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WORLD METEOROLOGICAL
ORGANIZATION

INTERGOVERNMENTAL
OCEANOGRAPHIC COMMISSION

REPORT OF THE GCOS DATA SYSTEM TASK GROUP

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SUMMARY OF THE MEETING

The Data System Task Group met to consider the development of a comprehensive plan for information management for GCOS. This document is the report of the meeting. A separate GCOS Data Management Plan has been drafted, circulated, and will be published early in 1995. A brief summary of the plan is included as Annex V.

Some key findings and recommendations from the Task Group meeting are summarized:

- o The GCOS data system should be based on existing systems to the degree possible;
- o Global data system should be developed co-operatively to produce an effective and integrated system;
- o GCOS recognizes and endorses the World Data Centres and certain specialized data centres as necessary to meet future archival needs of global observational systems;
- o The GCOS data system should include a data and information function to provide users with directory and access information;
- o Additional financial and manpower support are required to address international co-ordination issues in climate data management;
- o A Data Management Panel with comprehensive terms of reference should be established for GCOS;
- o The Panel should initiate and maintain an inventory of climate data systems and data product centres;
- o The Panel should develop a strategy and method for identifying and labelling data sets of particular importance in meeting GCOS requirements;
- o Where current data systems are found to be inadequate to meet climate requirements, the Panel should propose mechanisms to rectify the situation;
- o The Panel should develop a number of scientifically relevant pilot projects which would test the data collection, distribution, and archiving functions;
- o A GCOS data system ombudsman should be engaged as an interface between users and supplier to provide assistance.

REPORT OF THE GCOS

DATA SYSTEM TASK GROUP

1. OPENING OF THE SESSION

1.1 Mr. Gregory Withee, Chairman of the Data System Task Group, opened the meeting at the Deutscher Wetterdienst, Offenbach, Germany, on 22 March 1994 and welcomed the 25 participants (See Annex I). Before addressing the agenda (See Annex II), he invited Dr. Muller, Professor and Director of the Research Department of the Wetterdienst to provide opening remarks.

1.2 Dr. Muller welcomed the participants to Offenbach on behalf of the Deutscher Wetterdienst, Dr. Mohr. He reviewed the establishment of the GCOS for the Task Group, and noted that **the** Joint Scientific and Technical Committee (JSTC) had recently established a series of panels and task groups to assist in GCOS planning.

1.3 Dr. Muller cited important German contributions to GCOS, noting specifically the Global Precipitation Climatology Centre (GPCC), the Global Runoff Data Centre (GRDC), and the Global Collecting Centre (GCC) for ship observations, all to be discussed later in the meeting.

1.4 Mr. Vent-Schmidt, Chairman of the German GCOS Committee added his welcome to the Task Group. He briefly reviewed the activities of his Committee, and its supportive role in developing a German programme as a national contribution to the GCOS effort. On behalf of the host of the meeting, he informed the Task Group about the material arrangements.

2. INTRODUCTION AND GCOS BACKGROUND

2.1 Dr. **Spence**, Director of the Joint Planning Office (JPO) for GCOS provided an overview of the GCOS planning activities to date. He reviewed the highlights from the inception of the programme at the Second World Climate Conference to the present meeting, and noted the responsibilities of the Joint Scientific and Technical Committee (JSTC) in planning, implementing, and overseeing the development of the GCOS programme. He specifically noted that the Third Session of JSTC established several discipline-oriented panels and cross-cutting task groups.

2.2 The Data System Task Group was established to develop a plan for the data system required for GCOS. Its terms of reference are at Annex III. Fundamentally, the Task Group is expected to develop an initial plan for data management for GCOS, and to make recommendations to the JSTC concerning the subsequent steps toward implementation.

2.3 The Director described the other panels including their chairmen and schedules

for meetings. It was noted that the development of a data management system for GCOS will be dependent on the work of the science oriented panels which will meet later in the year.

3. OPENING STATEMENT OF THE TASK GROUP CHAIRMAN

3.1 The Chairman, noting that the participants represented diverse communities, invited them to make brief introductions. That completed, he restated the importance and timeliness of the Task Group meeting. He illustrated the rapid change occurring now in both data systems and data communication. He stressed the need for a "vision" of the data system for GCOS -- if the system is to effectively meet the user needs for comprehensive data for climate.

3.2 The Chairman described the data problem as one of the most challenging for GCOS. He noted that an integrating data system must be developed to bring the disparate observing pieces together. In other words, since GCOS will be a composite observing system based on atmospheric components (e.g., World Weather Watch, Global Atmosphere Watch); oceanographic components (e.g., Integrated Global Ocean Services System, Global Sea Level Observing System, climate module of the Global Ocean Observing System); and terrestrial components (e.g., Global Environmental Monitoring System, climate elements of the Global Terrestrial Observing System), it will only be a global climate observing system if it includes an truly integrated data and information system. At the same time, he noted the difficulties that must be overcome to integrate space-based measurements and *in situ* data, while also maintaining high data quality standards, and providing adequate monitoring of the performance of the integrated system.

3.3 The Chairman noted some specific ways that the data system could benefit from the work of the Task Group. The Group could make specific recommendations which might lead to improvements in the WWW Global Telecommunications System (GTS), and in linking data centre activities. He considered it timely to address such problems, since recent improvements in technology have provided new opportunities for large data transfers and for effective communication links.

3.4 The Chairman invited participants to consider the terms of reference developed by the JSTC for the Task Group. No major concerns were voiced, but a few questions were raised concerning the links among the other GCOS panels and groups, relations to other research and operational activities, and schedules of specific activities.

3.5 The Chairman then asked participants to consider the agenda and work plan that were submitted for adoption. The principal document to be considered was the GCOS Data Management Plan which had been prepared for the Task Group, noting that the agenda was structured to permit its early introduction, and to permit other speakers to relate their remarks to the plan. After a few additions and modifications, the agenda was adopted.

4. INVITED REPORTS

4.1 Overview of Current Climate Data

4.1.1 Dr. Karl was invited to present an overview of current climate data issues. In the presentation, "Assessing Climate Change: A Perspective on Existing Climate Data", he raised five key science questions which are arising in the context of the Intergovernmental Panel on Climate Change (IPCC). They are: (1) is the climate warming; (2) is the hydrological cycle changing; (3) is atmospheric/oceanic circulation changing; (4) is the climate becoming more variable; and (5) are extreme weather events changing in frequency/intensity?

4.1.2 To answer such questions, Dr. Karl said the scientific community must draw upon the available observations including global data bases, regional and national data sets, and model output. For each question, he noted that there are critical parameters and data products which are required. These parameters must be observed with appropriate space and time scales, with sufficient accuracy, and for an adequate duration.

4.1.3 Turning to specific parameters, Dr. Karl illustrated the many deficiencies in the current data base including, for example, incompatible data formats, uneven data quality, inadequate or missing metadata, inconsistent observational documentation, and others. He proposed that GCOS be sensitive to several of these issues including: long-term continuity, calibration, quality control, documentation of techniques, and international data availability.

4.1.4 To conclude, he recommended incentives be developed for science teams and national centres to incorporate relevant data sets into a directory. He stressed that the community needs: (1) numerous paths to access data sets; (2) better and up-to-date documentation of data set development; and (3) connectivity at all levels, world, regional, and national.

4.2 GCOS Data System Concept

4.2.1 Dr. McGuirk was invited to review the GCOS Draft Plan for Data Management which he prepared for Task Group consideration. He identified several of the principal assumptions that were made in developing in the plan. With regard to standards, for example, he noted that real-time data transfer requires standards, and although retrospective data need not be transmitted in real-time, standards should be developed for several aspects of that element as well (quality, transfer, storage, archive, etc.).

4.2.2 He noted that the needs of the users/participants in GCOS should be paramount, but that the users/participants are currently being identified and their requirements being refined, and likely to evolve as science and technology advance. In subsequent discussions, it became clear that the GCOS user community is broad and diverse, and will have data requirements which will require, *inter alia*, real-time and delayed mode systems, client-server systems, and more conventional data request-reply mechanisms.

4.2.3 The Task Group complimented Dr. McGuirk on the draft document. It agreed that it would provide an excellent start toward a comprehensive plan for GCOS data

management.

5. DATA SYSTEM MODELS

5.1 Meteorological approach

5.1.1 Dr. Love provided a background document on the data system needs for GCOS, and outlined a number of key issues to be considered. He noted the need for a logical data model, and identified a number of interdisciplinary issues facing the data management group. Based on his experience in the operational meteorological field and as Chairman of the Data Management Working Group of **WMO's** Commission for Basic Systems (CBS), he described the current meteorological data approach of the WMO. The WMO is composed of observing and modelling components, linked by a real-time Global Telecommunication System (GTS). The GTS links the Members of WMO and transmits data and products. At the current time, the GTS has a wide range of capabilities depending on the individual national components. It functions using rigid standards of transmission and codes. Dr. Love noted that recently, terms of reference for the GTS (and other CBS elements) have been broadened to include support to meet the needs of other WMO programmes such as GCOS. The current data plans for GTS include upgrades to the GTS, and the development of a distributed database system with more flexible protocols. These plans will evolve based on the needs of users.

5.1.2 Dr. Davidson described the data system model in place for climate information at the US National Climatic Data Centre. He used the Automatic Surface Observing System (ASOS) as an example, illustrating the steps in the data system from the actual observing instruments and data collection to transmission, storage, and finally delayed mode dissemination. As a Chairman of the Working Group on Climate Data of the **WMO's** Commission for Climatology (Ccl), he highlighted some of the difficulties in access and dissemination, particularly citing the transmission of climate messages on the GTS.

5.1.3 Mr. Ingram provided the view of a climate modeller at a major climate centre, representing users with specific needs for analyzed data, but who are not specialists in data analysis. Rather than raw data, such users want "added value" analyses of greatly reduced volume, and so have much lower communication requirements than specialists. However, they must be able to rely on the quality. He noted that at present, a non-specialist must rely on the reputation of the scientists concerned or on informal contacts in the data analysis community to judge data quality. Often, these informal contacts are essential just to obtain data.

5.1.4 Dr. Jose noted that all the elements, including the communication between the producers and users, must work effectively and should include awareness programmes so that users may make maximal use of the data system. She stated that people at both national and international levels must be responsive on this issue. She urged the formation of national GCOS committees for national coordination. She further called for a close cooperation between developed and developing countries, noting that the benefits in the latter countries will be particularly significant in mitigating natural disasters. She urged that GCOS should support capacity building and training activities for developing countries and recommended that the tropics be given special consideration for data centres dispensing climate information.

5.1.5 Considerable discussion was prompted by the preceding talks, and by participant comments concerning data availability, distribution, and utilization.

5.2 Oceanographic approach

5.2.1 Dr. Wilson discussed the Intergovernmental Oceanographic Commission (IOC) activities in data management, including preparations for the Global Ocean Observing System (GOOS) and contributions to the Global Temperature/Salinity Pilot Project. As Director of the Marine Environmental Data System (**MEDS**), he described some of its data management functions including directories, quality control, and data flow monitoring, asking if GCOS could have such a facility established and maintained. Further, with regard to GCOS, he recommended: (1) a consistent integration of information and data flow, (2) the rationalization of a distributed system organized so that a few sites organize the data, (3) the development of a complete data plan for each data flow, and (4) a common plan/system for both research and operational needs.

5.2.2 Dr. Koltermann emphasized that the data management structures in oceanography differ from those in meteorology, the former functioning principally through personal contacts. He stressed that the process of developing a data system should begin by determining which products are required, and using that information to guide the acquisition of appropriate data sets and techniques needed to develop the products. He provided a schematic of this process (Annex IV). Regarding data exchange, he contrasted the fast mode (IGOSS) with the slow mode (**IODE**). He emphasized the provision of high quality data sets which will be used and discouraged the collection into dormant archives.

5.2.3 Dr. Comillon described a distributed oceanographic data system being formulated principally by the scientific community. Its guiding principles are: (1) minimal impediment to data access; (2) access to data with regard to user application; and (3) access to data held by principal investigators as well as centralized data archives. The approach is to develop a client/server model with interfaces that permit efficient linkage among users. He felt it was important for the community to begin working on data structures, noting that they will be the major impediments to client/server systems of the future. Finally, he noted that mechanisms for transferring data should continue to include removable media (e.g., CD ROMs) as well as electronic networks.

5.3 Terrestrial approach

5.3.1 Dr. Rasool described the data and information activities on behalf of the scientific community through the International Geosphere-Biosphere Programme (**IGBP**) Data and Information System @IS). He noted that the role of DIS is to solicit requirements, including accuracy, **spacial** scales, etc., from the research community and to assist users in getting the data they need. He illustrated the process with an example of 1 km resolution global maps gathered from satellite AVHRR observations. He recommended that GCOS identify specific products required by the climate community so that projects could be proposed to obtain the necessary data for their development.

5.4. Space-based approach

5.4.1 Mr. Kikuchi provided a brief update on the activities of the Japanese Space and Development Agency (NASDA), the data and network activities of the Committee of Earth Observation Satellites (CEOS), and progress on data policy. The current and planned space activity in Japan will address a number of GCOS data needs. Mr. Kikuchi described the plans for a global network to distribute satellite information. He serves as Chairman of the *ad hoc* Working Group established by CEOS to guide the development of this network. He additionally discussed current and future data policy regarding data distribution, and emphasized that such policies have implications for national programmes and projects. Finally, he informed the Task Group that Japan, through NASDA, has shown its support for GCOS through the secondment of an engineer, Mr. Matsuura, to the JPO in Geneva, and through studies that have been funded to develop user requirements.

5.4.2 Dr. Maiden reviewed the plans for the Mission to Planet Earth of the National Aeronautics and Space Administration (NASA), and provided updates on the progress of the Earth Observing System Data and Information System (EOSDIS). This latter effort is designed to provide a comprehensive data system for the satellite missions of the EOS, as well as related *in situ* observations needed by the U.S. Global Change Research Program. She also described the Pathfinder project which follows specific data streams from the site of collection to the site of utilization.

5.4.3 Dr. Croom informed the participants about the work in preparation for the GCOS Space-based Observation Task Group. He and colleagues have developed a draft plan for consideration at the meeting early in May. He noted that there are several issues such as data standards and metadata in common between the two task groups. He also pointed out that CEOS has adopted definitions for standard data levels/products which are at variance with the data levels used in FGGE.

5.5 World Data Centres

5.5.1 Dr. Webster reviewed the activities of the World Data Centres. A number of them have been established as archives for environmental data, much of it of value to the climate community. Although he noted some of their difficulties, it is clear that they may provide the principal long-term archival functions for GCOS. It was noted that GCOS should assist in specifying what should be included in the archives, and should work with the various centres as appropriate. Following the discussion, it was agreed that GCOS endorse the work of the centres, encourage support for their activity, and cooperate closely with them.

5.6 Data Policy

5.6.1 The Data Policy developed at the JSTC-II meeting was reviewed. The data policy prompted considerable discussion, particularly with regard to the responsibility that the policy implies for individual nations. The Task Group suggested a few editorial changes be considered by the JSTC at its next meeting.

6. DEVELOPMENT OF THE GCOS DATA MANAGEMENT PLAN

6.1 Review of the Draft Data Management Plan

6.1.1 After the extensive review of the various community data models, the Task Group was urged to consider the draft Data Management Plan. The Chairman reviewed some of the comments that various speakers had made regarding the plan, and invited the participants to comment on the overall document.

6.1.2 **The** comments fall into 4 categories: (1) vision; (2) standards; (3) access; (4) product driven projects; and (5) editorial suggestions:

- (1) It was felt that the “vision” as described in the scenarios was not particularly visionary, since many of the technical ingredients are available currently;
- (2) Standards for data transmission, apart from the **WWW/GTS**, were felt to be in a state of flux at present. Participants agreed that standards are essential, particularly with regard to real-time systems, but that this may not be an opportune time for GCOS to consider them. Rather, due to the rapid development of distributed databases, particularly by the individual scientists and agencies, it would be preferable to focus on other issues at this time;
- (3) Access was an important topic for the Task Group. It agreed that GCOS could make major contributions to expedite access, and suggested that the Data Management Plan focus more attention on such activities;
- (4) The Task Group members emphasized that specific problems should be selected and developed. Defining key products would emphasize those data sets particularly critical for required products, and that these data sets in turn could be used to formulate a suite of pilot studies which could be proposed to agencies for action. Thus, the pilot studies would focus on gathering the appropriate data sets, and providing them to user/participants in an effective manner;
- (5) Finally, there were editorial issues such as inconsistencies, terminology that was too specific (e.g., gopher, **TCP/IP**) and ill-defined terms such as “GCOS data” which should be addressed in the subsequent versions.

6.2 Working Groups

6.2.1 The Chairman recommended that the Task Group divide into three working groups to consider: (1) the overall document; (2) implementation; and (3) data issues (content, quality, etc.) respectively.

6.2.2 . The working group considering the overall document suggested a restructuring of the Data Management Plan into two portions -- the first sections emphasizing the next five year period, and a section focused on longer issues including technical developments. This group considered the needs for telecommunication, distinguishing between near-real-time and

delayed mode. They recommended an effective two-way link with developing countries. The group provided suggested actions which could be initiated in the near-term: (1) solicit a study of the near-real-time needs for GCOS to provide telecommunication guidance; (2) initiate a CD-ROM project on climate data sets and software to exploit them; and (3) identify more precisely the needs of the user communities (e.g., research, operational, assessment). The working group provided additional constructive comments to improve the Data Management Plan.

6.2.3 The working group considering implementation discussed the needs of potential users of the GCOS data management system and recommended a two-level system to meet; (1) the needs of research and operational communities who often require level I or level II data, and (2) the needs of the assessor/integrator communities, the later group more likely interested in higher level data sets or composite products. The group noted that a better definition of the requirements from the science panels of GCOS and other sources is essential to properly scope the data management issues. As a first step, the group recommended that specific scientific problems be identified as pilot projects to evaluate current data system strengths and weaknesses, and proposed examples of such projects, charging the science panels to develop additional ones. It further called for a close cooperation, perhaps facilitated by GCOS, between research and operational groups. The working group provided considerable input to the draft of the Plan, and recommended that a standing Data Management Panel be established by the JSTC. They also recommended additional manpower on data issues be assigned to the Joint Planning Office.

6.2.4 The working group considering data issues discussed a number of topics such as the content and quality of the data, data policy, and access. The group addressed the levels of data to be addressed by the GCOS data system, and reiterated that the data system should be driven by user requirements for specific products. The working group noted that GCOS data sets should be identified in so far as they meet certain standards of quality, include appropriate metadata, or have been used in peer-reviewed publications. The group recommended that a sub-panel of the Data Management Panel should consider mechanisms to identify such data sets. The group strongly urged the inclusion of metadata that: (1) defines the content of various data sets; (2) provides the rationale for the data set; and (3) includes scientific assessments which indicate the quality of the data set. The group discussed the data policy outlined by the JSTC and considered it to be appropriate at this stage. The group did support strong actions by GCOS to ensure data access to users. The group urged GCOS to provide incentives to data and product providers to make their information available via appropriate distribution systems. The group also recommended close cooperation between GCOS and existing archiving activities.

6.3 Documentation of the GCOS Data Management Plan

6.3.1 Based on the plenary and working group sessions, a strategy for developing the document was described. Initial comments and discussion would be reflected in a subsequent draft document to be circulated to the attendees. After their review, the final version would be provided to the JSTC for their approval for publication as a GCOS planning document. Although the detailed plan is still under development, a summary of the plan is provided at Annex V.

7. **ROLE OF SPECIALIZED DATA CENTRES**

7.1 Global Data Centres

7.1.1 To provide background on existing global data centres, presentations were made on three typical centres by appropriate representatives.

7.1.2 Mr. Rudolf, Director of the Global Precipitation Climatology Centre (GPCC) in Offenbach provided an overview of the Centre's activities. The purpose of the Centre is to collect and quality control the gauge-measured world-wide precipitation data, to calculate **areal** means, and merge the analyses into products, including error analyses. Examples of the products of the GPCC, and some difficulties experienced by the Centre in obtaining information were presented to the Task Group. Mr. Rudolf suggested that GCOS could assist in increasing the flow of national data, not transmitted via the Global Telecommunication System (GTS) of the WMO, to the global centres.

7.1.3 On behalf of the Director of the Global Runoff Data Centre (GRDC) in **Koblenz**, Dr. **Lullwitz** presented a report on the activities of the centre. The purpose of the Centre is to collect runoff data on a global scale and disseminate the data for research and applications in hydrology and climatology. The range of services provided by the GRDC for the data users was presented to the Task Group. Additionally, some problems regarding the updates of hydrological time series and data quality were noted. The GRDC proposed to contribute actively to the production of specialized data products for GCOS, and to serve as a source of information on water-related data bases. In his presentation, it was stressed that the data suppliers must be given the opportunity to fully participate in appropriate GCOS activities. In this regard, it was proposed that a component for capacity building in data acquisition, processing and management in selected developing countries be supported. Difficulties were noted in meeting the goals of the GRDC. Some issues noted were: (1) hydrological networks are not well supported in many countries; (2) hydrological data is often not shared among countries; (3) the quality of such data is difficult to assess.

7.1.4 Dr. Wagner reported on the activities of the Global Collecting Centre (GCC) with regard to marine meteorological data. The principal role of the GCC is to provide quality control and distribution of data. The Group was informed of the status of the Centre.

7.1.5 The Task Group expressed appreciation for the reports and noted that the activities of such centres make a significant contribution to the objectives of GCOS. It recommended that GCOS support the activities of the centres, especially in their efforts to acquire additional data.

7.2 Regional Data Centres

7.2.1 Ms. Marume provided a review of the Drought Monitoring Centre in **Harare**, Zimbabwe. The Centre has the responsibility of monitoring drought in the region with regard to intensity, geographical extent, duration, and likely impact upon agricultural production. It collects meteorological data for countries which form the Southern African Development Community (SADC), Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, Tanzania, Zambia, and Zimbabwe. Ms Marume described the work

of the centre, and noted its difficulty in obtaining timely information.

8. SPECIFIC PROPOSALS FOR FUTURE WORK

8.1 Short-term recommendations

8.1.1 The Task Group discussed short-term actions and made recommendations for their inclusion in the Data Management Plan. These recommendations have been incorporated.

8.2 Longer-term recommendations

8.2.1 The Task Group considered the longer-term development of the data management plan, but suggested that the Data Management Panel should develop this area in due course.

9. ACTIONS

9.1 The Task Group reviewed a summary list of recommended actions (Annex VI). A few highlights include: (1) establishing a Data Management panel with responsibilities as outlined; (2) develop elements of the data system utilizing existing systems as appropriate; (3) develop an inventory of data systems and product centres; and (4) engage an ombudsman to interface between users and providers.

10. CLOSURE OF THE MEETING

10.1 The Chairman closed the meeting at 1315 hours on Friday, 25 March.

Annex I

Lii of Participants

Dr. Ray ARNOLD c/o IRPTC, Case Postale 956 15, chemin des Anemones 1219 Chatelaine, Switzerland	Tel: 41 22 979 9303 Fax: 41 22 796 9240
Dr. Peter CORNILLON Graduate School of Oceanography University of Rhode Island Narragansett Bay Campus Narragansett, RI 02882-1197, U.S.A.	Tel: 1 401 792 6283 Fax: 1 401 792 6728
Dr. David CROOM Space Science Department Rutherford Appleton Laboratory Chilton Didcot OX1 1 OQX, United Kingdom	Tel: 44 235 44 6428 Fax: 44 235 44 5848
Dr. Ken DAVIDSON National Climatic Data Centre (NCDC) NESDIS, NOAA, Room 301 D Federal Building Asheville, NC 28801-2696, U.S.A.	Tel: 1 704 271 4848 Fax: 1 704 271 4246
Mr. William INGRAM Hadley Centre Meteorological Office London Road Bracknell RG12 2SY, United Kingdom	Tel: 44 344 85 6873 Fax: 44 344 85 4898
Dr. Aida M. JOSE (Ms.) Philippine Atmospheric, Geophysical and Astronomical Services Administration ASIATRUST Bank Building 1424 Quezon Avenue Quezon City, Philippines	Tel: 632 922 7282 Fax: 632 922 9291
Dr. Thomas KARL National Climatic Data Centre (NCDC) NESDIS, NOAA 3 Battery Park Ave Asheville, NC 28801-2696, U.S.A.	Tel: 1 704 271 4319 Fax: 1 704 271 4328

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Mr. Hiroshi KIKUCHI Strategy and Planning Division Earth Observation Planning Department National Space Development Agency of Japan 2-4-1 , Hamamatsu-cho, Minato-ku, Tokyo 105, Japan	Tel: 81 3 5470 4238 Fax: 81 3 3432 3969
Dr. Peter K. KOLTERMANN Bundesamt für Seeschifffahrt und Hydrographie Postfach 301220 20359 Hamburg, Germany	Tel: 49 40 3190 3250 Fax: 49 40 3190 5000
Dr. Geoff B. LOVE Bureau of Meteorology G.P.O. Box 1289K Melbourne, Victoria, 3001, Australia	Tel: 613 669 4030 Fax: 613 669 4023
Dr. Thomas LÜLLWITZ Global Runoff Data Centre Bundesanstalt für Gewässerkunde Kaiserin-Augusta-Anlagen 15-17 56068 Koblenz, Germany	Tel: 49 261 1306 0 Fax: 49 261 1306 280
Ms. Martha MAIDEN NASA Headquarters, Code YDD 300 E St. , SW Washington, D.C., 20546, U.S.A.	Tel: 1 202 358 0759 Fax: 1 202 358 2770
Miss Wish MARUME Department of Meteorological Services P.O. Box BE 150, Belvedere Harare , Zimbabwe	Tel: 263 470 4955 Fax: 263 473 3120
Dr. David MCGUIRK Data Management Office, World Weather Watch Department World Meteorological Organization Case Postale No. 2300 1211 Geneva 2, Switzerland	Tel: 41 22 730 8241 Fax: 41 22 734 2326
Ms. Linda V. MOODIE National Environmental Satellite Data and Information Service, NOAA U.S. Department of Commerce FB 4, Room 0110 Washington, D.C. , 20233, U.S.A.	Tel: 1 301 763 4586 Fax: 1 301 736 5828

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Dr. Ichtiague RASOOL
IGBP-DIS
Université de Paris
4, Place Jussieu, **Boîte** 97
75230 Paris **cedex** 05, France
Tel: 331 4427 6168
Fax: 331 4427 6171

Dr. Robert REEVES
Office of Ocean and Earth Sciences
National Ocean Service, NOAA
1305 East-West Highway, SSMC4 Station 6612
Silver Spring, MD 20910, U.S.A.
Tel: 1 301 713 2981
Fax: 1 301 713 4392

Mr. Bruno RUDOLF
Global Precipitation Climatology Centre
Deutscher Wetterdienst
Postfach 10 04 65
63004 Offenbach, Germany
Tel: 49 69 8062 2981
Fax: 49 69 8062 2880

Mr. Volker VENT-SCHMIDT
Deutscher Wetterdienst
Abteilung Klimatologie
Postfach 100465
63067 Offenbach am Main, Germany
Tel: 49 69 8062 2958
Fax: 49 69 8062 2993

Dr. Volker WAGNER
Deutscher Wetterdienst
Seewetteramt
Bernhard-Nocht-Str. 76
Hamburg, Germany
Tel: 49 40 3190 8821
Fax: 49 40 3190 8803

Dr. Ferris WEBSTER
College of Marine Studies
University of Delaware
Lewes, DE 19958, U.S.A.
Tel: 1 302 645 4266
Fax: 1 302 645 4266

Dr. J. Ron WILSON
Marine Environmental Data Service
Physical and Chemical Sciences
1202-200 Kent Street
Ottawa, Ontario **K1A** OE6, Canada
Tel: 1 613 990 **0264**
Fax: 1 613 990 5510

Mr. Gregory W. **WITHEE** (Chairman)
National Environmental Satellite and
Environmental Service, NOAA
U.S. Department of Commerce
Washington, D.C. 20233, U.S.A.
Tel: 1 301 763 7190
Fax: 1 301 763 4011

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Mr. John **WITHROW**
IOC, UNESCO
1, Rue Miollis
75732 Paris **cedex** 15, France

Tel: 331 4568 4008
Fax: 331 4056 9316

Secretariat:

Dr. Thomas W. **Spence**
Joint Planning Office
Global Climate Observing System
c/o WMO, Case Postale 2300
CH-1211 Geneva 2, Switzerland

Tel: 41 22 730 8401
Fax: 41 22 740 1439

Annex II

Agenda

1. Opening of the Session
2. Introduction and GCOS Background
3. Opening Statement of the Task Group Chairman
4. Invited Reports
 - 4.1 Overview of Current Climate Data
 - 4.2 GCOS Data System Concept
5. Data System Models
 - 5.1 Meteorological approach
 - 5.2 Oceanographic approach
 - 5.3 Terrestrial approach
 - 5.4 Space-based approach
 - 5.5 World Data Centres
 - 5.6 Data policy
6. Development of the GCOS Data Management Plan
 - 6.1 Review of the Draft Data Management Plan
 - 6.2 Working groups
 - 6.3 Documentation of the GCOS Data Management Plan
7. Role of Specialized Data Centres
 - 7.1 Global Data Centres
 - 7.2 Regional Data Centres
8. Specific Proposals for Future Work
 - 8.1 Short-term recommendations
 - 8.2 Longer-term recommendations
9. Actions
10. Closure of the Meeting

Annex III

Terms of Reference for the Data System Task Group

Recognizing the need for a comprehensive approach to the various data management activities of the Global Climate Observing System, the JSTC hereby establishes an *ad hoc* Data System Task Group for a period of nine months to develop a plan for consideration. The Task Group has the following terms of reference.

Terms of Reference:

Based on **the** guidance in **the Draft Plan** for GCOS, the *ad hoc* Data System* Task Group will be established with the objectives to:

- o Develop a plan, in concert with GCOS science panel requirements and the GCOS user community, for a data system which will handle and provide data and data products to assist in climate monitoring, climate change detection, understanding, prediction and impact assessment;
- o Make recommendations to the GCOS planners regarding the data system, specifically including mechanisms to facilitate its implementation;
- o Develop a data policy under which the data system works;
- o Work with other GCOS panels, the space task group, and relevant data groups at WMO, IOC, UNEP, and ICSU;
- o Prepare a draft data work plan for the next 2 to 5 years which may be used to continue planning and to initiate implementation;
- o To outline and propose to the JSTC the responsibilities of a standing Data Management Panel which would ensure that appropriate data systems are developed and made available to meet GCOS objectives.

Scope:

The plan shall consider *inter alia* the following:

- i) the continual documentation of the data available, including data products up to and including level III, from the data system;

* The data system is defined as that system which performs the functions of acquisition, quality control, distribution, metadata documentation, archiving, performance monitoring and directory/inventory assistance for data of interest to GCOS. The GCOS data system is to be planned by the *ad hoc* data system group, but will be implemented by institutions or countries.

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- ii) the use of models for the assimilation of data in order to generate level III data sets;
- iii) the monitoring of the data system to identify gaps and system performance;
- iv) the accessibility of data to the wide variety of users;
- v) an information system which describes the type and location of data sets including levels I, II, and III;
- vi) the role of national and world data centres and specialized data centres (e.g., TOGA data **centres**) which could contribute to the operational data system;
- vii) a data system requirements translation process which involves a dialogue with the other GCOS science panels and the needs of developing countries;
- viii) the incorporation of necessary historical data into the data system, perhaps using CLIVAR guidelines;
- ix) reprocessing, production and distribution of satellite and *in situ* data sets;
- x) effective user interface to the GCOS data systems elements;
- xi) implementation, and activities over the next 5 years which will lead to or facilitate implementation.

Tentative Work Plan:

- o Prepare first draft plan and/or components
- o Develop initial data system plan and data policy at data system task group meeting
- o Review plan and complete revised draft
- o Complete final draft with expert groups
- o Begin assessment of existing data systems
- o Take draft plan to WMO CBS meeting for comment
- o Provide final draft plan and recommendations to JSTC-IV

Chairman: Mr. Gregory Withee, USA

Annex IV

Schematic of Data Product/Requirement Development

The following table illustrates the development of requirements and their dependence on certain products. In this example, taken from oceanography, the **final** requirement might be to have appropriate fields from the North Atlantic to force climate model calculations (upper right box). These fields will require the preparation of certain Level III products such as monthly maps of evaporation and precipitation (E-P), and the output from models. To develop such products, certain input fields, such as surface fluxes (E-P, radiation), are noted as the requirement at Level II B. These, however, depend on Level II B products such as heat flux estimates and winds. These in turn require observations of E-P, radiation, and wind stress, noted as the requirement from Level II A. Continuing, these require observations **from** satellites and *in situ* platforms, perhaps gathered by operational groups. Finally, we arrive at Level I where, for example, direct ship observations are taken at single stations by individual observers to meet the Level I requirements. Thus, the product required at any given level depends on satisfying the requirement at the next lower level.

Terminology	Who generates data	Product required	Requirement
Level III B	Dedicated group	Monthly maps of E-P, Assimilating or operational models outputs	Forcing fields: E-P in N. Atlantic, Variations in surface fluxes
Level II B	Dedicated group	Heat flux estimates, Thermocline depths, Scatterometer winds	Monthly E-P maps, Monthly LW & SW radiation, Wind stress
Level II A	Operational group	Satellite data, <i>In situ</i> data	LW & SW fields, Wind stress fields, Scatterometer winds
Level I	Individual observer	Single data point	Ship observations, XBT, XCTD casts, Evaporation and precipitation observations

Note: Levels I, II A, II B, and III are as defined by the First Global GARP Experiment (FGGE);

E-P is the evaporation minus precipitation;

LW, SW are Long-wave and Short-wave radiation components;

XBT, XCTD are expendable probes for ocean temperature and density.

Annex V

Summary of the GCOS Data Management Plan

Introduction

1. GCOS, the Global Climate Observing System, has been established to develop a dedicated observing system designed specifically to meet the scientific requirements for monitoring the climate, detecting climate change, and predicting climate variations and change. The first priority in the GCOS strategy is to define and develop an Initial Operational System (**IOS**) for observations and data. The IOS will include a comprehensive data management system which specifies procedures for collection and quality control, comparison of observations from different sources, dissemination, and utilization of all data relevant to GCOS. The GCOS Data Management Plan outlines the steps necessary to develop the **IOS** data management system.

2. Although, initial efforts will concentrate on the IOS, they must also contribute to realization of the long-term goal for the GCOS data management system: an internationally coordinated system of data bases which provide for effective end-to-end management of all data pertinent to GCOS. The system must ensure that:

- All required data are collected in a consistent manner;
- Data are subject to rigorous quality control procedures;
- Products needed to meet GCOS requirements are developed and routinely produced;
- All GCOS-relevant data and products are stored in suitable archives;
- All data and products are easily accessible at the lowest possible cost.

3. The GCOS data management strategy depends upon the following guiding principles:

- To the fullest extent possible, rely upon existing national and international programmes and institutions;
- Full and open sharing and exchange of GCOS-relevant data and information for all GCOS users is fundamental;
- Use international standards whenever possible;
- Encourage users of climate data and products to provide data sets and feedback to GCOS and, therefore, regard them as participants whose requirements are a primary concern;
- Ensure data are of the highest possible quality and consistency and are accompanied by comprehensive metadata;
- Monitor and evaluate the system constantly.

Management of the programme

4. The Joint Scientific and Technical Committee (JSTC) is responsible for formulating the overall concept and scope of GCOS and providing scientific and technical guidance. It will develop necessary plans and stimulate (and oversee as necessary) the implementation of those plans through appropriate national and international agencies. A Data Management

Panel, reporting to the JSTC, will ensure that a comprehensive data management system is available to meet GCOS requirements by coordinating and overseeing development and implementation of the Data Management Plan. A Joint Planning Office (JPO) , located at the WMO in Geneva, supports the JSTC and its sub-panels in their efforts.

5. It must be emphasized that the implementation and technical management of the GCOS data management system will be through existing national and international agencies and organizations. The system will be developed, implemented and operated by these organizations and programmes, and the **final** success of the programme rests in their hands. As additional resources may be required for these organizations to meet the additional responsibilities needed by GCOS, GCOS will strive to ensure that their requirements for support are considered by the appropriate national and multi-national funding agencies.

6. As the GCOS data management system will be built upon the existing and planned international data management infrastructure, it is essential that it carefully consider the full range of appropriate activities and evaluate the role they should play in the development of the GCOS data management system. Although many on-going international programmes will contribute to the GCOS data management system, at this time it appears that the programmes likely to make the most important contributions are the World Data Centres (**WDC**) of the International Council of Scientific Unions (**ICSU**), the World Weather Watch (**WWW**), the Global Atmosphere Watch (**GAW**), the World Climate Research Programme (**WCRP**) and International Geophysical-Biophysical Programme (**IGBP**), the Global Ocean Observing System (**GOOS**) and other Intergovernmental Oceanographic Commission (**IOC**) programmes, and the Global Terrestrial Observing System (**GTOS**) and related programmes of the United Nations Environment Programme (**UNEP**). Further information on the current activities and expected contributions of these programmes are found in the GCOS Data Management Plan.

7. Of particular interest to CBS, the WWW has recently begun planning the development of a series of international distributed data bases (**WMO DDBs**) to provide access to data not regularly exchanged over the GTS. These **DDBs** are intended to support the requirements of all WMO Programmes with GCOS particularly noted. The WWW will closely coordinate development of WMO **DDBs** with GCOS to ensure the **DDBs** provide the maximum possible benefit to the GCOS data management system.

Data Archival

8. All data pertinent to GCOS should be forwarded to and maintained by at least one designated and approved archive facility. GCOS will strive to ensure that each archive centre provides the following services:

- (a) Guarantee that data integrity and all necessary metadata are maintained indefinitely. Data (both digital and non-digital) must be maintained in a manner that ensures their long-term survival. Data must be stored in an environment compatible with long-term maintenance of the storage media used. Critical data should be duplicated with the copies stored at another location.

- (b) Provide on-line access to descriptions of their data. Each centre should operate an on-line data information system which can communicate with participants **over** international communication networks such as the Internet.
- (c) Provide access to GCOS data in accordance with the GCOS Data Policy.

Data centres that cannot provide the level of services required should be upgraded or should provide copies of their relevant data to an approved centre.

Access and distribution

9. If participants are to locate and utilize the data they require, these data must be described in and accessible from interconnected data management systems. Many such systems already exist and form a starting point for the GCOS data management system. These systems will continue to evolve and additional systems will be developed in a variety of locations. GCOS will monitor and encourage these activities as it investigates mechanisms to interconnect systems. Eventually, these independent data management systems will be connected and will operate as a coordinated entity so that data stored at different sites are accessible as if stored in a single location. A schematic of the system envisioned is provided in Figure 1 below.

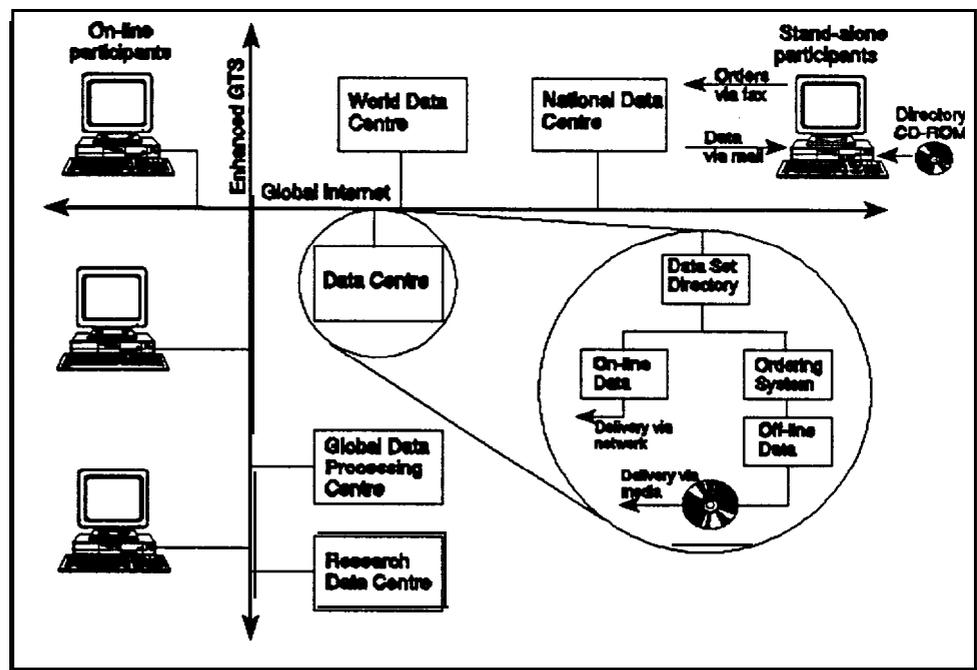


Figure 1. Conceptual data access system

10. To realize the maximum benefit from current and future data management activities, GCOS will rely upon a distributed data management system. A distributed data system spanning national and discipline frontiers is the only feasible mechanism for integrating the

activities of the wide range of nations and institutions contributing to GCOS while meeting the requirements and expectations of participants.

11. Developing an international system which functions in a coordinated manner is a formidable task. However, recent developments in data management and international communications technology point toward a solution: client-server techniques. In client-server systems, users run specially developed client software on their local systems. This software communicates with server software running on host or server computers located at the distant data centres. The client software provides the interface with the user while the server software provides the interface with the data centre's data base.

12. Previous experience in the development of large data and information systems for the scientific community has taught that it is difficult for participants to articulate their access requirements. Therefore, limited operational systems will be used to test and refine the requirements. As additional input is received from the GCOS community the requirements will be adjusted as necessary. The following high-level requirements are proposed for the GCOS On-Line Data System (GOLDS).

- (a) GOLDS must serve all participants. All participants should potentially have access to GOLDS. Initially, for trial implementations, access will be limited to those who have access to the Internet. Eventually, all participants should have access. This implies that gateways will be required between the Internet and other operational networks such as the WMO GTS.
- (b) GOLDS must provide a standard set of functions. GOLDS must provide the capability for participants to identify the existence, location(s) and accessibility of the relevant data. It must provide participants with information sufficient for them to determine if the data held at a particular site meet their requirements in terms of content, coverage and quality. It must provide access to supporting information such as current and historical station and instrument information. It must tell the participant whether the data and information is available, how much it will cost, and whether it is on line (i.e. immediately accessible) or off line (accessible but with a delay). Finally, GOLDS must provide information on the mechanisms by which required data or information can be delivered and should, ultimately, allow participants to make requests for data interactively. Although initially, participants might need to query each node to determine what is available, eventually, they should be able to find out what is available from any GOLDS centre by contacting any single site.

Communications

13. GCOS must ensure that a reliable communication system is available which is capable of collecting data from and delivering data to locations anywhere in the world. Although the same system may be used for transmitting data from observing platforms to data centres and from data centres to users, it will employ a wide range of transport services, dependent upon the data and locations served. Data required in real time will be transmitted over operational

telecommunication systems such as the WMO GTS. Data that are not required in real time **will** be transmitted over telecommunication systems where available and through other means when they are not. In the near term these other means will likely include conventional mail.

14. A variety of telecommunication services will be utilized, including the Internet, WMO GTS, and many others. The Internet is a loosely managed confederation of inter-connected regional, national, and international networks. With its enormous reach, currently on the order of 20 million users, it provides a de-facto standard for communications between a wide range of operational agencies and research institutions. The Internet currently provides a mechanism to support most aspects of the distributed data base envisioned by GCOS in developed countries. It is growing every day and some experts believe the Internet will eventually provide connections to developing countries as well.

15. The GTS is the communication system for operational meteorology and oceanography. It has connections to virtually all countries and regions of the world. As an operational system with a critical role in global weather forecasting it provides reliable, albeit sometimes low-bandwidth, communication services. Like the Internet, GTS is based on a confederation of interconnected networks. However, as a closed system, it is free from the security breaches that often plague the Internet.

16. It is likely that the Internet will grow to meet the needs of GCOS investigators in all developed countries without additional investment or encouragement from GCOS. However, to ensure that the needs of participants in developing countries are met, GCOS must actively advocate expansion and modernization of the Internet and other international networks such as the WMO GTS and ensure that all networks are interconnected. It will also encourage increased use of satellite point-to-point and point to multi-point communications wherever appropriate.

Implementation strategy

17. Development of the GCOS data system will follow an evolutionary approach that methodically builds upon ongoing national and international programmes. Initially, activities will concentrate on clarifying requirements, resolving technological uncertainties, and laying the foundation for the future by developing a loosely-coupled system of distributed data bases and file servers as shown in Figure 2. These systems will demonstrate the capabilities that will be available globally in less than ten years while immediately providing improved access to a substantial subset of GCOS data. Since they are largely based on existing software, development and implementation of these systems are already under way. The major activities required are listed in a five-year work plan within the Data Management Plan.

18. Over time, progressively more advanced systems will be developed and integrated on a global scale until the ultimate goal of an international system of interoperable distributed databases is achieved.

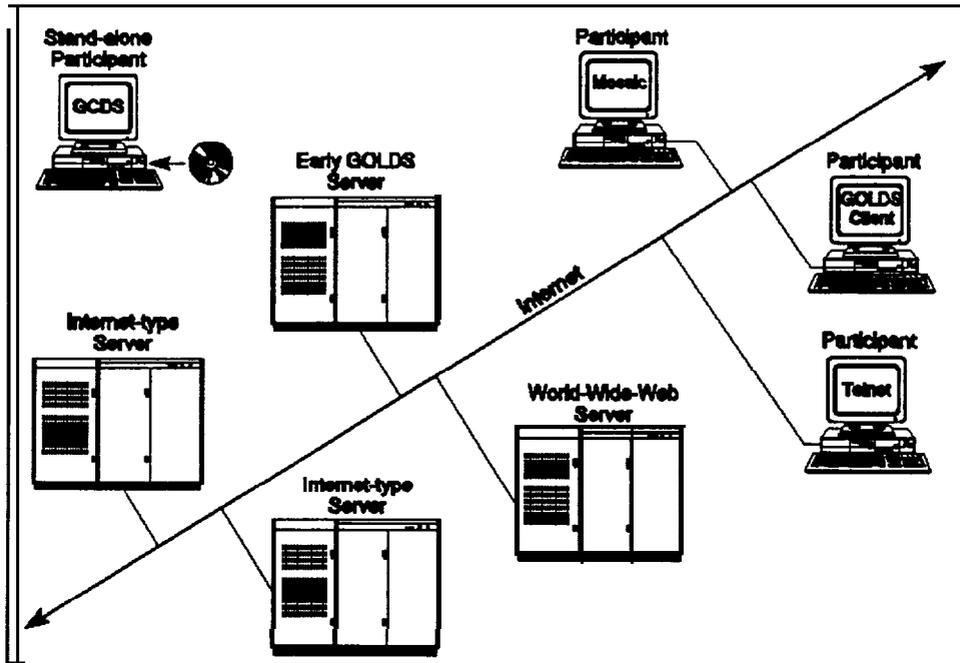


Figure 2. Example components of the early GCOS data management system

Annex VI

Summary of Findings and Recommendations

- o The JSTC should establish a Data Management Panel with comprehensive terms of reference (See Appendix 1);
- o Work on elements of the GCOS data system should begin now, and should evolve according to principles to be developed by the GCOS Data Management Panel;
- o The GCOS data system should be based on existing systems to the degree possible. Thus,
 - the WWW Global Telecommunications System (GTS) should be considered as an element to meet certain GCOS data transmission requirements,
 - data systems in other climate-relevant disciplines should be encouraged to co-operate with GCOS in developing an appropriate integrated system,
 - the World Data Centres (**WDC's**) should be endorsed by GCOS, and should be invited to co-operate in meeting future archival needs,
 - specialized data centres should be endorsed by GCOS, and should be invited to participate actively in the collection, distribution, and archiving of data,
 - other relevant research and operational data management functions should be invited to participate to provide an integrated system for climate;
- o **Where** current systems are found to be inadequate to meet GCOS requirements, the Data Management Panel should propose mechanisms to rectify the situation;
- o The GCOS data management efforts should strive for integrated solutions for climate data systems;
- o The GCOS Data Management Panel should develop a number of scientifically relevant pilot projects which would test the data collection, distribution, and archiving functions;
- o As an early project, the GCOS JPO should develop an inventory of data systems and data product centres;
- o The GCOS data system should include a data and information function to provide users with directory and access to information;
- o The Data Management Panel should develop a strategy and method for identifying and labelling data sets of particular importance in meeting GCOS requirements;

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- o A GCOS Data System Ombudsman should be engaged as an interface between users and suppliers to provide assistance;
- o Financial and manpower support should be obtained for the JPO to address GCOS data management issues.

Appendix 1

Provisional Terms of Reference for the GCOS Data Management Panel

It is recommended that the Joint Scientific and Technical Committee establish a standing GCOS Data Management Panel (**DMP**) to formulate, implement, and oversee the GCOS data management system.

The Data System Task Group considered that the DMP should be constituted of a core group of members (6-8) representing the different GCOS communities, and a number of representatives from related backgrounds and disciplines. The Task Group considered that the DMP should possess a broad range of expertise including research scientists who use and understand GCOS data sets, and data management experts responsible for significant components of the overall GCOS data management system. It was felt the DMP should be a highly focused “problem solving” group, concentrating on resolving crucial issues affecting the quality of GCOS data sets, and access to them. Individual agenda items could require additional participants as well.

The Task Group recommended that the DMP:

- o In concert with the GCOS science panels and the GCOS user community, formulate and develop the GCOS Data Management Plan;
- o Monitor the overall implementation of the GCOS Data Management Plan;
- o Make reports and present recommendations, as required, to the JSTC on data management issues.

The Task Group proposed the following specific responsibilities:

- o Based on requirements from the GCOS science panels and the climate community, to solicit data sets relevant in meeting GCOS objectives;
- o To identify gaps in available GCOS data sets and coordinate efforts to redress data deficiencies;

- o To consider and develop a process whereby data sets be identified and included as GCOS Data Sets. The process should include an assessment addressing, *inter alia*:
 - that the data quality meets standards acceptable to peers of the submitting scientists using that type of data,
 - that the data contain documentation (metadata) of a standard acceptable to peers using similar data;

- o To review and provide oversight of the GCOS data management system to ensure:
 - that deficiencies in data sets are addressed,
 - that access to data is provided as required,
 - that archiving activities are adequate.