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**REPORT OF THE GCOS DATA CENTRE
IMPLEMENTATION/CO-ORDINATION MEETING**

(Offenbach, Germany, 27-29 June, 1995)

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REPORT OF THE GCOS DATA CENTRE

IMPLEMENTATION/CO-ORDINATION MEETING

1. ORGANIZATION OF THE MEETING

1.1 Opening remarks

The meeting opened Tuesday 27 June 1995, at 0900 hours at the Deutscher Wetterdienst, in Offenbach, Germany. Mr Mildner welcomed the participants (See Annex I) on behalf of the president of the Deutscher Wetterdienst and wished them a fruitful and productive meeting. He noted the importance of GCOS and the key role that data management will play in its implementation. He further noted that since GCOS is to be built upon existing systems and centres this co-ordination meeting was particularly important.

1.2 Election of chairman

Dr Webster was elected chairman by unanimous consent.

1.3 Adoption of the agenda

The agenda as shown in Annex II was adopted by the session.

2. PROPOSED GCOS DATA AND INFORMATION SYSTEM MODEL

2.1 Introduction

Dr Webster introduced the GCOS data and information system model as agreed at the first session of the GCOS Data and Information Management Panel (Washington, 6-10 February 1995). He noted that the GCOS information management strategy depends upon the following guiding principles:

- To the fullest extent possible, rely upon existing national and international programmes and institutions;
- 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 and products reflect the highest possible quality and consistency and are accompanied by comprehensive metadata;
- Monitor and evaluate the system constantly.

He pointed out that as the GCOS data and information system will be built upon the existing and planned national and international information management infrastructure, it is essential that GCOS carefully consider the full range of appropriate activities and evaluate the role they should play in the development of the GCOS data and information system. He noted that many on-going international programmes will contribute to the GCOS data and information system and the World Data Centres of the International Council of Scientific Unions (ICSU) and WMO as well as specialized data centres are expected to play a key role.

Dr Webster provided a brief introduction of the GCOS data and information system functional model. He pointed out that the model is built upon Global Assembly Centres, National/Regional Assembly Centres, Specialized/Research Centres, Operational Centres and Archive Centres. All of these functions would be supported by a GCOS Information Centre .

2.2 GCOS data management concept

An overview was presented of the overall concept for the GCOS data and information management system as given in the GCOS Data and Information Management Plan (Version 1 .O). It was stressed that it is envisioned to be a distributed system spanning national and discipline frontiers with the system eventually operating in a coordinated manner so that information stored at many different sites could be accessible as if stored in a single location.

It was noted that developing an international distributed information access and retrieval system which functions in a coordinated manner is a formidable task. However, recent developments in information management and international communications technology point toward client-server techniques as a likely solution.

The participants demonstrated a keen interest in the proposed concept and there was considerable discussion on the advantages and disadvantages of some of the possible technological approaches. The session agreed that a distributed concept utilizing client-server techniques was the best approach and recommended it be implemented in an evolutionary manner starting with a loosely connected distributed system based on existing software. Over **time**, as a variety of technical details are agreed, additional functions could be added until the system envisioned is implemented.

2.3 Role of World Data Centres in support of GCOS

Dr Webster made a brief presentation on the ICSU World Data Centres (WDC) and how they could support GCOS. He explained that the WDC system is based upon geographical distribution of centres that specialize in a discipline and that the system was originally set up to ensure that data could be exchanged between scientists despite cold war politics. He described the WDC principles as follows:

- Data held by a WDC must be completely accessible by scientists in all countries, upon written request or personal visit;

- **WDCs** exchange data among themselves on a mutually agreed, reciprocal basis;
- **WDCs** operate for the benefit of the international scientific community and provide a mechanism for international exchange of data in all disciplines related to the Earth, its environment and the Sun.

Dr Webster pointed out that nine **WDCs** are listed as individual participating data centres in the GCOS Data and Information Management Plan. However, he noted that they participated as individual centres and that a coherent system approach may be preferable. He recommended that the WDC system be challenged to respond to GCOS requirements and that it could begin serving GCOS with a few centres and thereby encourage others to participate. To integrate **the** WDC system into GCOS plans he recommended that GCOS **define** some specific short-term goals and that GCOS needs might stimulate new WDC procedures.

He explained what the **WDCs** are doing to prepare for the expanded functions needed to support GCOS. He noted that about 12 centres are now accessible via the World Wide Web on Internet and the WDC system was developing a central on-line directory. He informed the session that the first all-WDC conference was planned to be held in the Netherlands this October and the conference should address the questions of how a system can be developed and how it can evolve and respond to changes in requirements and technology.

2.4 Role of **Specialized** Data Centres in support of GCOS

In his presentation, Mr V. Vent-Schmidt of the Deutscher Wetterdienst, DWD, stressed the importance of Global, Regional und National Data Centres besides the **WDC's** of ICSU. To invite Member states to co-operate it was mentioned that the activities within GCOS are mainly based - among other things - on **UN/FCCC** Article 4 and the Four Thrusts of WCP given by the "Climate Agenda at IGM-WCP in April 1993. The role of national contributions was identified as a top priority. Thus, the Joint Scientific and Technical Committee (JSTC) and the Joint Planning Office (JPO) of GCOS have a clear mandate to invite the sponsoring agencies to **define** a definite contribution of existing data centres in their area of business. Mr. Vent-Schmidt reminded the experts of the recommendations made by the first session of the GCOS Data and Information Management Panel (Washington, February 1995).

To foster discussion he mentioned data centre activities within the different components of GCOS such as World Meteorological Centres (**WMC's** of WWW), **SA/QAC** of GAW, GPCC and GRDC as part of GEWEX with long-term **commitment** in support of GCOS, EOS-Centres in USA (NASA), Japan (NASDA), Europe (CEO), **GCC's** for maritime-meteorological data in GOOS as examples. Also he gave examples of Regional Data Centres which are important to serve for regional aspects of fingerprints for detecting climate change, or regional climate forecasting such as **BALTEX-MDC** and the Drought Monitoring Centres in Africa. With regard to national efforts, he pointed out that present German activities cover all aspects of GCOS and that there exist several data centres holding global data sets which are documented in INFOCLIMA of WMO.

To establish national gateways to the global world and to exchange climate related data and products, he emphasized the need for information standardization, information systems, and the knowledge of the users' needs. To achieve this he proposed a Global Climate Support Network which should be composed of national contributions to the IOS from so-called GCOS Support Data Centres. The European Climate Support Network (ECSN) could serve as an example where a network of NMS's within Europe has already been established.

Finally, he also stressed the need for long term commitments for dedicated observations and the enhancement of existing observing systems and related data centres.

2.5 The GCOS Information Centre status and outlook

The proposed functions of the GCOS Information Centre approved at the first meeting of the GCOS Data and Information Management Panel were introduced by Mr **McGuirk**. He described the actions taken to date by the JPO to implement the centre and noted that the system operated by the JPO now provides extensive information on GCOS plans and reports as well as a simple prototype directory to participating data centres. Furthermore, the JPO now has the capability to establish a bulletin board to facilitate communication between research and operational communities. The JPO believes the most difficult function will be providing access to a directory of climate data and information and that this will require further development of the GCOS data system before it could be implemented.

The session welcomed the actions taken by the JPO and expressed its appreciation for the progress made. However, the experts agreed that the actions taken to date have not been advertised sufficiently and recommended that the JPO redouble its efforts to ensure that the climate community is aware of the prototype Information Centre so it can take advantage of the information provided and provide feedback to the JPO.

While discussing the Information Centre, the session agreed that, although the centre could be implemented as a distributed activity, it was important that the functions be coordinated through centralized control.

3. DATA CENTRE AND PROGRAMME PRESENTATIONS

Representatives from each of the participating data centres and programmes made short presentations on their data management activities with emphasis on areas pertinent to GCOS. The presentations are briefly **summarised** below.

Global Precipitation Climatology Centre (GPCC)

The main functions of the Global Precipitation Climatology Centre are:

- (a) Acquisition of all available rain gauge measurements (at least on a monthly basis) world-wide;

- (b) Quality-control of the gauge-measured monthly precipitation data;
- (c) Objective analysis of the global monthly precipitation fields over land on a 2.5° grid (in future on a 1.0° or 0.5° grid);
- (d) Merging these analyses with satellite-based precipitation estimates (and NWP model results where no observational data are available) to produce complete global data sets of monthly precipitation;
- (e) Operational production, distribution and archival of these data sets.

Currently, analyses for the period 1986-89 have been produced on a preliminary database of about 6,700 stations. In September 1995 preliminary analyses will be available for the 7-year period 1986-92. Re-analyses based on data from 30,000 or more stations will be carried out when these data have been fully processed and added to the GPCC database (probably starting in early 1996).

Global Runoff Data Centre (GRDC)

The principal objective of the GRDC is to collect, store, analyze and distribute river stream flow data together with river basin information. The GRDC operates for the benefit of WMO Members as well as for the international scientific community. The Centre started its first task in 1988 at the Federal Institute of Hydrology, Koblenz, Germany. The coordination of the Centre's work is being controlled by an International Steering Committee and the Centre is fully operational. The Centre operates on the basis of a state-of-the-art Databank Management System which ensures fast data entry and retrieval services, complex queries and fast responses to data requests.

The database is continuously updated and so far, 143 countries have contributed to the development of the database which now consists of data from 3325 stations monitoring 2619 rivers worldwide. General criteria for data collection are: Data should be collected for rivers with mean annual discharge greater than 100 m³/s, from rivers with catchments greater than 10⁶ km² and from river basins with more than 10⁶ inhabitants.

The highest priority of the Centre's work most recently has been to update existing time-series as well as working out a software profile for the quality control of the data.

WWW Centres and GCOS data management

The operational components of the WWW system were established to serve operational meteorology, i.e., the day-to-day forecasting needs of all WMO Members. Basic principles are the sharing of data and products between National Meteorological Services and sharing telecommunications and data processing facilities. The objective is to enable all Members to participate in the scientific and technical developments and draw benefits from the WWW system irrespective of their own capabilities.

For national meteorological services the existing operational structures of the WWW, including those dealing with data management and data services, are natural candidates for multipurpose use. Consequently, the Twelfth WMO Congress expanded the terms of reference for the Commission for Basic Systems (CBS) to serve the requirements of all WMO and related international programmes.

Regional and Specialized Meteorological Centres (RSMCs) are centres in the WWW system with geographical or activity specialization. They must have a well defined task to cover essentially regional requirements for data and products, must **commit** to operationally performing the task, and must demonstrate their capability **to meet the** specified requirements. For several years now WMO Congress has established a designation procedure for RSMCs which comprises and documents the above elements. CBS and the WMO Regional Associations take serious interest in ensuring that all functions of an RSMC are properly implemented before any centre is designated RSMC. Once a centre is designated, its performance is monitored continuously by the Members depending on its services and reviewed by the relevant constituent bodies, i.e. CBS and the Regional Associations. In regard to GCOS, the RSMCs offer three main functions: data monitoring and quality assurance, archiving and database services, and data processing and generation of products.

Each WWW centre performs monitoring as part of its telecommunications and processing routine. This functionality currently varies widely from centre to centre with a range between zero and about 80%. Only very few centres can claim to be able to maintain full real-time monitoring of their incoming data. This is not surprising, given the fact that in most centres these functions are not fully automated and appropriately powerful tools are only now becoming available. Experience gathered over the last years shows the power of this monitoring in continuously improving the WWW database. It also provides valuable feedback to Members producing and using the data in their day-to-day operations, thus sharpening the view of the value of data relative to the costs of generating them.

German Remote Sensing Data Centre (DFD)

The German Remote Sensing Data Centre, located at the German Aerospace Research Establishment, **DLR**, at Oberpfaffenhofen near Munich, is the Central German archiving facility for satellite data. DFD acquires, processes, archives, and disseminates data primarily from the European Radar Satellite ERS/X-SAR, NOAA-AVHRR and the German MOMS-02. In the future DFD will focus on radar data (ERS- 1, ERS-2) and atmospheric data (TOMS, **ERS-2/GOME**, ENVISAT/SCIAMACHY/MODAS, MERIS) as part of the German Atmospheric Research Programme, ATMOS. In addition to raw data, DFD processes data up to levels 3 and 4 providing high quality data products such as sea surface temperatures, vegetation index (NDVI), or black body temperatures (in progress) for Europe. DFD provides world wide access to its archive via modem and Internet (<http://www.dfd.dlr.de>) and an easy-to-use graphical browse-and-search user interface.

International Geosphere-Biosphere Programme (IGBP)

The International Geosphere-Biosphere Programme focuses on understanding global change from the perspective of biogeochemistry and the role of the global biosphere

in global change. Central to this role is the identification, compilation, and dissemination of data. The IGBP Data and Information System Framework Activity supports other elements of the Programme, and the global change research community at large, in this role. **IGBP-DIS** is not a data facility, nor is it a physical system. Rather, it seeks to coordinate the development and distribution of data through direct involvement with those agencies or existing programmes whose mission is to acquire data for global change research, such as NASA's Earth Observing System Data and Information System (EOS-DIS). To do this three foci frame IGBP-DIS activities:

- (a) Data set development;
- (b) Data dissemination;
- (c) Coordination with other international programmes.

The development of the global 1 km AVHRR data set represents a primary example of this approach. This is a project initiated through the efforts of IGBP-DIS and implemented through participation of NASA, ESA, USGS and NOAA. Data are acquired daily and globally through an internationally coordinated effort of over 20 ground stations. These data are then processed into global **10-day** composites and distributed to the research community by the Land Processes Distributed Active Archiving Center (LP-DAAC) of NASA's EOS-DIS at the EROS Data Center (EDC). On-going participation in IGBP-DIS provides independent scientifically-focused oversight. A land cover working group of **IGBP-DIS** develops community consensus on the requirements, algorithms, and procedures for developing and validating the raw data and derived products. A complete description of this activity has been published in the peer reviewed literature ensuring outreach to, and involvement of, the broader community.

Another example is a joint project of IGBP-DIS and GEOS to acquire a series of high resolution satellite data to:

- (a) Support core project site-specific research;
- (b) Develop a calibration and validation of the AVHRR land cover products in specific test sites globally.

This activity works through a IGBP-DIS High Resolution Working Group in collaboration with CEOS partners from NASDA (Japan), ISRO (India), NASA (US), CNES (France) and ESA (Europe) to acquire several hundred scenes from the **Landsat**, SPOT, ERS-1, JERS, MDS, and IRS satellites.

US Geological Survey, EROS Data Center

The EROS Data Center (EDC) is a field centre of the US Geological Survey (USGS), managed by the USGS's National Mapping Division. EDC manages the National Satellite Land Remote Sensing Data Archive, legislatively mandated by the Land Remote Sensing Policy Act of 1992. The Center also cooperates with NASA in the Mission to Planet Earth (MTPE) Programme, with responsibility for managing the archiving and processing

facilities for land processes data acquired by the Earth Observing System (EOS) and **Landsat 7** satellite missions. The Center is also WDC-A for Land Remotely Sensed Data. These data management responsibilities are supplemented by a co-located scientific staff that focuses on research, development and application of specialized remote sensing products and data sets of earth science data. National, continental, and global data set development activities focus on topography, global land observations from various Earth-sensing satellites, soils data, and a variety of derivative products. All standard data products are available to all users, consistent with national data policies for scientific data, which emphasize product availability at the nominal cost of reproduction and dissemination.

The EOS Land Processes Data Processing and Archiving Center, and the EDC (in its role as a WDC-A) plan to cooperate with GCOS by making available digital data sets of topography, existing satellite remote sensing data, and a variety of land surface and land cover characterization data sets. As MTPE satellite missions acquire land observations from a variety of instruments, these data will be processed, archived, and distributed by the EDC. The data products described above will be important elements of global data set assembly and analysis activities, and will be readily available to GCOS users through Internet and other associated information access mechanisms.

Global Terrestrial Observing System (GTOS)

Dr M. Baumgardner, Chair of the GTOS Working Group on Data Management, Access and Harmonization outlined the activities of GTOS since its first organizational meeting in December 1993. He pointed out that the terms of reference of the working group **define** its responsibilities with regard to its developing a data and information management plan. The plan should make recommendations concerning access and harmonization principles, data management structure, specification of system components such as metadata, organizational issues and capacity building. Furthermore, the plan should be responsive to the requirements of sponsors and users, should identify gaps in existing capabilities and should make every effort to build on existing capabilities. Finally, the plan should be coordinated with complementary activities of organizations such as GCOS, the Global Ocean Observing System (GOOS) and IGBP-DIS.

The GTOS Data and Information System (DIS) will include data, a data referral system, metadata, peer-reviewed models and tools for inputting, accessing and analysing the data. It should be a distributed system with a global centre and regional centres with functional specialization.

Dr Baumgardner noted that the principles guiding the operation of GTOS are similar to and compatible with the guiding principles for GCOS and GOOS.

Role of Internet to Connect Specialized Data Centres for Climatological Purposes in GCOS

In his presentation, Mr S. Roesner of the Deutscher Wetterdienst, reflected on the rapid evolution of Internet, starting with first ideas in the late 1950s and now having more than 35 million users on-line. In parallel, the software used on Internet to connect to remote computers or to find and get information has also improved significantly. Therefore the use of the World Wide Web for GCOS purposes is obvious.

Using some examples he discussed existing information systems with relation to GCOS. On the global level he pointed to information about the ISCU WDC-System available on World Wide Web, allowing on-line access to some of the ICSU **WDCs**. The **WMCs** of WMO, which are linked via the GTS but do not allow access for Internet users are of enormous importance as a pathfinder to climatological data sets. Thus they should be connected to Internet, as was already discussed at the First Inter-Programme Data Management Co-Ordination Meeting (Geneva, November 1994). The already existing GCOS On-Line Data and Information System (**GOLDIS**) of WMO, which lists centres and agencies willing to participate in GCOS, should provide increased on-line access to most of these centres .

On the regional level he mentioned the ECSN Pilot Project on Climate Metadata Catalogues (see presentation of Dr Lautenschlager) and the ECMWF information system.

As an example for a national approach he introduced the Climate Information System (Klirnainformationssystem, **KLIS**) which was developed at the DWD and will be available on the World Wide Web server of DWD by the end of the year. An off-line version of **KLIS**, running on a PC, was demonstrated at the local meeting office. **KLIS** could be used as a first guess for the implementation of similar climate information systems.

In order to improve the acceptance of such information systems by users, he recommended the compilation of national, regional and global climate catalogues (e.g. such as the ECSN catalogue) and the use of database management systems in the future. As a first step he proposed to include INFOCLIMA and provide links to regional bodies such as ECSN. It was also recommended that guidance on the structure (hierarchical order) of information systems be provided in order to make the best use of it.

European Climate Support Network (ECSN)

Mr B. Orfila presented an outline of the ECSN, an action of 18 National Meteorological Services of Europe to promote greater collaboration in climate data collection, data-processing, modelling, exchange of personnel and the united development of recommendations. He also outlined the content of the ECSN collaborative programme of scientific and technical projects and the way that their **metadata** may be incorporated to the ECSN catalogue and made available through the World Wide Web. The guidelines of the ECSN data exchange policy were also presented. He noted that the possibility of ECSN being one European correspondent to GCOS is currently under consideration.

ECSN climate data catalogue

The National Meteorological Services (NMS) are members of the European Climate Support Network (ECSN). The Working Group on Data Exchange and Management (WGDEM) is responsible for the coordination of efforts within ECSN to catalogue climate data holdings. A prototype of the catalogue has been established at the **DKRZ**. The ECSN climate data catalogue is based on the Internet and on the World Wide Web (Web) facilities. Beside a brief description of ECSN and WGDEM the catalogue consists of three parts, a short description of the participating institutes with respect to ECSN, a link to the institute's

Web page and a direct link to the climate data information and partly to the climate data themselves (e.g. DKRZ). The ECSN catalogue is planned to be realized in three steps:

- (a) Incorporation of climate data information as they are;
- (b) Harmonization of the climate data information;
- (c) Substitution of catalogues by local database systems.

The ECSN catalogue is being developed with the guideline of keeping it as simple as possible in order to provide a system which works every time.

ECSN decided recently that the catalogue will be used operationally. The individual NMSs will participate in the catalogue once their local Web servers are installed. WGDEM will work on standardization of metadata and data storage formats. A still unresolved problem is the search for data by topic or by keyword in local catalogues. WGDEM will review existing schemes like GENIE or Web Crawlers.

WDC-A for Meteorology, U.S. National Climatic Data Center (NCDC)

The Director of WDC-A for Meteorology reviewed the responsibilities and presented the functions and activities of the WDC-A and its host centre, NCDC. Due to the extensive involvement of the WDC-A and NCDC in activities supporting the World Climate Research Programme, World Climate Data & Monitoring Programme and World Meteorological Organization, several functions and activities were noted as potential key contributing components to the GCOS. It was mentioned that as a first step to support GCOS, the Centre was seeking resources to respond to the recommendation of the GCOS Data and Information Management Panel (improve global access to CLICOM data) suggesting that a centre such as NCDC should assemble CLICOM data sets on CD-ROM and put these data on-line.

WDC-A for Oceanography, U.S. **National** Oceanographic Data Center (NODC)

The National Oceanographic Data Center is one of the national environmental data centres operated by the U.S. National Oceanic and Atmospheric Administration. The NODC holds global physical, chemical, and biological oceanographic data collected by US **federal** agencies, state and local government agencies, universities and research institutions, and private industry. NODC acquires foreign data through direct bilateral exchanges with other countries and through the facilities of the WDC-A for Oceanography, which is operated by NODC under the auspices of the US National Academy of Sciences.

Each year the NODC provides oceanographic data and information products and services to thousands of users around the world. Among **NODC's** data products are a growing number of CD-ROMs holding large, frequently used oceanographic data sets. The NODC is also now using the global communication capabilities of the Internet to make its vast oceanographic data and information holdings more easily accessible to the worldwide oceanographic research community and other users in industry, academia, government, and the general public.

The NODC/WDC-A, Oceanography, has begun a project to identify and rescue historical oceanographic data in jeopardy of being lost. This project, called the Global Oceanographic Data Archive and Rescue (GODAR), is sponsored by the Intergovernmental Oceanographic Commission's (IOC) International Oceanographic Data Exchange (IODE) Program. The data recovered via GODAR has been made available without restriction to the international scientific **community** as a nine volume CD-ROM set called the World Ocean Atlas 1994.

International Council for the Exploration of the Sea (ICES)

The International Council for the Exploration of the Sea includes 19 Member countries bordering the North Atlantic. ICES plays a major role in coordinating marine research and providing information, advice and management and ICES has coordinated a number of major oceanographic and multi-disciplinary investigations.

A substantial activity in some ICES Member country facilities is the routine collection of data. ICES maintains a bank of oceanographic data supplied by Member countries dating back to the early 1900s. Submission to the database is subject to rigorous quality control, thus providing some measure of validation. The database is supplemented by an inventory of cruise information based on Reports of Oceanographic Cruises and Data Stations (ROSCOP) which summarizes all oceanographic cruise activities of Member countries.

The procedures governing the exchange of oceanographic data are similar to those adopted in the **IOC/IODE** system. Most of the older data are passed to WDC-A for Oceanography and more recent data are passed to WDC-A if so requested by the data originator. Some data originators request restrictions on the release of their data and in these cases approval of the originators is required to release data collected within the past 10 years.

4. REFINEMENT OF DATA AND INFORMATION SYSTEM MODEL

The session reviewed the proposed data system model and there was considerable discussion on the implications of the various functions and how they could be improved. It was agreed that an effective means to **refine** the model would be to test existing centres against the proposed functions. The resulting analysis is given in Table 1. Within the table X indicates the centre performs the function and -- indicates it may perform the function (depending upon definition of the function). The experts emphasised that the centres given are just a start and the table should not be considered to be complete or exclusive and encouraged the JPO to solicit input from additional data centres. Nonetheless, it provided useful insights into the proposed system model. As can be seen from the table, most of the overall functions required by GCOS are performed by existing centres, albeit in an uncoordinated manner that does not address GCOS-specific requirements. The activities of numerous centres can be classified as global assembly, national/regional assembly, specialized/research, operational and archival. Therefore, these centres should be able to contribute to initial activities to support these functions for GCOS. However, the table also shows that there is a dearth of centres that provide operational services to GCOS and additional centres may need to be asked to provide this function.

| Centre | Specialty | Global Assembly | National/Regional | Research | Operational | Archive |
|--------------------|--|-----------------|-------------------|----------|-------------|---------|
| WDC-A Meteorology | Atmosphere | X | X | X | -- | X |
| GPCC | Precipitation | X | | X | | X |
| EDC | Land surface Land cover | X | X | X | | X |
| NMC/CPC | Climate forecasts | | | X | X | |
| WDC-A Oceanography | Ocean | X | X | X | | X |
| GRDC | Hydrology | X | | X | | X |
| GCC | Marine Meteorology | X | X | | -- | X |
| CDIAC | Atmospheric Chemistry | X | X | ? | -- | X |
| NCAR | Atmosphere | | | X | | |
| GO ₃ DC | Atmospheric Chemistry | X | -- | | | X |
| GSFC DAAC | Atmosphere | X? | | X | | |
| WDCGG | Atmospheric Chemistry | X | | | | X |
| WMC Bracknell | Atmosphere | X | X | | X | X |
| WDC-A Glaciology | Cryosphere | X | X | X | | X |
| ICES | Ocean | | X | X | | X |
| QA/SAC GAW | Atmospheric Chemistry | | X | X | | X |
| DLFUDFD | Satellite Radar; Atmospheric Chemistry | | X | X | X | X |
| BALTEX MDC | Hydrology | | X | X | | |
| ESOC (EUMETSAT) | Meteorology Satellite | | X | X | X | |

Table 1. Match of existing data centres with proposed GCOS functional model

After careful consideration of the capabilities of existing data centres and the requirements of GCOS, the experts agreed on the **final** functional model as given in Table 2. It recommended that the model be considered by the Chairman of the Data and Information Management Panel for presentation at JSTC-V in October 1995. Furthermore, in considering the priorities of the functions described in the model, the session agreed that Global Assembly Centres were of the highest priority.

The following is an outline of functional rather than physical centres to support GCOS. **All** elements participate in and are part of the GCOS data support network. The term “climate” as used here should be interpreted to mean atmospheric, oceanic, and terrestrial data of interest to climate research, observation and prediction.

Global Assembly Centres

(Centres will likely be distributed, based on expertise)
 Assemble climate information, data, and metadata
 Carry out validation and quality assurance of data and metadata
 Monitor the quality and completeness of data sets and provide feedback to data providers
 Carry out data archaeology and rescue activities
 Coordinate the activities of national and regional assembly centres
 Work with research groups, **national** and regional centres to coordinate adoption of preferred algorithms and methods
 Distribute data and products

National/Regional Assembly Centres

Assemble climate information, data, and metadata
 Develop and distribute climate products to meet national and regional needs
 Make national and regional data available to Global Assembly Centres
 Obtain specialized products and analyses from the global centres to meet national and regional needs.
 Provide feedback to data sources on the quality and completeness of data sets
 Carry out data archaeology and rescue activities

Specialized/Research Centres

Carry **out** research on **methods** and develop methodologies
 Develop **application** products
 Produce **analysis** products including reanalyses
 Produce climate assessments and **identify** climate trends
 Assess climate impacts and provide **socio-economic** evaluations
 Disseminate specialized products

Operational Centres

Produce regular operational products
 Make climate forecasts and predictions
 Detect climate events and prepare global alerts
 Disseminate operational products, documentation, and publications

Archive Centres

Ensure long term preservation of data, metadata, and information for future use
 Assemble and **preserve** programme documentation, plans, reports and ancillary information
 Distribute climate data, products, and information

GCOS Information Centre

Helps users; provides “Ombudsman” function
 Provides access to a distributed directory of climate data and information
 Provides information on GCOS programs and plans
 Prepares documentation on the system
 Maintains a bulletin board to facilitate communication between research and operational communities, **including** plans for data collection

Table 2. GCOS Data and Information System Model

5. RECOMMENDATIONS AND FOLLOW-UP ACTIVITIES

The experts considered how to involve developing countries in the design and implementation of the proposed system to ensure that the GCOS data and information system serves their needs. They agreed that more effort should be made to reach out to activities and programmes that are being carried out in developing countries. As one such step, GCOS should seek endorsement of the GCOS Data and Information System from the Consultative Group for International Agricultural Research (CGIAR) based in Washington, D.C. Furthermore, the meeting agreed that, although it will be a difficult task and depends upon further development of the data and information management system, a directory of GCOS data sets should be published on CD-ROM.

The session considered a variety of proposed recommendations to be considered by the JSTC and directors of participating World and Specialized Data Centres regarding the role of their centres in the GCOS data and information management system. It also discussed a number of approaches for soliciting and enhancing participation of data centres and for guiding development/agreement on the technical aspects of operating the system and decided the GCOS data and information system should be developed through an evolutionary process. In the near future, centres would be invited to contribute to GCOS with few restrictions and a minimum effort required. Over time the system would evolve through development and adoption of more advanced functions and guidelines and would eventually provide the full capabilities needed. An outline of steps that should be taken is given below.

1. The Chairman of the DIMP should recommend to the JSTC that GCOS establish a GCOS Data Support Network (GDSN) **modelled** on the European Climate Support Network (ECSN). The GDSN will:
 - Provide a framework for stimulating and supporting increased collaboration in processing and accessing climate information;
 - Agree on a programme of collaborative scientific and technical projects and present proposals for these projects to relevant authorities;
 - Identify and promote more effective use of climatological databases;
 - Provide a forum for resolution of technical issues and agreement on standards necessary for effective operation of the GCOS data and information system;
 - Provide united recommendations and requests in support of management and access to climate data and products;
 - Promote more effective exchanges of scientific and technical personnel between centres involved in climate data processing or research.

2. As participating centres must have a commitment from their agencies for long term funds to perform GCOS-related functions, the JPO should request data centre participation in the GDSN through letters to the policy-level administrators of each centre's parent agency. To participate, centres would only be required to provide Internet access to a catalogue of their data that describes each data set and provides information on how to get it (contact, restrictions, pricing, etc). Centres without Internet access could provide their catalogue information to a surrogate centre. The letter should also note that standards for further development of the system will be developed by a GDSN Technical Advisory Group to provide an added incentive for centres to join the GDSN.
3. The Chairman of the DIMP should form a GCOS Data and Information System Technical Advisory Group (TAG) with members selected from the GDSN. The advisory group will establish procedures and guidelines for operating the elements of the GCOS DIS such as standard formats, metadata guidelines, directory interfaces, etc. Alternative approaches for resolving these issues using electronic mail discussions or a GCOS bulletin board were discussed. However, the session decided that a formal group is needed. It would help to instill the needed feeling of responsibility and accountability and would provide the continuity needed to avoid the effort needed to bring new members up to date. Once formed, the TAG will provide guidance on technical issues while the DIMP will be responsible for policy level issues.
4. Over time the GDSN will evolve and participating data centres will be expected to conform to mutually agreed standards. Although the priority and schedule for the following actions must be determined by the DIMP, it is expected that, eventually, centres will be expected to meet the following requirements.
 - Provide Internet access to a directory of their data that describes each data set and provides information on how to get it (contact, restrictions, pricing, etc).
 - Agree on and abide by standards (in both content and communication protocol) to support the capability for crossdirectory searches. The group noted the activities of the CEOS Catalogue Interoperability Experiment (CINTEX) in this area and encouraged further coordination with this activity.
 - Provide on-line access to comprehensive information on their data holdings that provides the capability for users to easily identify the existence, location and accessibility of data and provide information sufficient to determine if the data held at a particular site meets a user's requirements in terms of content, coverage and quality. The centre should also provide on-line information on the mechanisms by which data or information can be delivered and should, ultimately, allow users to request data interactively.

- Provide an evaluation of their data sets regarding documentation, data quality, etc in accordance with agreed guidelines.

Identify which data sets are likely to be of interest to GCOS according to agreed priorities. The session noted that WMO publication **WCRP-56** (WMO-TD 412) could provide a useful starting point for establishing these priorities.

- Notify the GCOS Information Centre whenever a new GCOS-relevant data set is produced.
- Agree to follow an approved GCOS data policy.
- Be prepared to provide data electronically.
- Be able to provide data in at least one of agreed GCOS standard formats.
- Agree to use community-approved algorithms for processing data.
- Endeavour to develop data sets that are needed by GCOS but which do not currently exist.

As a step towards development of a directory of data sets that may be relevant to GCOS, the session welcomed the offer of Germany to provide on-line access to a database version of the INFOCLIMA catalogue of climate data.

6. CLOSURE OF THE MEETING

The meeting closed at 1200 hours on Thursday, 29 June 1995.

ANNEX1

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ANNEX II

Agenda

ORGANIZATION OF THE MEETING

- 1.1** Opening remarks
- 1.2** Election of **chairman**
- 1.3** Adoption of the agenda

2. PROPOSED GCOS DATA AND INFORMATION SYSTEM MODEL

- 2.1** Introduction
- 2.2** GCOS data management concept
- 2.3** Role of World Data Centres in support of GCOS
- 2.4** Role of Specialized Data Centres in support of GCOS
- 2.5** The GCOS Information Centre status and outlook

3. DATA CENTRE AND PROGRAMME PRESENTATIONS

4. REFINEMENT OF DATA AND INFORMATION SYSTEM MODEL

5. RECOMMENDATIONS AND FOLLOW-UP ACTIVITIES

6. CLOSURE OF THE MEETING