS planning and implementation activities, including the considerations and recommendations by the Steering Committee, and to present this report to the sponsoring organizations.

3.3 The duties of the Vice-Chairs are to assist the Chair in his tasks and to substitute for him/her when necessary.

4. Sessions

4.1 The Steering Committee shall meet at least annually, the venue and dates to be decided by the Chair of the Committee in consultation with the Secretary-General of WMO. Sessions shall normally be arranged so as to avoid scheduling conflicts with meetings of executive bodies of the sponsoring organizations.

4.2 The Director of the GCOS Secretariat, acting on behalf of the Chair of the Committee, shall inform the sponsoring and participating organizations and agencies, notify the members and make appropriate practical arrangements for the session.

4.3 Each sponsoring organization shall nominate one or two representatives to participate in the sessions of the Committee. The attendance of these representatives shall not be charged to the GCOS Fund.

4.4 Representatives of participating organizations and agencies and of the other observing systems, GOOS and GTOS, may be invited to attend the sessions, in the capacity as observers.

4.5 Individual experts may be invited to participate in the sessions upon decision of the Chair of the Committee. The sponsoring organizations shall be informed of such invitations.

4.6 The Secretary-General of WMO shall provide such interpretation facilities as may be required, within budgetary provisions. Documents will normally be distributed in the original language in which they were submitted.

5. Working Groups and Consultants

5.1 The Steering Committee shall be authorized to establish and convene working groups, panels of scientific and technical experts, special study groups, etc. within its field of responsibility and within the budget approved by the sponsoring organizations, taking account of relevant scientific or technical groups established by the sponsoring organizations and their constituent bodies.

5.2 The membership, terms of reference and special requests addressed to working groups will be documented by the Director of the GCOS Secretariat on behalf of the Chair of the Committee.

6. GCOS Secretariat

6.1 The general functions of the GCOS Secretariat shall be to assist the Steering Committee in formulating the concept and in organizing the implementation of the GCOS, and any other organizational or technical task, as the Steering Committee may decide. In particular, the Secretariat, under the responsibility of its Director, shall take charge for:

- (a) Assisting the Steering Committee in preparing plans and other guidance material for the development and implementation of the GCOS;
- (b) Providing secretarial support to the Steering Committee;
- (c) Maintaining scientific and technical liaison with relevant departments and constituents bodies of the sponsoring organizations, and all other relevant institutions or agencies, as required for the development and implementation of GCOS;
- (d) Serving as the documentation and information centre for GCOS and preparing information or action documents pertaining to GCOS, as required by the sponsoring organizations;
- (e) Making arrangements for GCOS planning and coordination activities, in accordance with the provisions of Annex C on Financial Arrangements and following the guidelines provided by the Steering Committee.

6.2 The Secretariat shall be composed of a Director and supporting scientific, technical and clerical staff seconded by the sponsoring organizations and other participating agencies, or supported directly by the Climate Observing System Fund (COSF).

6.3 The Director will be selected by consensus agreement of the Executive Heads of the sponsoring organizations and the Officers of the GCOS Steering Committee. The Director will normally have the status of a staff member of WMO and will be appointed by the Secretary-General of WMO.

6.4 The Director will be responsible, for scientific and technical tasks discharged by the Secretariat, to the Chair of the Steering Committee acting on behalf of the sponsoring organizations, and for administrative and financial matters, to the Secretary-General of WMO, in accordance with the provisions in Annex C.

6.5 The duties of the Director shall be:

- (a) To direct the work of the GCOS Secretariat;
- (b) To guide and support the activities of working groups set up by the Steering Committee;
- (c) To maintain liaison with the Chair and the members of the Steering Committee;
- (d) To serve as the channel for communication between the Steering Committee and the sponsoring and participating organizations and agencies;
- (e) To collaborate, as required, with the Executive Heads of the sponsoring organizations.

6.6 The climate-related component of the GOOS will form the oceanographic component of the GCOS, under the authority of the Director of the GCOS Secretariat.

6.7 The climate-related component of the GTOS will form the terrestrial component of the GCOS, under the authority of the Director of the GCOS Secretariat.

ANNEX C

FINANCIAL ARRANGEMENTS

1. The planning and implementation activities for the Global Climate Observing System (GCOS) will be financed by the sponsoring organizations, each from funds appropriated in their budgets for this purpose, and from extra-budgetary resources.
2. The Secretary-General of WMO shall administer the Climate Observing System Fund (COSF) made available from the sponsoring organizations and extra-budgetary resources in support of GCOS activities. The Fund will be administered in accordance with WMO Financial Regulations.
3. Each sponsoring organization will make appropriate annual financial contributions to the Climate Observing System Fund or through other agreed upon arrangements.
4. Other contributions in kind such as secondment of staff, provision of facilities, or support for meetings, publications, or other expenses may be made by sponsoring organizations, supporting nations and participating organizations and agencies.
5. The Fund will adopt a biennial budget and reporting cycle, consistent with the practice of WMO. Corresponding periodic financial reports will be made available to the sponsoring organizations.
6. The cost of staff seconded to the GCOS Secretariat will normally be supported by the responsible sponsoring organizations. Alternatively, a sponsoring organization or participating agency may choose to make a financial contribution to the COSF, in the appropriate amount, to cover the cost of a position. WMO Regulations shall apply to staff positions.
7. A comprehensive budget estimate for all GCOS planning activities and the activities of the Steering Committee and its supporting staff will be submitted by the Chair of the Steering Committee to the Executive Heads of the sponsoring organizations, in due time for consideration in the preparation of programme and budget proposals, as required.
8. Additional contributions and grants to the COSF from sources other than sponsoring organizations may be accepted by the Secretary-General of WMO, provided the purposes of such contributions and grants are consistent with the overall objectives and tasks of GCOS, as described in this Memorandum of Understanding. The specific activities funded from such grants will be treated as an addition to the programme and level of expenditure approved for GCOS.
9. Should the activities of the GCOS be brought to an end, then the remaining balance of the COSF, after the settlement of all financial commitments by the Secretary-General of WMO, will either be donated to WMO for the execution of specific scientific and technical activities subject to the agreement of the sponsoring organizations and other donors of GCOS or it will be shared among the sponsoring organizations and other donors in proportion to their respective contributions to the Fund over the previous two years immediately preceding the end of GCOS.
10. These financial Arrangements may be modified at any time by mutual agreement among the sponsoring organizations provided that no modification would result in conflict with applicable WMO Financial Regulations.
11. In case of doubt as to the interpretation or application of any of the present provisions, the Secretary-General of WMO is authorized to rule thereon, subject to prior consultation with the Executive Heads of the sponsoring organizations.

ANNEX V

UNFCCC COP-4, DECISION 14/CP.4

Decision 14/CP.4

Research and systematic observation

The Conference of the Parties,

Recalling Article 4. 1 (g)-(h) and Article 5 of the United Nations Framework Convention on Climate Change, and its decision 8/CP.3,

Noting with appreciation the comprehensive report on the adequacy of the global observing systems for climate,¹ prepared and coordinated by the Global Climate Observing System secretariat in the World Meteorological Organization on behalf of organizations participating in the Climate Agenda,

Noting the conclusions of the report that, *inter alia*, in many instances global and regional coverage is inadequate,

Noting the recommendations contained in the report to improve the global observing systems for climate,

Noting the ongoing work of the agencies participating in the Climate Agenda and others in support of global observing systems for climate, including their contributions to capacity-building,

Recognizing the significant national contributions made to the global observing systems for climate,

1. *Urges* Parties to undertake programmes of systematic observation, including the preparation of specific national plans, in response to requests from agencies participating in the Climate Agenda, based on the information developed by the Global Climate Observing System and its partner programmes;
2. *Urges* Parties to undertake free and unrestricted exchange of data to meet the needs of the Convention, recognizing the various policies on data exchange of relevant international and intergovernmental organizations;
3. *Urges* Parties to actively support capacity-building in developing countries to enable them to collect, exchange and utilize data to meet local, regional and international needs;
4. *Urges* Parties to strengthen international and intergovernmental programmes assisting countries to acquire and use climate information;
5. *Urges* Parties to actively support national meteorological and atmospheric observing systems, including measurement of greenhouse gases, in order to ensure that the stations identified as elements of the Global Climate Observing System networks, based on the World Weather Watch and Global Atmosphere Watch and underpinning the needs of the Convention, are fully operational and use best practices;

¹ Contained in document FCCC/CP/1998/MISC.2 and summarized in document FCCC/CP/1998/7.

6. *Urges* Parties to actively support national oceanographic observing systems, in order to ensure that the elements of the Global Climate Observing System and Global Ocean Observing System networks in support of ocean climate observations are implemented, to support, to the extent possible, an increase in the number of ocean observations, particularly in remote locations, and to establish and maintain reference stations;

7. *Urges* Parties to actively support national terrestrial networks including observational programmes to collect, exchange and preserve terrestrial data according to the Global Climate Observing System and the Global Terrestrial Observing System climate priorities, particularly hydrosphere, cryosphere and ecosystem observations;

8. *Requests* Parties to submit information on national plans and programmes in relation to their participation in global observing systems for climate, in the context of reporting on research and systematic observation, as an element of national communications from Parties included in Annex I to the Convention (Annex 1 Parties) and, as appropriate, from Parties not included in Annex I to the Convention (non-Annex 1 Parties);

9. *Requests* the Subsidiary Body for Scientific and Technological Advice, in consultation with the agencies participating in the Climate Agenda, drawing, *inter alia* on the information provided in the second national communications from Annex 1 Parties and, as appropriate, in the initial national communications from non-Annex 1 Parties, to inform the Conference of the Parties at its fifth session of developments regarding observational networks, difficulties encountered, *inter alia*, with respect to the needs of developing countries and options for financial support to reverse the decline in observational networks;

10. *Invites* the agencies participating in the Climate Agenda, through the Global Climate Observing System secretariat, to initiate an intergovernmental process for addressing the priorities for action to improve global observing systems for climate in relation to the needs of the Convention and, in consultation with the Convention secretariat and other relevant organizations, for identifying immediate, medium-term and long-term options for financial support; and *requests* the secretariat to report results to the Subsidiary Body for Scientific and Technological Advice at its tenth session.

*5th plenary meeting
11 November 1998*

ANNEX VI

UNFCCC COP-4, DECISION 2/CP.4

Decision 2/CP.4

Additional guidance to the operating entity of the financial mechanism

The Conference of the Parties,

Recalling its decisions 11/CP.1, 10/CP.2, 11/CP.2 and 12/CP.2,

Recalling further that the Global Environment Facility (GEF), as stated in its operational principles for the development and implementation of its work programme¹, will maintain sufficient flexibility to respond to changing circumstances, including evolving guidance of the Conference of the Parties and experience gained from monitoring and evaluation activities,

Welcoming the New Delhi Statement of the First GEF Assembly² and the Report on the Second Replenishment of the GEF Trust Fund, completed in March 1998³,

Noting the continued concerns and difficulties encountered by developing country Parties with the availability and disbursement of financial resources, including for the transfer of technology, the problems arising from the GEF project cycle, the application of the concept of incremental costs, and the availability of resources through the GEF implementing/executing agencies,

Noting also the current and ongoing efforts of the GEF to address these concerns, *inter alia*, by streamlining its project cycle, increasing support for country-level coordination, strengthening its monitoring and evaluation programme, ensuring that its activities are country-driven and consistent with national priorities and objectives, further developing its resource allocation strategy to maximize the effectiveness of its climate change activities and making the process of determining incremental costs more transparent and pragmatic,

Noting further the need to examine and address climate change impacts and minimize the adverse impacts, in particular for the Parties identified in Article 4.8 of the United Nations Framework Convention on Climate Change,

1 . Decides that, in accordance with Articles 4.3, 4.5 and 11.1 of the Convention, the GEF should provide funding to developing country Parties to:

(a) Implement adaptation response measures under Article 4.1 of the Convention for adaptation activities envisaged in decision 11/CP.1, paragraph 1(d)(ii) (Stage II activities) in particularly vulnerable countries and regions identified in Stage I activities, and especially in countries vulnerable to climate-related natural disasters, taking into account their preparatory adaptation planning frameworks in priority sectors, the completion of Stage I activities, and in the context of their national communications;

¹ Global Environment Facility, *Operational Strategy* (Washington, D.C., February 1996), p. 2.

² See document FCCC/CP/1998/12, annex B.

³ Document GEF/C. 1 1/6 of 24 March 1998.

(b) Enable them, in light of their social and economic conditions and taking into account state-of-the-art environmentally sound technologies, to identify and submit to the Conference of the Parties their prioritized technology needs, especially as concerns key technologies needed in particular sectors of their national economies conducive to addressing climate change and minimizing its adverse effects;

(c) Build capacity for participation in systematic observational networks to reduce scientific uncertainties relating to the causes, effects, magnitude and timing of climate change, in accordance with Article 5 of the Convention;

(d) Meet the agreed full costs of preparing initial and subsequent national communications, in accordance with Articles 4.3 and 12.5 of the Convention and decision 11/CP.2, paragraph 1(d), by maintaining and enhancing relevant national capacity, so as to prepare the initial and second national communications which will take into account experiences, including gaps and problems identified in previous national communications, and guidelines established by the Conference of the Parties. Guidance on subsequent national communications will be provided by the Conference of the Parties;

(e) Assist them with studies leading to the preparation of national programmes to address climate change, compatible with national plans for sustainable development, in accordance with Article 4.1 (b) of the Convention and paragraph 13 of the annex to decision 10/CP.2;

(f) Assist in developing, strengthening and/or improving national activities for public awareness and education on climate change and response measures, in full accordance with Article 6 of the Convention and decision 11/CP. 1, paragraph 1(b)(iii), and taking into account, where appropriate, relevant GEF operational programmes;

(g) Support capacity-building for:

(i) The assessment of technology needs to fulfil the commitments of developing countries under the Convention, the identification of sources and suppliers of these technologies, and the determination of modalities for the acquisition and absorption thereof;

(ii) Country-driven activities and projects to enable Parties not included in Annex I to the Convention (non-Annex I Parties) to design, evaluate and manage these projects;

(iii) Strengthening the capacity of non-Annex I Parties to host projects, including from project formulation and development to their implementation;

(iv) Facilitating national/regional access to the information provided by international centres and networks, and for working with those centres for the dissemination of information, information services, and transfer of environmentally sound technologies and know-how in support of the Convention;

2. *Requests* the GEF to continue to provide, and developing country Parties to avail themselves of, funding to translate, reproduce, disseminate and make available their initial national communications electronically;

3. *Encourages* the GEF to:

(a) Further streamline its project cycle with a view to making project preparation simpler, less prescriptive, more transparent and country-driven;

(b) Further simplify and expedite its procedures for the approval and implementation of GEF-funded projects, including disbursements for such projects;

(c) Make the process for the determination of incremental costs more transparent, and its application more pragmatic;

4. *Requests* the GEF to ensure that its implementing/executing agencies are made aware of Convention provisions and decisions adopted by the Conference of the Parties in the performance of their GEF obligations and are encouraged, as a first priority, whenever possible, to use national experts/consultants in all aspects of project development and implementation;

5. *Further requests* the GEF to include in its report to the Conference of the Parties the specific steps it has undertaken to implement the provisions of this decision.

*8th plenary meeting
14 November 1998*

ANNEX VII

CONSOLIDATED LIST OF SC DECISIONS

- (1) The SC, recognizing the changing nature of GCOS as a result of recent developments, requested the Chairman to lead the development of an updated and refined statement of the roles and responsibilities of GCOS and how the programme relates to the various other components of the global environmental observing system.

UNFCCC

- (2) The SC requested the Secretariat to develop guidelines for use by Parties to the UNFCCC in submitting information on national plans and programmes relating to their participation in global observing systems for climate as an element of their national communications to the COP. It urged the preparation of an initial draft for presentation at the SBSTA Workshop in Bonn on 17-19 March 1999 and an updated version for consideration by the SBSTA at its tenth session in May-June 1999.
- (3) The SC recognized that there is limited experience in the preparation of national plans and programmes for global observing systems for climate, and that their development presents a number of unique problems. It noted in addition that development of responses by nations to guidelines for national communications would likely generate a range of questions and issues. The SC therefore requested that the Secretariat identify, assemble and develop, as needed, the information resources that would be required to address those questions, building on the experience of those nations that had prepared, or are in the process of preparing, national plans and programmes for GCOS. The SC expected that these information resources would include an update of the 1995 GCOS Plan and its Initial Operational System.
- (4) The SC noted that there is a requirement to integrate national plans and programmes into a global programme and to assess how well the needs stated by GCOS are being met. It requested the Secretariat to develop a range of options for consideration by the SC on how such integration could be carried out. It also requested the Secretariat to prepare a progress report on actions taken to address the adequacy of global observing systems for climate for presentation to the next meeting of the COP in October 1999.
- (5) The SC requested that the Secretariat, in consultation with GOOS and GTOS: investigate and report on the funding difficulties being experienced by both nations and international agencies that are associated with implementing, operating and co-ordinating the global observing systems for climate; assess any barriers in making use of national and international assistance programmes, such as the GEF, for these purposes; and make recommendations on appropriate actions which could be taken to address such barriers. The SC noted that it would need to provide an initial identification of some of the possible immediate, medium- and long-term options for financial support to the SBSTA at its upcoming session in May-June, 1999.
- (6) The SC noted the invitation of COP-4 for IACCA, through the GCOS Secretariat, to initiate an intergovernmental process for addressing the priorities for action to improve global observing systems for climate and noted that the GCOS-JSTC had

explored this question on a number of occasions in the past. It requested that the Secretariat explore and report on the various options suggested at this meeting and at the previous meeting of the JSTC, especially the concept of establishing an intergovernmental board for GCOS. It further requested that such exploration include consultation with WCRP, and others as appropriate, on the possibility of such a board being focussed on both research and monitoring needs. The SC urged the Secretariat to seek advice on such mechanisms at the upcoming meetings of IACCA (March), the WMO Congress (May) and the G3OS Sponsors (June), noting the need to be in a position to address this matter at the meeting of COP-5 in October of 1999.

AOPC

- (7) The SC requested the Secretariat to seek a formal link between AOPC and the WMO/CBS Expert Team on Observational Data Requirements and Redesign of the GOS.
- (8) The SC noted the recommendations from the recent AOPC-OOPC Workshop on Global SST Data Sets (Palisades, USA, 2-4 November 1998) and expressed its appreciation to the IRI for hosting the meeting.
- (9) The SC endorsed the need for an AOPC-OOPC project on SST/Sea-Ice Analysis aimed at identifying and systematically minimizing differences in the analyses produced by the main centres. It requested the AOPC to develop terms of reference for the project, including a specific duration for the activities involved.
- (10) The SC noted the outcome of the APN Workshop on Climate Extremes (Melbourne, Australia, December 1998) and endorsed the value of a follow-on workshop to produce a regional report for the IPCC Third Assessment Report.
- (11) The SC noted the results of the recent workshop on Implementation of the GSN Monitoring Centre (Offenbach, Germany, 19-20 January 1999) and expressed its appreciation to the DWD for hosting it. It also recognized with appreciation the ongoing contributions of DWD and JMA (Japan) in carrying out near-real-time monitoring of GSN data.
- (12) The SC noted with appreciation the continuing efforts of ECMWF and the WMO/CBS in support of the GUAN.
- (13) The SC endorsed the proposal that the provision of historical GSN data be extended to include precipitation, pressure and winds as well as temperature, and daily as well as monthly data.
- (14) The SC requested the Secretariat to facilitate, as a matter of some urgency, the formal request from WMO to NMHSs seeking historic daily GSN data and associated metadata.
- (15) The SC recognised the need to establish direct feedback to the operators of GSN and GUAN stations as an integral part of the operation of the GSN and GUAN.
- (16) The SC endorsed the overall data system planned for GSN and GUAN.
- (17) The SC noted the improving state of the GUAN and encouraged the AOPC to pursue the steps needed toward its completion.

- (18) The SC requested the Secretariat to work with AOPC towards establishment of a project office for GSN and GUAN, building synergistically on existing efforts being carried out by the WMO Secretariat.
- (19) The SC endorsed the proposed actions by AOPC-GOSSP to secure the satellite measurements needed to complement GUAN data and to determine the broad-based global top-of-atmosphere radiation budget.
- (20) The SC endorsed the proposed action by AOPC to investigate the needed links between GCOS and the WCRP/GEWEX Global Precipitation Climatology Project, with respect to global precipitation measurements complementing those of the GSN.
- (21) The SC noted and endorsed the potential role for GCOS in adding value to GAW measurements through international calibration activities.

OOPC

- (22) The SC welcomed the initiative of the OOPC in convening the first International Conference on the Ocean Observing System for Climate (OCEANOBS99), to be held in St.-Raphaël, France from 18-22 October 1999. It recognized the important role of this conference in implementation of the GCOS Initial Operational System (IOS) and in beginning the process of enhancement with CLIVAR activities, and agreed that GCOS would act as a cosponsor of the conference. The SC noted that preparation activities for OCEANOBS99 would provide an important input for COP-5 with respect to ocean observations for climate, and asked that the Scientific Organizing Committee ensure that this aspect be taken into account. It also asked that committee to identify issues which would impact on other components of GCOS and to report to the next meeting of the SC on these outstanding issues.
- (23) The SC endorsed the pilot project GODAE and associated activities such as Argo, and encouraged the OOPC to continue its work on these initiatives. In particular, it supported the strengthening of GODAE activities in the area of data assimilation and modelling.
- (24) The SC commended the actions taken by the OOPC through various workshops and studies. In particular, it endorsed the need for a commissioned study on the upper ocean thermal network, including data-processing activities. These networks were a critical element of the GCOS IOS and it is timely to revisit the design and provide a plan for future operation.
- (25) The SC supported the high priority being given by the OOPC to the integration of remotely-sensed and *in situ* data and noted that the GOSSP would also play an important role in this regard, as would the OCEANOBS99 conference.
- (26) The SC noted and welcomed the progress made in the establishment of a WMO/IOC Joint Technical Commission for Oceanography and Marine Meteorology (J-COMM). It recognized that this initiative, *inter alia*, would provide a permanent mechanism for implementing, monitoring and maintaining the ocean observing system for climate.
- (27) The SC recognized the importance of the climate component of GOOS in characterizing the global climate system and noted with appreciation the support of OOPC meetings by GOOS. It urged the G3OS sponsors to ensure continuing financial support and priority for GOOS among their programmes.

TOPC

- (28) The SC noted with appreciation the progress achieved on the establishment of glacier, permafrost and ecology networks through the efforts of the TOPC.
- (29) The SC encouraged the enhancement and further development of the glacier observation network (GTN-G), for example by incorporating satellite data (as Tier 5) through new initiatives such as the proposed global land ice monitoring system (GLIMS), by establishing new sites in data-sparse regions, and by revitalizing existing sites where measurements have been discontinued. It endorsed efforts aimed at developing common reporting, performance-measurement and review procedures with ICSU and other appropriate groups.
- (30) The SC endorsed the establishment of a permafrost network (GTN-P) based on the guidelines and observation-strategy documents developed by TOPC, and requested that the GCOS Secretariat, in cooperation with the GTOS Secretariat, send out invitations to participate in GTN-P.
- (31) The SC considered the establishment of a GCOS hydrology network an important step toward meeting the climate observation needs for hydrological information. It recognized the wide range of activities at both national and international levels in this area and encouraged the TOPC, in consultation with other appropriate groups and programmes and with support from the GCOS Secretariat, to work toward organizing an expert meeting on the subject. The SC acknowledged with appreciation the offer of the DWD to host such a meeting.
- (32) The SC welcomed and endorsed the suggestion that GTOS and GCOS increase collaboration in the establishment of GT-Net and GSN, respectively, to maximize the potential benefits for both systems.
- (33) The SC recognized the importance of the Global Observation of Forest Cover (GOFC) and Net Primary Productivity (NPP) pilot projects toward establishing an initial terrestrial observation system for climate purposes. It also recognized the relevance of these projects to an understanding of the global carbon cycle and recommended further consideration of the role they can play in quantifying the components of this cycle. Toward this end, the SC encouraged the TOPC to pursue further discussions, both within the projects and as part of the analysis initiated in the framework of IGOS.
- (34) The SC acknowledged the importance of the initial steps taken in the establishment of terrestrial observation networks for climate, while recognizing that many of these networks have serious gaps in coverage, and that in many cases the sites involved lack the funding or institutional support necessary to reliably and effectively participate in a long-term global observing system. The SC recommended that these issues be brought to the attention of nations as part of the response to COP-4, along with suggested remedial actions.
- (35) The SC recognized the fundamental importance of effective interaction with research programmes such as IGBP and WCRP in establishing a global observing system for climate, as well as the importance to those programmes of long-term systematic observations for climate. It acknowledged with appreciation the co-sponsorship by WCRP of the AOPC and OOPC, while noting that enhanced collaboration with research programmes is desirable in the terrestrial domain. The SC therefore invited the IGBP and WCRP to increase their participation in the work of TOPC through ensuring effective representation at its meetings and through co-sponsorship of the Panel.

- (36) The SC recognized the importance of the climate component of GTOS in characterizing the global climate system and noted with appreciation the support by GTOS for TOPC meetings. It urged the G3OS sponsors to ensure continuing financial support and priority for GTOS among their programmes.

JDIMP

- (37) The SC agreed to review the draft G3OS Data and Information Management Plan and provide comments to the SC Chairman by the end of March 1999.
- (38) The SC expressed its appreciation for the efforts of JDIMP in preparing the draft information management plan and in carrying out its other activities. It encouraged the Panel to continue with its GOSIC and other pilot projects.
- (39) The SC requested JDIMP to increase its activities in the area of data exchange policy, taking into account the ongoing activities of the WMO in this regard, including the work of the WMO Technical Commission for Climatology. In particular, it requested the Panel to document concrete examples of data-policy-driven problems in the international exchange of GCOS data, including any impacts of WMO Resolution 40 on the collection and exchange of global climate data. The SC requested that such information be available for presentation to COP-6 in 2001.

GOSSP

- (40) The SC endorsed the themes proposed by GOSSP for classifying areas of interest under the IGOS initiative including the explicit identification of an atmospheric chemistry and climate component. It also strongly supported the proposal to focus on the 'Oceans' theme for an initial, fast-track gap/overlap analysis. It noted that results of this analysis are to be available for 30 April 1999 if possible.
- (41) The SC requested the GCOS science panels, in consultation with GOSSP, to review the latest information on GCOS data requirements in the WMO/CEOS database to confirm its validity and provide updates as appropriate.
- (42) The SC endorsed the terms of reference for GOSSP as presented in Annex V of the draft report of the preliminary GOSSP-4 meeting (Washington, USA, 22-23 October 1998).

OTHER

- (43) The SC expressed its appreciation for the commitments by its sponsors to continue to provide resources to support the planning operations of the GCOS Secretariat. The SC nevertheless concluded that this level of resources is totally inadequate for co-ordinating the implementation of GCOS as expected by both the sponsors and clients. Addressing the priority actions identified at this meeting would urgently require additional financial and human resources. It therefore requested the Secretariat to identify this requirement for specific project resources as a matter of great urgency at upcoming meetings of the IACCA, the WMO Congress and related events.
- (44) The SC also requested that this urgent need for additional resources be drawn to the attention of potentially interested nations who might be willing to provide either personnel and/or financial support for GCOS at this critical time. It noted with appreciation the willingness expressed by one country to provide immediate financial resources for one of the urgent projects (specifically, the development of

guidelines for national communications on participation in global observing systems for climate and for encouraging and assisting the development of national plans and programmes for GCOS.) The SC urged other nations to consider providing support for specific priority activities.

- (45) The SC requested the Secretariat to prepare a report on the proposed GCOS response to the decisions of SBSTA-9 and COP-4, for presentation at the upcoming meeting of IACCA on 11–12 March in Paris. The report would be on behalf of all the global observing systems for climate including the climate components of GOOS and GTOS.**
- (46) The SC requested the Secretariat to prepare appropriate documentation for the WMO Congress in May 1999 and the IOC Assembly in June-July 1999, taking particular account of the results of this meeting and the resource requirements identified.**
- (47) The SC requested the GCOS science panels (AOPC, OOPC, TOPC) and JDIMP to review their Terms of Reference and membership with a view to identifying possible modifications or updates, noting that such review had just been completed for GOSSP, and to report results to the next meeting of the SC.**

ANNEX VIII

LIST OF ACRONYMS AND ABBREVIATIONS

ACE	Advisory Committee on Environment (ICSU)
APN	Asia-Pacific Network
AOPC	Atmospheric Observation Panel for Climate
APDA	Arctic Precipitation Data Archive
CBS	Commission for Basic Systems (WMO)
CCGCOS	China Commission for GCOS
CCI	Commission for Climatology (WMO)
CEOS	Committee on Earth Observation Satellites
CLIPS	Climate Information and Prediction Services (WMO)
CLIVAR	Climate Variability and Predictability (WCRP)
CMA	China Meteorological Administration
CMM	Commission for Marine Meteorology (WMO)
COP	Conference of the Parties (to UNFCCC)
COSF	Climate Observing System Fund (GCOS)
DWD	Deutscher Wetterdienst
EC	Executive Council (WMO)
ECMWF	European Centre for Medium-Range Weather Forecasts
ENSO	El Niño-Southern Oscillation
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
FAO	Food and Agriculture Organization of the United Nations
G3OS	GCOS, GOOS and GTOS
GAW	Global Atmosphere Watch
GCMD	Global Change Master Directory
GCOS	Global Climate Observing System
GEF	Global Environment Facility
GEWEX	Global Energy and Water Cycle Experiment
GHOST	Global Hierarchical Observing Strategy
GLIMS	Global Land Ice Monitoring System
GMS	Geostationary Meteorological Satellite
GODAE	Global Ocean Data Assimilation Experiment
GOFC	Global Observations of Forest Cover
GOOS	Global Ocean Observing System
GOS	Global Observing System
GOSIC	Global Observing Systems Information Centre
GOSSP	Global Observing Systems Space Panel
GPCC	Global Precipitation Climatology Centre
GPS	Global Positioning System
GRDC	Global Run-off Data Centre
GSN	GCOS Surface Network
GT-Net	GTOS Network
GTN's	GCOS Terrestrial Networks
GTN-G	Glacier Monitoring Network
GTN-P	Permafrost Monitoring Network
GTOS	Global Terrestrial Observing System
GTS	Global Telecommunication System
GUAN	GCOS Upper-Air Network
IACCA	Inter-Agency Committee on the Climate Agenda
ICSU	International Council for Science

I-GOOS	Intergovernmental GOOS Committee
IGOS	Integrated Global Observing Strategy
IOC	Intergovernmental Oceanographic Commission
IOS	Initial Operational System (GCOS)
IPA	International Permafrost Association
IPCC	Intergovernmental Panel on Climate Change
IRI	International Research Institute for Climate Prediction
J-COMM	Joint Technical Commission for Oceanography and Marine Meteorology
JDIMP	Joint Data and Information Management Panel
JMA	Japan Meteorological Agency
JPS	Joint Planning Staff (WCRP)
JSTC	Joint Scientific and Technical Committee (GCOS)
JSC	Joint Scientific Committee (WCRP)
MC	Monitoring Centre
MOU	Memorandum of Understanding
NASA	National Aeronautics and Space Administration (U.S.A.)
NEP	Net Ecosystem Productivity
NMHS	National Meteorological and Hydrological Service
NOAA	National Oceanic and Atmospheric Administration
NPP	Net Primary Productivity
NWP	Numerical Weather Prediction
OOPC	Ocean Observations Panel for Climate
OPAG	Open Programme Area Group
RTD	Research, Technological development and Demonstration
SAF	Satellite Application Facility
SBSTA	Subsidiary Body for Scientific and Technological Advice
SC	Steering Committee
SIT	Strategy Implementation Team (CEOS)
SST	Sea-Surface Temperature
TAO	Tropical Atmosphere-Ocean Array
TAR	Third Assessment Report
TOGA	Tropical Ocean and Global Atmosphere Programme
TOPC	Terrestrial Observation Panel for Climate
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WCDMP	World Climate Data and Monitoring Programme (WMO)
WCRP	World Climate Research Programme
WHYCOS	World Hydrological Cycle Observing System
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment (WCRP)
WWW	World Weather Watch (WMO)