Global Terrestrial Observing System

Report of the Joint Meeting of

The GCOS/WCRP
Atmospheric Observation Panel for Climate

&

The GCOS/GOOS/GTOS
Joint Data and Information Management Panel

Fourth Session

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The GCOS/WCRP Atmospheric Observation Panel For Climate and the
GCOS/GOOS/GTOS Joint Data and Information Management Panel

1. Opening of the Joint Session

1.1 Opening

The Global Climate Observing System (GCOS)/World Climate Research Programme (WCRP) Atmospheric Observation Panel for Climate (AOPC) and the GCOS/Global Ocean Observing System (GOOS)/Global Terrestrial Observing System (GTOS) Joint Data and Information Management Panel (JDIMP) jointly held their fourth sessions at the Hawaii Imin International Conference Center in Honolulu, Hawaii, USA, from 28 April to 1 May 1998. On behalf of the Chairmen of the two panels, Dr T.W. Spence, Director of the Joint Planning Office of GCOS, opened the joint session at 10:00 hrs on 28 April 1998.

1.2 Welcome and Conduct of the Meeting

Dr Spence welcomed all the participants (Annex I) of AOPC and JDIMP to the joint session, and particularly Prof. Magaard, Associate Dean of the School of Ocean and Earth Science and Technology, University of Hawaii, and Dr. T. Schroeder, Director of the Joint Institute for Marine and Atmospheric Research (JIMAR). Dr Spence invited Prof. L. Magaard to give some opening remarks. He presented information about the School of Ocean and Earth Science and Technology (SOEST) and discussed research activities of the International Pacific Research Center (IPRC), which has been established jointly by USA and Japan. He noted that participating organisations include the University of Hawaii, the Japan Marine Science and Technology Center (JAMSTEC) and the National Space Development Agency (NASDA). Their research is focused on the Asia-Pacific Climate, Asia-Pacific Hydrological Cycle and Impacts of Global Changes on Asia-Pacific Climate.

1.3 Election of the Joint Session Chairmen

It was suggested that the first two agenda items of the joint session are chaired by Mr M. Manton, Chairman of AOPC, and the third agenda item is chaired by Mr T. Karl, Chairman of JDIMP (Annex II).

1.4 Approval of the Agenda

The agenda of the joint session was modified and adopted (Annex II).

2. Reports on Current Status and Update

2.1 Sponsors Reports

The Chairmen invited representatives of the three global observing systems (G3OS)[1] and the World Climate Research Programme (WCRP) to update participants on recent programme activities.

2.1.1 Global Climate Observing System (GCOS)

Dr Spence explained the relationship among the global observing systems and described a context for the observations from atmosphere, ocean, and land surface as they relate to the Climate Agenda. GCOS has the responsibility to ensure that the needed elements from these three areas are addressed through partnerships with research and observing programmes. The final goal should be the delivery of products to the various user communities.

Dr Spence provided a brief update on recent GCOS progress. Now that plans have been published, a number of networks have been established. These include atmospheric components obtained through partnerships with the World Weather Watch and the Global Atmosphere Watch, oceanic components through partnerships with a number of implementation groups and GOOS, and terrestrial components, similarly with a number of collaborators including GTOS.

He noted that this joint session of the AOPC and JDIMP would provide an opportunity to develop a close relationship between the specialists in atmospheric observations for climate, and in data and information management. An end-to-end process from observations to delivery of products was envisioned. Particular focus should be on the atmospheric components such as the GCOS Upper-Air Network (GUAN) and the GCOS Surface Network (GSN), for example.

2.1.2 Global Ocean Observing System (GOOS)

Mr J. Withrow reported on recent GOOS activities and progress. He informed the participants about the first GOOS Steering Committee held in Paris, 20 to 23 April 1998. The Steering Committee reviewed the overall GOOS programme including the activities of the various GOOS panels. The GCOS/GOOS/WCRP Ocean Observations Panel for Climate (OOPC) reported considerable progress in developing components of the ocean climate module. OOPC also co-sponsored a few workshops on time series, sea-level, and co-ordination of implementation activities. The Health of the Oceans Panel (HOTO) has developed plans and are initiating regionally focussed elements; the Living Marine Resources Panel (LMR) and the Coastal Panel (CP) are now defining requirements[2].

Mr N. Hasegawa updated the panels on the recent development of the North East Asian Regional GOOS (NEAR-GOOS) activities. He noted that the NEAR-GOOS is a regional pilot project of GOOS, which was at the stage of the initial implementation with the emphasis on the exchange of existing oceanographic data. He informed the

[1] G3OS stands for the three global observing systems GCOS, GOOS and GTOS.
[2] Relevant documents are available from the GOOS Project Office.

panels that the number of users of the NEAR-GOOS data exchange system and the volume of the exchange data have been substantially increased since the last JDIMP meeting. He particularly noted the increased contribution from the Fisheries Agency of Japan to the real time exchange of subsurface temperature profile data. He also reported that the collaboration between NEAR-GOOS and the Global Temperature Salinity Profile Project (GTSPP) on the quality control of temperature profile data was progressing as suggested by JDIMP-III. A proposal on the use of GTSPP as quality assurance mechanism in NEAR-GOOS would be made at the next meeting of the NEAR-GOOS Co-ordinating Committee planned for August 1998. The collaboration was also expected to make the GTSPP data coverage more complete.

2.1.3 Global Terrestrial Observing System (GTOS)

Ms G. Martin reported on the activities of GTOS. Since the last JDIMP meeting in July 1997, an Implementation Plan for GTOS has been prepared. It is a substantial document, which lays out the rationale for GTOS, the guiding principles, the structure of the observing system, and the general activities to be undertaken. The plan covers three phases - a preparatory year (1997), establishment (1998) and development (1999) - and prioritises tasks to be undertaken to establish GTOS for the 21st century.

GTOS is seen as a "network of networks", that will build on existing national and international networks bringing together their data, information and facilities. The emphasis throughout is on the provision of high quality, reliable information and data collected to answer identified needs of users. The development and implementation of policies on data and information is a high priority for the current year.

She noted two specific GTOS activities. The first is the operation of the Terrestrial Ecosystem Monitoring Sites (TEMS) metadatabase, which can be accessed and queried through the World Wide Web. There are over 1000 terrestrial sites listed, and support is being sought to update the content and quality of existing data. The site information may be of interest and/or of applicability to the other observing systems. The second activity is the establishment of a Global Terrestrial Observing Network (GT-Net) resulting from a GCOS/GTOS meeting of experts on Ecological Networks[3]. It will be composed initially of the networks represented at that meeting and will be undertaking projects to demonstrate the effectiveness of linking existing networks. Key activities will be the application of policies and guidelines in areas such as metadata, data exchange and release of data and information. Essentially it provides a test-bed for development of a wider network of networks in the longer term.

Dr J. Vande Castle reported on a demonstration project of GT-Net, to initiate interaction between GTOS monitoring sites and the National Aeronautics and Space Administration/ Moderate Resolution Imaging Spectrometer (NASA/MODIS) Land team. The purpose of the project will be to validate products produced by NASA from the MODIS sensor system of the NASA/ Earth Observing System (EOS) AM-1 satellite platform. The basis for the work is a need for climatic and land cover data to compare with the satellite data and data products. A key component of this work is the use of the TEMS database of global monitoring sites to provide information for

[3] Report of the Meeting of Experts on Ecological Networks, Guernica, Spain, June 17-20, 1997, (GCOS-38/GTOS-10).

potential validation sites. To take advantage of existing networks, site information within the TEMS database will be used for access to data from sites of the International Long-Term Ecological Research (ILTER) Network for the MODIS validation work. The long-term component of the ILTER network proposes a commitment to the data collection and a more operational rather than purely research component of the data. ILTER sites in exchange will receive MODIS product maps for their region. Dr H. Kibby has updated the older version of the TEMS database produced by the United Nations Environment Programme (UNEP), and further augmentation of the TEMS database is planned for the GT-Net interaction. The Network co-ordination office of the Long-Term Ecological Research (LTER) programme in the USA will facilitate data exchange between the ILTER and NASA/MODIS groups. Future plans are to integrate this work within the framework of the proposed Global Observing Systems Information Center (GOSIC).

2.1.4 World Climate Research Programme (WCRP)

Dr M.-L. Chanin reported that the WCRP Joint Scientific Committee (JSC) at its last meeting in March 1998 stressed the need for GCOS to implement an independent programme complementing the operational activities of the World Meteorological Organization (WMO) and the Intergovernmental Oceanographic Commission (IOC), and helping the scientific community to go from research to operational mode. A close co-operation with the Committee on Earth Observing Satellites (CEOS) in developing an Integrated Global Observing Strategy (IGOS) is developing. Encouragement was given to AOPC to work in close co-operation with WCRP programmes: for example with the Stratospheric Processes and their Role in Climate (SPARC) programme for improving the observations of water vapour in the stratosphere and upper troposphere, and with the Global Energy and Water Cycle Experiment (GEWEX) for observation of the monsoon system. Strong encouragement was also given to the Global Ocean Data Assimilation Experiment (GODAE) and to the realisation of a real global ocean observation system in close relation with the Climate Variability and Predictability (CLIVAR) and World Ocean Circulation Experiment (WOCE) programmes.

2.2 Reports of Panels and Other Bodies

The Chairmen invited individual participants to report on items for joint panel consideration.

2.2.1 Atmospheric Observation Panel for Climate (AOPC)

Dr Manton reported on the Joint Scientific and Technical Committee (JSTC) recommendation related to the AOPC. He reported that the Panel is effectively co-operating with other programmes (i.e., CLIVAR) and that the draft of the Plan is making rapid progress. This session, the panel will review the GUAN and GSN "best practices", consider atmospheric constituents and aerosols, and address networks for precipitation.

2.2.2 Joint Data and Information Management Panel (JDIMP)

Mr Karl reviewed briefly the actions from JDIMP-III and JSTC. He noted the current joint meeting with the AOPC in response to JSTC recommendations. He reviewed the guiding principles for JDIMP.

2.2.3 Terrestrial Observation Panel for Climate (TOPC)

Ms Martin reported on the activities of TOPC. Through its activities to date the Panel has identified the set of terrestrial observations required to detect, predict and assess impacts of climate change[4]. Two types of initiatives are planned to acquire data for the required variables-establishment or consolidation of terrestrial networks, and identification and access to existing data sets. With regard to the latter, Panel members have identified over 150 possibilities and are assembling comments on each, describing such things as existing metadata, quality assessments, uses, etc. The Panel is due to meet in May to review the data sets and plan next steps, and seeks guidance from JDIMP, specifically with regard to format, standards and metadata requirements. A further question concerns the process or procedures to be followed once a data set has been identified as one, which meets the requirements of the observing systems.

2.2.4 Ocean Observations Panel for Climate (OOPC)

Dr D.E. Harrison reported on the progress of the OOPC, which met in Grasse 6-8 April, 1998[5]. He noted the recent activities of the panel directed toward implementation. He informed the participants that the Tropical Atmosphere-Ocean (TAO) array, which contributed essential information to document the 1997-1998 El Niño, has recently received operational support. The OOPC was also influential in organising a meeting to address ocean climate observations for GOOS and GCOS in Sydney, Australia. At the OOPC meeting, the panel considered the needs for biogeochemical sites in conjunction with the Joint Global Ocean Flux Study (JGOFS) programme and further refined the recommendations from the Time-Series Workshop[6] in Baltimore which it organised. The panel also played an important role in assessing sea-level programmes for climate. One of the most important projects of OOPC is the Global Ocean Data Assimilation Experiment (GODAE) which will address the assimilation of *in situ* and space-based information to provide a physical characterisation of the ocean.

2.2.5 WMO Commission for Climatology (CCl)

Mr P. Scholefield informed the joint session on recent deliberations of CCl at its 12th Session in August 1997 and at its Advisory Working Group held in February 1998. As a result of these recent meetings, new terms of reference for the Commission have been adopted which include an overall guiding statement that CCl shall be responsible for promoting and facilitating activities relating to climate and its relationship with human well-being, human activities, natural ecosystems and sustainable development. CCl also adopted a new structure assigning over 70 specific

[4] GCOS/GTOS Plan for Terrestrial Climate-related Observations (GCOS-32).

[5] Report of the third session of the GCOS/GOOS/WCRP Ocean Observations Panel for Climate (GCOS-44).

[6] Report of the Joint GCOS GOOS WCRP Ocean Observations Panel for Climate (OOPC) Ocean Climate Time-Series Workshop (GCOS-41).

individuals to serve on one of four working groups or as individual rapporteurs. He cited two of importance for this session: the Joint CCl/CLIVAR Working Group on Climate Change Detection and a newly formed Working Group on Climate Information and Prediction Services (CLIPS).

Interaction with GCOS was discussed at both sessions and it was reaffirmed that the World Climate Data and Monitoring Programme (WCDMP) formed an important mechanism for meeting Members' needs for co-ordinating climate data services and monitoring. Concern was expressed that GCOS activities might appear to lie outside that mandate and with the need to maintain visibility and strong support for the extensive national climate observing networks of WMO Members. CCl agreed that the existing liaison channels with GCOS be strengthened and that CCl should take more interest in the broader scope of data types important to climate such as cryospheric, oceanic and terrestrial data.

CCl identified a number of priorities for future work within the Commission, which included the following: (i) further development and implementation of CLIPS, including seasonal to interannual climate predictions; (ii) the development of a comprehensive climate database management system for WMO Members to replace the existing Climate Computer (CLICOM) software; (iii) facilitate improved international exchange of climate data and products including promoting greater use of the Internet; (iv) the development of indices for monitoring and detecting climate change; (v) promoting the use of climate information to support sectoral activities such as agriculture, energy, urban development and human health; and (vi) completion of the revised Guide to Climatological Practices.

Participants welcomed the opportunity to see a pre-print copy of the 6th Global Climate System Review, which includes chapters on the oceans and cryosphere produced in collaboration with GCOS. The participants noted the imminent publication of a prospectus on the climate of the 20th century.

2.2.6 WMO Commission on Basic Systems (CBS)

Dr A.P.M. Baede reported on the outcome of the latest meeting of the CBS Working Group on Observations (CBS/WGOBS), 17-31 October, 1997. It discussed in particular GUAN and GSN and dealt with several items of relevance to the work of AOPC.

The WGOBS took note with appreciation of the monitoring report on GUAN stations, prepared by the European Centre for Middle-Range Weather Forecasts (ECMWF), and was informed that several GUAN stations were reported "silent" or "suspect". It recommended that these reports be distributed to the members concerned, requesting their comments and reports on any remedial action taken. Moreover, it agreed that it would be desirable to evaluate the implementation of GUAN on the basis of ECMWF's six-monthly reports, and requested the Secretariat to undertake the necessary action. This might lead to some changes in the composition of GUAN.

The WGOBS noted the status of the establishment of the GSN and the offer of Germany and Japan to monitor the availability and quality of CLIMAT reports

received from GSN stations, and that CCl had agreed that the World Data Centres (WDC) A and B would be appropriate depositories for CLIMAT messages transmitted through the Global Telecommunication System (GTS), including historical data and metadata. The WGOBS stressed that CBS should play a leading role in the implementation and operation of GUAN and GSN, but that other agencies involved (UNEP, United Nations Educational Scientific and Cultural Organisation (UNESCO) and the International Council for Science (ICSU)) should have substantial responsibility for the maintenance of GCOS networks and assistance to National Meteorological and Hydrological Services (NMHSs) in case of financial difficulties of Members in keeping their GCOS stations fully operational. The WGOBS further developed a set of "best practices" for GUAN and GSN stations, to be reviewed by AOPC for submission to the forthcoming CBS meeting for approval and adoption in the Manual of the Global Observing System (GOS).

Dr Baede reported then on the closure of the Omega radio-navigation system. The WGOBS noted that, of the 258 stations affected by the closure, by mid 1998 some 200 were expected to have been converted to alternative systems. For the remaining 50 stations, solutions were sought with priority being given to GUAN stations. It noted there is a continuing pressure on radio frequency bands used by the meteorological community. Further, the WGOBS noted a growing trend and increasing importance of Automatic Weather Stations (AWSs). Mr A.J. Lourens of South Africa was nominated as Rapporteur on this issue. Additionally, the WGOBS discussed the Year-2000 problem on the basis of a report of Mr J. Nash of the UK MetOffice, who reported that difficulties may be expected in particular in the operation of radio sondes. WMO will keep Members informed on the issue through their Internet site. The WGOBS requested Ms M. Atkins (UK) and Mr A. Sharp (Australia) to keep abreast of developments and to inform the Chairman of WGOBS and the Secretariat. Also, the WGOBS recalled that CBS-XI had agreed upon a Work Programme for the Working Group, one of the items of the Programme being "to provide assistance in the review of implementation of the GCOS upper-air and surface networks". Finally, Dr Baede noted that he had been nominated to act as Rapporteur on GCOS matters to the WGOBS.

2.2.7 WMO Commission for Marine Meteorology (CMM)

The President of the Commission for Marine Meteorology (CMM), Mr J. Guddal, described its functions and contributions relevant to GOOS. The major CMM issues with regards to JDIMP were: (1) metadata base establishment; (2) facilitation and compliance with the 'end-to-end' process, (3) consideration of a proposed 'High Quality' GOOS Services Bulletin. The bulletin should be aimed not only to describe the servicing and production, but also impact information from the end user communities. He noted that a process is underway to consider the merger of the Integrated Global Ocean Services System (IGOSS) and CMM.

2.2.8 Integrated Global Ocean Services System (IGOSS)

The Chairman of the Joint IOC-WMO Committee for IGOSS, Prof. D. Kohnke, informed the joint session about its observation system and its data management arrangements. He mentioned the establishment of a new organisational structure for the management of the Ship-Of-Opportunity Programme (SOOP), and the plans of the Joint Committee for the development and long-term maintenance of an

operational SOOP network. Prof Kohnke briefly described the end-to-end data management system of real-time and non-real-time data streams, which has been established jointly with the IOC Committee for the International Oceanographic Data and Information Exchange (IODE). A very important part of this end-to-end data management scheme is GTSPP, which improved the real-time capture of data, the quality control of both real-time and non-real-time data, the monitoring of data flows, as well as the precipitation and distribution of data products. GTSPP may be used as an example for the management of data from the G3OS programmes.

2.3 Other Technical Reports

2.3.1 Integrated Global Observing Strategy (IGOS)

Ms L. Moodie explained that IGOS is a strategy to involve the major systems for satellite and *in situ* global environmental observations, for the atmosphere, oceans and the land in a framework that delivers maximum benefit and effectiveness in their final use. The major focus of IGOS is on definition of the requirements and responses. Organisations that represent suppliers and users want to present their needs and their capabilities. They want to develop a common understanding of current and planned systems, help to influence priorities and help to obtain new commitments for future investments in systems and services. Ms Moodie then gave an activity summary ranging from the first year of the introduction of the concept in 1995, to the first meeting of the Strategic Implementation Team (SIT) in February 1997 and the latest one in Paris, in March 1998. She pointed out that the tasks of the CEOS Analysis Group (AG) which was disbanded in November 1997, could be taken over by the Global Observing Systems Space Panel (GOSSP). The AG was created to identify overlap and gaps, and to analyse which existing and planned satellite missions, programmes and products meet defined user and national requirements. Furthermore she stressed that two out of the six IGOS pilot projects, Upper-Air and Ozone measurements, are an important element of the work of the AOPC.

2.3.2 Re-analysis Projects

Dr P. Arkin reported briefly on re-analyses projects, and stressed that the results give a more homogeneous view than *in situ* observing systems. The reanalyses concept has been implemented by three groups: the NASA Goddard Space Flight Center Data Assimilation Office (DAO), the National Oceanographic and Atmospheric Administration (NOAA)/ National Centers for Environmental Prediction (NCEP) in partnership with the National Center for Atmospheric Research (NCAR), and the ECMWF. The DAO reanalysis is complete from 1980 through 1993. Extension to February 1995 is planned, and a series of reanalyses of the year 1979 are also proposed. The NCEP/NCAR reanalysis is complete from 1958 through 1996, and, together with the Climate Data Assimilation System (CDAS), provides a time series through the present. CDAS is an attempt to bring the concept of reanalysis into use in the monitoring of current climate variations through the use of the identical assimilation system to analyse current observations. The ECMWF reanalysis was completed for the period 1979-1993, and a longer version, covering the period 1957-1997, is planned to be completed by July 2001.

Mr D. Parker commented on the advantages and problems of re-analyses. They ensure global coverage, and unlike many quality-control procedures applied to available *in situ* data, can remove local biases. However, the introduction of satellite data into the NCEP Re-analysis resulted in spurious warming in the lower stratosphere in the tropics in 1979 and in high southern latitudes in 1977. The underlying problem probably lies in the model's physics, which, in the absence of sufficient data, makes the lower stratosphere too cold. Latitude-height profiles of zonal mean temperature changes from 1965-74 to 1988-97 show the same problem, which is largely removed by blending with radiosonde data as ground-truth. Mr Parker pointed out that there is a need for application of bias adjustments to radiosonde data, to compensate for instrument changes. Unadjusted data overestimate stratospheric cooling in some regions, and this will affect re-analyses if the data are not corrected. The biases in the NCEP Reanalysis are much smaller after 1979, and the NCEP Re-analysis's dynamics better represent Arctic lower stratospheric cooling than radiosonde data alone. The NCEP Reanalysis-radiosonde blend maintains the improvement over the Arctic.

2.3.3 Extreme Events Workshop

Mr Karl informed the participants on the results of a workshop on Indices and Indicators for Changes in Climate Extremes which was held at Asheville in June 1997. He also mentioned plans for an Asian Pacific Network for Global Change Research (APN) workshop later in 1998, hosted by Dr Manton, and referred to a follow-up climate extremes meeting in Asheville early in 1999. Mr Scholefield added that an Indices Task Group CCl/CLIVAR Working Group on Climate Change Detection is going to meet at the beginning of September 1998 in Bracknell, UK.

2.3.4 European Climate Support Network (ECSN)

Dr R. Heino described the ECSN and the work of the members of the European Meteorological Network (EUMETNET)/ECSN Programme. He added that ECSN could be seen as complementing the global activities of GCOS, by working on a regional scale through co-operation with the NMHS services. Dr Heino noted as an example the ECSN Regional Historical Climate Database (Regal Database).

2.3.5 El Niño - Southern Oscillation (ENSO)

Dr Harrison briefly revisited the 1997-1998 ENSO event. He reported that the observing systems performed very well and delivered quality data and operational products, e.g., sea surface temperatures. He suggested introducing an ENSO index to better identify the intensity of each event. It was emphasised that the monthly sea-level data will be an important element of the ENSO operational system. The panel stressed that WMO produces a monthly up-date on ENSO, which was considered as an excellent tool to communicate from end-to-end.

2.3.6 El Niño - Southern Oscillation Retrospective

Dr Spence informed the participants that an ENSO retrospective was being planned in response to a request from the United Nations. The retrospective will include a technical component organized jointly by WMO and IOC, and a component focused

on socio-economic issues and impacts organized under the auspices of the International Decade for Natural Disaster Reduction (IDNDR). A major conference is being planned in Ecuador for fall 1998.

2.3.7 United Nations Framework Convention on Climate Change (UNFCCC)

Dr Spence also reported on the third UNFCCC Conference of the Parties (COP-3) in Kyoto, December 1997. COP-3 requested a report on the adequacy of the observing systems to support the needs of the Convention. GCOS has agreed to take a lead role in preparing a document for the Subsidiary Body for Scientific and Technological Advice (SBSTA) to address this issue. This document may be submitted to COP-4 in Buenos-Aires in November 1998. The participants discussed a possible co-operation between GCOS and the Intergovernmental Panel on Climate Change (IPCC), particularly with regard to providing assistance to IPCC for its Third Assessment Report.

3. Coordination of Joint AOPC and JDIMP Activities

3.1 Data and Information Activities for GCOS Networks

Dr Baede reviewed the history of GSN for the joint session. A Task Team developed a procedure to create an objective methodology for selection, which let to a first list of some 1000 stations. The CBS WGOBS reviewed the selection inviting input from regional lead centres, regional co-ordinators and rapporteurs on GCOS matters, and by Members concerned. The responses were evaluated during a second expert meeting, and recommendations were formulated on the monitoring of the exchange of actual and historical information and on the formulation of a set of “best practices”. In the meantime the Secretary-General of WMO requested Members to comment on the selection and on the list of all surface stations, compiled by the Task Team, to correct this list and to indicate which stations were acceptable. Dr Baede commended the Task Team on its excellent job. He said that in particular the compilation and correction of the list of all stations was a very important achievement, which should be renewed regularly. On the basis of all information received, the Task Team completed a Final Selection of 969 GSN stations, 758 stations of which had already been approved and 211 of which were awaiting approval by the Members concerned. Germany and Japan offered to CCl to monitor the quality and availability of CLIMAT Reports, distributed by GSN stations over GTS. The WDC A and B would be depositories for the reports, the historical data and the metadata. The final selection will be submitted to the Presidents of the Regional Associations (RAs) for approval and subsequently to the GCOS JSTC and CBS for official confirmation.

Mr M. Werscheck elaborated on Germany’s contribution to the joint Germany/Japan GSN Monitoring Centre (MC) at the German Weather Service (DWD), which will have a special emphasis on precipitation, due to the co-location with the Global Precipitation Climatology Centre (GPCC). He described the routine of processing CLIMAT data and the activities involved in monitoring, quality control and quality assessment. The DWD will use the expertise of the GPCC, the Global Collecting Centre (GCC) and the other national data centres to implement the database and procedures on the relational database system. The MC will report biannually to WMO and disseminate monitoring results via Internet according to WMO regulations. In

addition, the MC will provide a quality controlled and flagged data set to the WDC A and B. The preparatory phase will be finished end of 1998. The database and quality control mechanism should enter the operational phase in 1999.

Mr Hasegawa presented the planned contribution of the Japanese Meteorological Agency (JMA) to the GSN monitoring. JAM has agreed to the general concept and will share the responsibilities with the German MC. The Japanese MC will focus on temperature because it is already monitoring SYNOP reports due to earlier agreements.

3.2 Global Observing Systems Information Center (GOSIC)

Drs F. Webster and J.R. Wilson gave a presentation demonstrating the GOSIC. It will provide access to data sets, identify gaps in data information, but will avoid duplicating activities of the G3OS.

3.3 Metadata and Data Set Registration

Dr Heino presented information on the Marine and Coastal Data Directory of Australia, a prototype search facility for data sets. The user can, for example, select the region, define search criteria and will obtain relevant metadata. He noted that the homogenisation of metadata is a problem. He added that the selection procedure for data sets is in process and that some data have been rejected which raised concern among some of the panel participants. It was proposed that instead of rejecting data, it should be flagged to indicate the quality.

With respect to data set registration, GOOS reported that it has not gone into the registration of data, but if so, it will seek guidance from JDIMP. GTOS is discussing data set registration. GTOS agreed that metadata is necessary but not sufficient, and that variables depend strongly upon subject of the data set.

3.4 WMO Resolution 40 on the Exchange of Meteorological Data

Panel attendees noted that very often restrictions are imposed by countries on data supply. There was concern that if the commercial use of data is restricted the use of data is being narrowed. It was proposed that discussions should be initiated about data availability and its use for all user communities.

Mr Scholefield reported on Resolution 40 as it applies to the international exchange of climate data and products. CCl established a Task Team to see how the resolution is being interpreted and what problems might arise in the future. Due to the divergent views expressed by the Task Team Members, a meeting of the task team is planed for 10-11 June 1998 to develop a consolidated position that the President of CCl can use in his report to the 50th Session of the Executive Council of WMO in mid June.

3.5 Formation of a Joint Working Group on AOPC/JDIMP Issues

An *ad hoc* working group was formed jointly by the AOPC and JDIMP. The purpose of this working group was to discuss AOPC/JDIMP cross-cutting issues including GUAN and GSN, extreme climate events, and an ENSO index. The Panel was charged to identify and clarify the interactions, responsibilities and joint projects

between the two panels. Further, the progress of on-going projects should be reviewed and assessed, and new projects should be identified (see D 9.2).

4. Joint Session of AOPC and JDIMP

4.1 Briefing of the Panel Chairmen on Outcome of the Individual Sessions

The two panels resumed in joint plenary after the individual sessions and the break-out sessions of the working groups. The panel chairmen noted that both panels sharing members for their sessions. Working groups have been successfully set-up with mixed memberships to support and foster the cross-cutting activities between AOPC and JDIMP.

4.1.1 The AOPC Chairman summarised the action items of the individual panel session as follows. The elaborated list can be found in section A 9 of the AOPC session report.

Actions as recommended by the AOPC are:

1. Consider the overall process for the collection, processing, archiving, analysis and distribution of the atmospheric component of GCOS.

2. Designate specific centres to ensure the overall quality of data and to produce basic products from GCOS data.

3. Provide the panel with some statistics on the performance of the GTS, especially as it relates to the operation of GSN and GUAN stations.

4. Identify replacement stations for GUAN at high latitudes.

5. Approach NMHSs for their historic GUAN data to develop the generation of a CD-ROM of global quality-controlled historic GUAN data.

6. Identify additional GSN stations in central and western France to fill the data gaps.

7. Seek a more comprehensive data set from the GSN. GSN data should consist of: mean daily temperature, maximum daily temperature, minimum daily temperature, total daily precipitation, daily mean sea level and station pressure, daily mean wind speed.

8. Consider the issue of GSN data availability and adequate distribution with the help of NCDC.

9. Prepare a letter from WMO to NMHSs seeking GSN stations' historical daily data and meta-data, which would be sent to the World Data Centres A and B.

10. Develop a process for handling links with research groups providing atmospheric constituents observations.

11. Hold a workshop on SST, to be hosted by IRI, in November 1998.

12. Develop a draft of the AOPC Plan by September 1998 for CBS to consider.

13. Seek advice on whether AOPC could further assist IPCC with the provision of other data sets, diagrams and documentation to support the IPCC Third Assessment Report process.

Recommendations by the AOPC:

1. Send an annual letter from the JSTC Chair to the NMHSs that contribute to GUAN and GSN providing positive feedback on the appreciation of the broad community for contributions to GCOS, and informing NMHSs directly of the outcomes and outputs of their efforts.

2. Support the development of basic GUAN products.

3. Maintain GUAN core stations to provide long-term consistent upper-air observations.

4. Add new stations to the GUAN list, i.e., 4 sites in India and 1 site in each of Diego Garcia, Sudan, Democratic Republic of Congo, and Angola. Approach USA to re-activate the TOGA radiosonde stations for GUAN at Wake Island and Canton island.

5. The Hadley Centre, the UK Met Office and NOAA/National Climatic Data Center (NCDC) to take the lead in quality control and assembly of GUAN data sets.

6. Exchange GUAN data free of charge in real time as deemed essential under WMO Resolution 40.

7. Identify the cause of any problem in the GUAN network and assist CBS with the development of appropriate solutions.

8. Note in the SBSTA document that developing countries have problems in funding continuing operations.

9. Continue to provide analyses of observation statistics of South American GUAN and non-GUAN data.

10. All GSN stations report in the correct CLIMAT format.

11. Send an AOPC representative to the GSN monitoring expert meeting, organised by Germany and Japan.

12. Provide daily GSN data directly from NMHSs in delayed-mode time and monthly GSN data in real time using CLIMAT format from the GTS.

13. NCDC take the lead in quality-control and analysis of daily GSN data.

14. Investigate the consistency and longevity of the International Satellite Cloud Climatology Project (ISCCP) and determine the links between ISCCP and *in situ* cloud observations.

15. Review the AOPC variables with respect to the WMO Affiliates Database and the AOPC Plan.

16. Consider the use of satellite data in GUAN and GSN both to assist validation and to develop composite products.

17. Consider the handling of satellite-based estimates of precipitation, particularly the Global Precipitation Climatology Program (GPCP) products at the next meeting of AOPC.

The AOPC endorsed:

1. "Best practices" for GUAN.

2. The revised list of GSN stations.

3. A GSN expert meeting hosted by the DWD, in co-operation with JMA end of 1998.

4. "Best practices" for GSN, suggesting changes in GSN to include daily data.

5. Proposal of OOPC to develop a number of reference sites around the world's oceans to provide baseline data on air-sea properties related to surface fluxes.

6. A workshop on extreme events in 1999 to follow on from the Asheville workshop in June 1997.

7. A proposal for the APN to sponsor a similar meeting on extreme events focused on the Asia Pacific region.

4.1.2 The JDIMP Chairman summarised the results of the individual JDIMP session as follows: (The individual issues have been discussed in detail in section D 9.)

Actions as recommended by the JDIMP:

1. Establish a link to the IPCC Data Distribution Centre.

2. Identify participating data centres in the G3OS data centre workshop.

3. Prepare a draft Data Management Plan.

Recommendations by the JDIMP:

1. Monitor GUAN and GSN data for temperature in an operational mode and for precipitation, pressure and wind in a delayed mode.

2. Prepare a letter from the WMO/CCl to NMHSs seeking historical climate data for GUAN and GSN stations.

3. Develop a feedback mechanism from users who participate in the metadata related activities.

4. Hold a participating data centre workshop in 1999.
5. Proceed with the Meta Data pilot project.

The JDIMP endorsed:

1. A workshop on extreme events in 1999 to follow on from the Asheville workshop in June 1997.

2. A workshop on SST as initiated by the AOPC (see AOPC action item 10.)

4.2 Future Joint Activities

The agenda of the GSN expert meeting[7] was outlined by Mr Hasegawa and Mr Werschek (Annex A-I). Both panels recommended inviting experts from the UK Meteorological Office and NCDC.

The participants agreed that expert-meetings need to be set-up to identify products and responsible product centres. A workshop which will assess global and near-global sea-surface temperatures (SST) was agreed to be held to establish criteria satisfied by SST analyses. [*Workshop on SST, to be hosted by the International Research Institute for Climate Predictions (IRI), at Lamont-Doherty Earth Observatory (LDEO) of Columbia University in Palisades, New York, 2-4 November 1998. Further information by Dr Phil Arkin: parkin@iri.ldeo.columbia.edu*]. Recommendations will be developed for AOPC and OOPC.

4.3 Co-ordination of Cross-panel Activities

The AOPC Chairman suggested that future AOPC meeting formats start with the review of current climatic events and of the GCOS systems *per se*. The Panel then should discuss new activities and propose revisions to the AOPC Plan. The meeting should receive input from other bodies and panels and set-up task groups as needed (Annex A-II).

5. Closure of the Joint Session

The Chairmen of AOPC and JDIMP thanked the participants for attending the session. They particularly thanked Dr Spence for the preparations for this joint session and his efforts on behalf of GCOS. The Chairmen closed the joint meeting at 13:00 hrs, 1 May, 1998.

[7] Workshop on GSN monitoring, hosted by the German Weather Service (DWD), in Offenbach, end of 1998.

Part II: Individual Session of AOPC

A 6. Organization of the Individual Session of AOPC

The Chairman of the AOPC proposed a modified agenda for the individual session, which was accepted by the Panel (Annex II).

A 7. Development of an Atmospheric Observation Plan

A 7.1 The Chairman informed the AOPC participants of the progress on the GCOS Plan for Atmospheric Climate Observations since the last meeting. The Panel proposed that the Plan should take into consideration the role of satellite data, the monitoring of extreme local events (i.e., El NiZo), volcanoes, solar variability and data assimilation. The participants agreed that future issues to be incorporated should include radiative transfer, aerosols, precipitation, sea surface temperature and ice analyses, and the link to GOSIC. Furthermore, a discussion on the percentage of global radiosonde coverage should be integrated. The outline of the Plan, the lead authors of the respective chapters and an elaboration on each component of the Plan, was discussed and approved by the Panel (Annex A-III).

A 8. Current Activities and Developments

A 8.1 GCOS Upper-Air Network (GUAN)

Mr Parker discussed the temporal changes in radiosonde coverage in the UK Meteorological Office Hadley Centre data set. He showed that the Northern Hemisphere has a greater coverage in radiosondes than the Southern Hemisphere, and that there is a recent overall decline. Additional GUAN stations in India and Africa will be necessary to complete the global coverage. The GUAN reserve list, to be reviewed by CBS, should be short and well justified. The Panel recommended including new stations in the GUAN list. Mr Parker then discussed the purpose of the GUAN in its present state, considering it as a very valuable calibration tool. The combination of GUAN and the emerging technology of the Global Positioning System (GPS) should benefit the global observing systems.

Dr V. Barros gave a presentation on the radiosonde coverage and its performance in South America. He demonstrated that there are various possibilities to up-grade existing radiosonde stations to GUAN stations. Most of the non-silent GUAN stations were fully operational. Nevertheless, GUAN stations have a problem in following the 'best practice'. He noted that only very few stations reach 10hPa and only about 30% of the soundings reach 20hPa. He made it clear that developing countries have priorities in obtaining new instruments rather than maintaining long-term commitments for operational systems. Therefore, some funding should be made available to support developing countries, e.g., through the Voluntary Co-operation Programme of WMO. To avoid future poor GUAN performance in South America, Dr Barros suggested the Panel should consider integrating radiosondes which will be established for regional projects, e.g., the proposed radiosonde network for the Large-Scale Biosphere-Atmosphere Experiment in Amazonia (LBA). These are initially research networks, which will exist on a permanent basis, and which will become operational after the project ends.

Dr R. Okoola reported on the African upper-air network. There has been a decline in the network since 1979 when the First GARP[8] Global Experiment (FGGE) took place. The radiosonde stations did not increase to make up for the decline in the pilot balloon observations. More conventional sounding data (radiosondes, etc) have now declined further due to the phasing out of the Omega and Loran-C navigation systems and the narrowing of the radio frequencies available for use. Dr Okoola showed a typical upper air chart used in operational forecasting at the National Meteorological Centre, Nairobi, which showed the lack of stations over equatorial Africa. He stressed the fact that the GUAN has large gaps over Africa, for example over the Congo Basin, and over the Sudan. The Congo Basin has been shown to be part of the rising branch of the East-West circulation (Walker Circulation). The displacement of this circulation leads to socio-economic hardships for many African countries whose economy is largely dependent on rainfed agriculture. Relationships have been found between ENSO and African seasonal rainfall, and between the Southern Oscillation (SO) and rainfall over the East African coast/Lake Victoria basin. The study of the variability in the SO over Africa demands for at least one upper-air Station within the African Convective Centre that sits in the mean over the Congo Basin. Dr Okoola recommended that two additional GUAN stations (one station over the Congo Basin, either Mbandaka or Kinshasa; and one station over Sudan preferably at Khartoum) would improve the description of the general circulation of the atmosphere over tropical Africa.

A 8.2 GCOS Surface Network (GSN)

This agenda item was tabled jointly with a JDIMP A*d Hoc* working group 1 (see D 9.2.1). The discussion was focused on the adequacy of the network for (i) temperature, (ii) pressure, and (iii) precipitation measurements.

Dr P. Jones gave some background information on the selection process of the GSN. In March 1996, an expert meeting in Norwich, UK, designed a procedure to select components of the GSN. The procedure included a review of primary data sources to assess the most appropriate stations, a scoring algorithm for recording quality measures of candidate stations into one value, and requirements with regard to the geographical coverage and spacing of selected stations. A second expert meeting in June 1997 reviewed the final GSN station selection. The network includes a basic list together with a "stand-by" list of stations. The stand-by list includes stations of very high quality, but which are closed and stations which are well located geographically, but are either of lower quality (e.g., a rather short record) or lack sufficient quality information. Dr Jones pointed out that the network is adequate to capture large regional to global phenomena, but it is not for regional climate. GSN is sufficient for analysing temperature trends, but is insufficient for precipitation measurements, which require a denser network.

It was mentioned that transmission problems influence the performance of the network. In the following discussion the Panel recommended that it is necessary that all stations in the GSN should report CLIMAT measurements, and should serve as reference and baseline stations for regional and national climate purposes. The importance of a responsible data centre was stressed again. The Panel discussed as well the value of collecting daily rather than monthly data, since extreme events cannot be

[8] Global Atmospheric Research Program

captured using only monthly information. There was some concern that with respect to historical data, daily data records do not go back as long as the monthly data record. The Panel noted that a meeting will be organised by the German Weather Service (DWD), where invited experts will discuss GSN data quality/control issues.

A 8.3 Atmospheric Constituents and Radiative Transfer

Dr D. Whelpdale reminded participants that at the third session of AOPC an agreement was reached on the list of atmospheric constitutents needed for climate. A chapter for the Plan has been drafted which integrates radiative transfer and clouds as well. The draft chapter discusses the contribution of atmospheric constituents measurements to: (i) an improved knowledge of biogeochemical cycles, particularly the sources and sinks of greenhouse gases, carbon and sulphur; (ii) understanding climate change and variability through improved knowledge of radiative forcing; (iii) improved capability to predict climate change by providing information to simulate the climate system and to initialise models; (iv) the capability to monitor the effectiveness of controls imposed on emissions of radiatively active substances by nations and under international agreements; and (v) understanding the effects of climate variability and change by enhancing knowledge of the feedback of climate on sources, sinks and ambient levels of atmospheric constituents and harmful radiation. The measurements of constituents should follow agreed guidelines. The draft chapter then gives examples of the main users of atmospheric constituents observations (i.e., scientists from International Geosphere-Biosphere Programme (IGBP)/International Global Atmospheric Chemistry (IGAC) and WCRP/SPARC, modellers, synthesis groups, IPCC Working Group I and others on assessing the state of the ozone layer, policy community and industry. The observing system products relate to the long-term observations of high-priority variables such as greenhouse gases, water vapour, tropospheric and stratospheric ozone and aerosols. The necessary information should be provided by combined surface and satellite measurements. The draft chapter also describes requirements on geographical coverage, spatial and temporal resolution. Dr Whelpdale pointed out that these requirements depend as well on the end-use of the products. Specifications are still needed for each observation and need to be solicited. To assign priority to the variables is difficult and depends on GCOS objectives, urgency and feasibility (i.e., if instruments are available). The current status of networks such as Global Atmosphere Watch (GAW), the Network for the Detection of Stratospheric Change (NDSC), the Atmospheric Lifetime Experiment-Global Atmospheric Gases Experiment (ALE-GAGE) and NOAA's Climate Monitoring and Diagnostics Laboratory (CMDL), needs to be updated. Information on spaced-observations of atmospheric constituents is available.

Dr Whelpdale discussed the next steps in completing the first version of the Plan: (i) to acquire a more complete understanding of what actions are required (i.e., specify requirements), (ii) identify gaps, (iii) propose actions to identify deficiencies, (iv) review status of observations, (v) discuss the GAW aerosol project and the CEOS SIT ozone projects. Further, short-term actions needed to address water vapour, ozone and aerosol measurements, which should be assigned to a task team. Overarching issues include the integration of observing systems which combine surface, satellite and other observations, the maintenance of observations for the long-term and the role of new observational platforms (e.g., aircraft).

In the following discussion about additional requirements, participants considered whether or not to include emissions. Existing projects, in which emissions are being studied were noted (e.g., the Global Analysis, Interpretation and Modelling Program (GAIM)). Flux measurements may be considered by GTOS. The Panel concluded that the Global Hierarchical Observing Strategy (GHOST) may not be relevant to atmospheric constituents measurements, because they are dependent on height and distributions differ considerably.

A 8.4 Air-Sea / Air-Ice Interface

Dr Harrison gave some examples of how surface data are successfully assimilated, and suggested improvements that are needed. With respect to SST, the analyses show differences (i.e., global trends of NCEP and of UK Meteorological Office differ from each other). Additionally, SST information will be missing if the NOAA Geostationary Operational Environmental Satellite (GOES) loses SST channels. Sea surface level pressure is one of the priority parameters, and small observational errors in the tropics have large impact on the simulation of equatorial Pacific winds. With respect to surface winds, scatterometer missions need better coverage to observe energetic scales. Re-analyses have not captured wind fields in the tropical Pacific, as may be demonstrated by using the TAO array observations. Precipitation measurements agree better with model results due to new technologies. Sea surface salinity observations, especially using sensors for long-term observations, are progressing. He noted that coupled models will face the same problems in analysing climate signals due to unsatisfactory observations of the ice-edge.

A 8.5 Emerging Technologies

Dr R. Fleming elaborated on new technologies to complement climate observations. Commercial airlines can provide water vapour, ozone, wind profiles and aerosol measurements and the very-high frequency (VHF) data links are improving continuously. Aircraft in future may be equipped with a variety of aerosol sensors and will be able to observe atmospheric species. He noted that the second generation of ultraviolet radiation and ozone sondes are already available. Light Detection and Ranging (Lidar) systems may provide wind profiles over the ocean. The GPS occultation technique may be of benefit for temperature observations in the upper troposphere, but water vapour may be difficult. Other new technologies will be interferometric techniques on satellites. Data provided by projects like MOZAIC (Measurement of Ozone and Water Vapour by Airbus in-service aircraft) could be discussed if appropriate. Dr Fleming pointed out that composite systems will be necessary to have a complete picture of the atmosphere, but stressed as well that there are still restrictions due to large errors in some fields.

A 8.6 Extreme Events

This agenda item was jointly discussed with the JDIMP A*d Hoc* Working Group 1 (see D 9.2.1). Mr Karl informed the panel about the meeting on extreme events in Asheville 1997, which was focused on precipitation, temperature, wind and storms. A follow-up workshop will be held in 1999, engaging insurance and energy companies representing a broader community. The joint CCl/CLIVAR Working Group on Climate

Change Detection would convene its second meeting in Bracknell, UK, in September 1998, to discuss precipitation and temperature indices, focussing on available data sets.

Several presentations were given on long-term analyses of climate data. Dr Heino informed the participants about the REWARD project (Relating Extreme Weather to Atmospheric circulation using a Regionalised Dataset). The REWARD data sets of climatic extremes include monthly data for all Nordic countries and contain climatic data for more than 50 stations for temperature, precipitation, pressure, snow cover and cloudiness. The data have been recorded mainly between the years 1890 to 1996. Dr Jones reported on daily temperature record comparison and trend analyses over several decades. Several European cities (Uppsala, St Petersburg, Padua, Milano, Brussels, Cadiz) and Central England have over 200 years of records of daily temperature and will be used to perform climate analyses. Prof P. Zhai reported that China has updated its climate data between 1951 to 1996, and that minimum and maximum temperatures are being recorded and analysed. Furthermore, the Chinese precipitation network is providing daily measurements. Dr V. Razuvaev informed the panel that Russia is using data sets of exteme air temperatures, daily precipitation and pluviograph data to detect extreme events. He mentioned that not only scientists are interested in this data set, but the building companies and atomic power plants as well. Mr Z. Atheru informed the group on the activities in Africa on extreme events, stressing the importance of the drought severity index, rainfall anomalies and flood indicators.

A 8.7 Monitoring of GCOS Data

Mr Karl discussed the possibility of assisting the IPCC to gain access to data archives, material and documentation. The SPARC data archive of upper-troposphere and lower-stratosphere ozone, water vapour and temperature data would be an invaluable contribution. With respect to historic data and data rehabilitation, Dr Manton recommended that CCl obtain historical data and metadata to support GSN and GUAN. Letters should be sent to Members requesting digitised daily data from historical records. Full records of historical GUAN data for wind, temperature and humidity should be made available for all standard levels and significant levels. Full records of historical GSN data should be made available for temperature, minimum and maximum temperature, pressure, wind speed and precipitation. The participants recommended that rehabilitated data should be archived and distributed on a CD-ROM, when available.

Dr Manton proposed a scheme of processing GCOS data. The first stream of monthly data would be distributed via GTS in near real-time to the national weather services, and collected in the GCOS monitoring centres. These centres would provide statistics and quality review on the data sets, as well as historical ones. The second stream of daily data would go via the national weather services, after a certain delay time, to the archives of the WDC.

A 8.8 GCOS Requirements

Dr C. Richter provided a background document on requirements and invited the panel participants to review and approve the variables and the respective requirements already in the WMO Affiliate Database, and to suggest variables whose requirements still need to be identified. The panel recommended to enter the variables into the Affiliate Database and to review the requirements before its next session.

A 8.9 Satellite data

The panel noted that the Microwave Sounding Unit (MSU) and GPS data become more and more significant with respect to GUAN. It was decided that a working group should look into the issue of how to integrate these data.

A 9. Recommendations and Final Report

A 9.1 Data flow for GCOS

The AOPC decided that it should consider the overall process for the collection, processing, archiving, analysis and distribution of the atmospheric component of GCOS. Such consideration is necessary to ensure that the observed data are of appropriate quality and value, and that the research and operational communities have timely access to these data. In this context, the contribution of CBS to GCOS is seen as vital in providing continuing advice and expertise to NMHSs operating sites in GCOS networks and in supporting real-time quality control. [**Action 1**]

Using GSN and GUAN as models, AOPC decided that it was necessary to have specific centres to ensure the overall quality of data and to produce basic products from GCOS data, in addition to the real-time centres that monitor initial data flow and validation. The data and basic products from GCOS networks should be finally available to the research community through the World Data Centres. [**Action 2**]

The generation of GCOS products, such as CD-ROMs of quality-controlled data, would serve the broad community and demonstrate direct outputs from GCOS. These outputs should encourage participants, such as NMHSs, in the overall GCOS process. The AOPC decided that it would be appropriate for the Chair of the JSTC to contact each year the NMHSs that contribute to networks such as GSN and GUAN. This contact would complement the continuing interaction through CBS, provide positive feedback on the appreciation of the broad community for contributions to GCOS, and inform NMHSs directly of the outcomes and outputs of their efforts. [**Recommendation 1**]

In discussion of GSN and GUAN, there was some uncertainty about whether there are some data transmission problems with the GTS. The Panel requested CBS to provide some statistics on the performance of the GTS, especially as it relates to the operation of GSN and GUAN stations. [**Action 3**]

A 9.2 GUAN

A review of GUAN observation statistics provided by CBS showed that there are a large number of silent or suspect stations. Moreover, not all the old Omega stations have yet been replaced. Given the closure of GUAN polar stations, the Panel also requested CBS to work with NMHSs to identify replacement stations at high latitudes. [**Action 4**]

GUAN is the minimal network needed to capture synoptic scale features for global monitoring; e.g., monsoons. It should also provide the baseline for regional

networks to analyse regional climate features. The Panel also noted that the development of basic GUAN products, such as global heat budgets, is one means of justifying continuing support. [**Recommendation 2**]

The AOPC decided that GUAN needs to provide the long-term consistent backbone of upper-air observations to support GCOS. Thus at the outset GUAN needs to consist of existing core stations that can provide the required measurements. The effort must then be placed on maintaining those core stations. [**Recommendation 3**]

In order to achieve the required global coverage, the Panel recommended that new stations should be added to the GUAN list. The new stations would comprise 4 sites in India and 1 site in each of Diego Garcia, Sudan, Democratic Republic of Congo, and Angola. The Panel also requested USA to re-activate the TOGA radiosonde stations for GUAN at Wake Island and Canton Island. [**Recommendation 4**]

The Panel recommended that the Chair of JSTC should write annually to the NMHSs contributing to GUAN to thank them for their contribution and to inform them of outcomes of GUAN. A particular outcome should be the generation of a CD-ROM of global quality-controlled historic GUAN data. In order to develop that product, the Panel will request CBS to approach NMHSs for their historic GUAN data not already available through the CARDS programme. (This approach will be made after the GSN data issues are resolved.) [**Action 5**]

The quality control and assembly of GUAN data sets need to be carried out through a formal institutional arrangement. The Panel recommended that the Hadley Centre and NOAA/NCDC, who are collaborating on the CARDS project, should be requested to take the lead in this activity. [See **Recommendation 1, Recommendation 5**]

The AOPC recommended to CBS that GUAN data should be deemed essential under WMO Resolution 40 and to be exchanged free of charge in real time. [**Recommendation 6**]

The Panel considered and generally endorsed the best-practice procedures for GUAN developed by CBS. However, it was recognised that most of the stations are not reaching the best-practice altitude of 5 hPa, and that for broad GCOS purposes of monitoring the general circulation an upper altitude of 30 hPa should be discussed. [*After confirmation from Dr Chanin, the Panel recommended that the best practice altitude of 5hPa should be maintained* .] [**Endorsement 1**]

The AOPC recommended that, where the performance of GUAN stations is consistently poor, GCOS should work with CBS and the NMHSs to identify the cause of any problem and to assist with the development of appropriate solutions. In particular, specific training may be helpful at some stations under overall capacity-building programs. [**Recommendation 7**]

The Panel recognised that there is a problem for developing countries in funding continuing operations; i.e. while one-off grants to establish activities can be found, external organisations are reluctant to offer continuing funds. This is a critical

issue for GCOS that should be noted in the submission to SBSTA on climate observations. [**Recommendation 8**]

In reviewing the status of GUAN, the AOPC noted that an analysis of South American GUAN data showed that their quality was no better than that from neighbouring (non-GUAN) sites. The Panel recognised the value of these analyses of observation statistics, and encouraged members to continue to provide them. [**Recommendation 9**]

A 9.3 GSN

The AOPC noted that 65% of GSN stations are reporting over the CLIMAT network, and requested CBS to encourage all GSN operators to move to the correct CLIMAT format. [**Recommendation 10**]

The AOPC endorsed the revised list of GSN stations proposed by the Group of Experts and recommended that CBS should approve the list. However, it was noted that there are gaps in central and western France, and AOPC requested the Group of Experts to identify additional stations to fill the data gaps. [**Endorsement 2**, **Action 6**]

The Panel thanked the NMHSs of Germany and Japan for offering to monitor the real-time performance of the GSN. It was also noted that Germany will host an expert meeting later this year on real-time monitoring and quality control of GSN data. This meeting will involve participants from Germany, Japan, UK and invited experts. The Panel thanked Germany for the initiative and decided that it should have representation at the meeting. Mr M. Werschek and Mr Hasegawa will develop an agenda for the meeting. [**Recommendation 11, Endorsement 3**]

The detection and analysis of extreme events is a key requirement from GSN, and this means that daily data must be collected. In fact, although GSN CLIMAT reports are based on monthly summaries, those summaries depend upon daily data. The strategic sensitivity of some daily data is recognised by AOPC, and so it is proposed that the daily and monthly data be provided through different processes. The monthly data will be processed in real time using CLIMAT format from the GTS through the GSN real-time centres in Germany and Japan. The daily data will be sought directly from NMHSs in delayed-mode time through nominated GCOS data centres for research purposes. [**Recommendation 12**]

It is apparent that the GSN was initially designed on requirements for monitoring the global surface temperature distribution. Having established GSN and recognising that NMHSs almost invariably observe other parameters at GSN sites, the AOPC decided that GCOS should seek a more comprehensive data set from the GSN. [**Action 7**]

In particular, the GSN data should consist of:

- Mean daily temperature (calculated using current national practice)
- Maximum daily temperature
- Minimum daily temperature
- Total daily precipitation

- Daily mean sea level and station pressure (calculated using current national practice)
- Daily mean wind speed.

While AOPC expect the GSN to be appropriate for these additional variables, some basic analysis should be carried out to ensure that the data are available and that the distribution is adequate. With data-coverage information from NCDC, Dr Jones will consider these issues. [**Action 8**]

The AOPC stressed the importance of meta-data to complement the routine GSN observations. Analysis of both monthly and daily climate data for changes and trends requires detailed information on the station history so that spurious effects can be identified and corrected. The decisions of AOPC on the scope of GSN data need to be considered with WMO. The first issue to resolve is the availability of historical daily data and meta-data at GSN stations. A task group[9] was asked to prepare a letter from WMO to NMHSs seeking these data, which would be sent to the World Data Centres A and B. [**Action 9**]

In order to ensure that the daily GSN data are appropriately quality-controlled and analysed, AOPC will seek a commitment from an organisation (which may involve more than one institute) to become the formal GCOS data centre for GSN data. The Panel recommended that NCDC should be requested to take the lead in this activity and entrain other qualified institutes. The activities of the GCOS data centre would include the rehabilitation of the global climate record. [**Recommendation 13**]

The best-practice criteria developed by CBS were endorsed by AOPC with amendments to cover the suggested changes in GSN to include daily data. [**Endorsement 4**]

As with GUAN, the Panel recommended that the Chair of JSTC should write to participating NMHSs each year to thank them for their contribution to GCOS and to inform them of outcomes from GSN activities. [see **Recommendation 1**]

A 9.4 Atmospheric constituents

Dr Whelpdale will continue to co-ordinate with the broader community on the development of the constituents chapter of the AOPC plan. Dr Chanin will provide comment particularly on the need for observations above the stratosphere.

The Panel agreed that the atmospheric component of GCOS generally will not involve the estimation of the sources of most atmospheric constituents. This function is being carried out internationally through the IPCC and Organisation for Economic Co-operation and Development (OECD) under obligations for the UNFCCC and the Kyoto Protocol. However, analysis of GCOS atmospheric data will draw on the emission data, and so each will provide a consistency check on the other.

It was noted that, while the Panel is developing a data-flow process for GUAN and GSN, the requirements for atmospheric constituents are not clear at present. It is assumed that the data collection, quality control, archive and access are all being

[9] Consisting of T. Spence, P. Jones, T. Karl and P. Scholefield.

handled by GAW. There was some question about the consistency of all the archived constituent data from different sites. An issue for future consideration is the need for specific GCOS products on constituents generated at identified GCOS data centres.

Many of the constituent observations are carried out at research sites, such as those of the NDSC. It was agreed that AOPC must develop a process for handling links with these groups. [**Action 10**]

The constituents section of the AOPC plan will include radiative transfer, clouds and aerosols. It was noted that the current global observations on aerosols are limited to satellite-based measurements in the stratosphere, but the research community is moving towards a more comprehensive programme for the tropospheric aerosol. This issue is a vital component of GCOS.

The most comprehensive programme for measuring global cloud is the ISCCP, which is a project in WCRP. The consistency and longevity of the programme should be investigated by AOPC, and the links between ISCCP and *in situ* cloud observations determined. [**Recommendation 14**]

A 9.5 Air-sea interface

The AOPC endorsed the proposal of OOPC to develop a number of reference sites around the world oceans to provide baseline data on air-sea properties related to surface fluxes. [**Endorsement 5**]

The AOPC noted that SST data are vital to the IPCC process and to the climate community in general. However, there are substantial differences in the analyses produced by different groups around the world. Difficulties arise especially at high latitudes where data are sparse and where uncertainties in the treatment of the marginal ice zone tend to magnify differences in SST analyses. The Panel recognised the importance of the Comprehensive Ocean-Atmosphere Data Set (COADS) and the continuing activity associated with it. However, it was seen that there are issues for GCOS that are not being covered by other groups. It was decided that AOPC should organise a workshop on SST analysis. A primary objective of the workshop is to determine criteria for best practice, so that specific GCOS products can be identified. The workshop[10] could also consider the scope for enhancing the observational network in data-sparse areas. [**Action 11**]

It was noted that there are also large differences in the analysis of sea level pressure (SLP) from different centres. As with SST, the major differences occur at high latitudes where there are few observations. However, the highest priority needs to be on SST and so the workshop will not cover SLP.

A 9.6 Emerging technologies

The AOPC noted the rapid evolution of aircraft-based technology which will provide global-scale data on parameters such as water vapour, ozone and aerosol. These measurements, which are important for GCOS, will be supplemented by surface-

[10] The workshop organising committee will include D. Parker and E. Harrison and it will be chaired by P. Arkin.

based remote sensing, which is also developing quickly. In particular, the GPS-based technique for estimation of total water in the atmosphere is moving towards operational use in some countries. It is also appropriate for AOPC to monitor progress with the satellite-based GPS-Met system, which will provide global-scale temperature measurements, especially in the upper troposphere and higher.

A 9.7 AOPC plan

Dr Manton will co-ordinate the overall structure and editing. An initial draft should be available for the Director by June. The plan will be developed iteratively after that time. It would be desirable to have a good draft by September for CBS to consider at their next meeting (see Annex A-III). [**Action 12**]

A 9.8 WMO Affiliates Database

The AOPC noted the need to continue to specify the detailed measurement criteria for all the variables listed in the GCOS plan. It is seen that these specifications will be best developed in conjunction with the AOPC measurement programme. Thus the initial priority is on temperature, precipitation, pressure and wind, associated with AOPC measurement projects. In particular, it will be important for the AOPC plan to account for the needs of satellite measurements to complement the in situ observations from GUAN and GSN. [**Recommendation 15**]

A 9.9 IPCC linkages

It was recognised that AOPC should be able to assist the IPCC with several data issues. One initiative, arising from JDIMP, has been the joint project on the analysis of historical climate records for the detection of changes and trends in extreme events. The Panel endorsed the proposal to have a workshop in 1999 to follow on from the Asheville workshop in June 1997, and it also endorsed the proposal for APN to sponsor a similar meeting focused on the Asia Pacific region. [**Endorsement 6, Endorsement 7**]

Dr Jones and Mr Karl agreed to seek advice on whether AOPC could further assist IPCC with the provision of other data sets, diagrams and documentation to support the IPCC Third Assessment Report process. In particular, the JDIMP data centre may be able to assist. [**Action 13**]

During the discussion on extreme events, the AOPC noted the work being carried out in Europe in the REWARD project, which involves analysis of temperature and rainfall data. Other national activities in China, Russia and Kenya were also noted.

A 9.10 Satellite data

It is recognised that satellite data contribute to GCOS in three ways. There are satellite data, such as the Normalised Difference Vegetation Index (NDVI), that directly provide global data-sets of climate variables. There are satellite data that are combined with *in situ* data to yield composite estimates of climate variables, such as SST. There are also satellite data that are used in validation of *in situ* data, such as the

use of TIROS[11] Operational Vertical Sounder (TOVS) in GUAN. These differences are not always clear cut, but it is useful to recognise the scope of the application of satellite data. The use of satellite data in GUAN and GSN both to assist validation and to develop composite products should be considered further by AOPC. [**Recommendation 16**]

It is appropriate for AOPC to consider the endorsement or certification of satellite-based climate products. The planned workshop on SST analysis is a step towards the development of a policy on this issue. The handling of satellite-based estimates of precipitation, particularly the GPCP products, should be considered at the next meeting of AOPC. [**Recommendation 17**]

The Panel noted that two of the six CEOS SIT projects are of direct interest to AOPC. The ozone project, for which Dr Whelpdale is the GCOS contact, has received little feedback at this stage. The second project is on upper-air measurements, but it has been firmly focused on the needs for weather analysis and prediction, rather than climate needs. The Panel noted that the purpose of the CEOS IGOS, to which the SIT projects contribute, is to ensure that the overall needs of the community are accounted for in the development of satellite projects.

A 9.11 JDIMP links

Following discussion of the responsibilities of each GCOS Panel, it was agreed that AOPC would focus on planning and implementation issues related to the atmospheric component of GCOS. The role of JDIMP will include cross-cutting issues, such as the GOSIC at the University of Delaware which was seen as very important in improving access to GCOS data. It was seen that JDIMP would also take the lead on the international issues of data availability and intellectual property rights on data.

A 9.12 Terms of reference of AOPC

On the basis of decisions on AOPC activities, it is appropriate for the AOPC terms of reference to include explicitly data quality control issues and the generation of GCOS products.

A 9.13 Format of AOPC meetings

There was some discussion on the need to have a balance of science and planning/organisational issues in AOPC meetings. The schedule as outlined in Annex A-II was suggested for the format of future meetings. It may be possible to complete the tasks in three full days. If feasible, participants should bring personal computers so that reporting and writing assignments can be done efficiently.

A 10. Closure of the AOPC Individual Session

The individual session of AOPC was closed at 10:45 hrs, 1 May, 1998. As there will be a change in Director and Chair of JSTC over the next few months, it was

[11] Television Infrared Observation Satellite

suggested that AOPC could delay its next meeting until autumn 1999. On the other hand, there are several issues on GUAN and GSN that need consideration, as well as finalisation of the AOPC plan, and so a meeting in spring 1999 may be necessary.

Part III – Individual Session of JDIMP

D 6. Organization of the Individual Session of JDIMP

Mr Karl, Chairman of JDIMP, opened the individual session of JDIMP at 09:00 on 29 April 1998. The agenda of the individual session was modified and adopted (Annex II).

D 7. Current Activities and Developments

D 7.1 JDIMP Data Plan

Dr W. Murray presented the draft of the revised Data Management Plan prepared with Mr R. Keeley, who was not able to attend the session. He stressed the importance of the linkages to other programmes, highlighted the key changes chapter by chapter, and summarised issues to be addressed in a working group to be formed during the session (Annex D-I).

D 7.2 Technical Advisory Group

Dr Webster reviewed the concept of the Technical Advisory Group. The group planned to set up a transparent data management system to deal with technical issues and to be composed of distributed data centres. He proposed that a participating data centre workshop be held in the next year making use of the results of the meeting of the Data System Task Group[12]. The importance of defining a role of the G3OS data centres was pointed out. Such centres should not only be data archiving centres but also have clearinghouse function. The metadata issue was suggested as the primary focus at the workshop. It was agreed that the workshop was necessary but its scope needed further discussion.

D 7.3 JDIMP Metadata Project

Dr Heino informed the panel of the progress of the JDIMP metadata pilot project. He stressed that the project had been addressing the directory level of metadata and not with the actual data itself. He reported that ocean keywords had already been selected, atmospheric keywords were chosen as were the variables in the GCOS/GTOS Plan for Terrestrial Climate-related Observations. INFOCLIMA was cited as a good reference.

Mr B. Searle demonstrated the Australian Oceanographic Data Centre (AODC) Environmental Data Web System designed to provide users with basic information on data sets in ocean, climate and terrestrial fields including contacts to get the data sets. He explained that keywords were essential for data discovery, especially for users from other disciplines. Keywords on satellites have not been incorporated. With regard to the linkage between this metadata system and the Information Center (IC), Dr Webster noted that the IC, which was to be designed to serve users, would point to the metadata system. It was confirmed that metadata would be managed at distributed sites and that data sets would reside with the collectors. It was suggested that the G3OS data centres workshop discuss this matter (see D 7.2).

[12] Report of the GCOS Data System Task Group (GCOS-5)

D 7.4 Activities in the Asia-Pacific Region

Dr A. Jose reviewed some climate-related activities in the Asia-Pacific Region. She emphasised the provision of data for assessing the potential of developing countries to improve existing observational networks and data and information management. She pointed to some regional meetings and workshops for improving awareness of policy and decision-makers, for building regional capabilities, and for demonstrating the value of the end-to-end climate monitoring systems supporting greater participation of national governments. She listed some climate monitoring development projects at regional and national levels. She stressed the potential for enhanced participation of developing countries, proposed the establishment of national committees and a regional co-ordinating body to guide and to harmonise national climate-related activities. A pilot project on the utilisation of global observing system data in short-term climate prediction and assessment of climate change has been developed. Documentation of experiences in the use and benefits of seasonal climate forecast and early warning systems in the Association of South East Asian Nations (ASEAN) region would provide a focus for the project.

D 7.5 ACSYS Data Management and Information Panel (ACSYS DMIP)

Dr Razuvaev, member of the Arctic Climate System Study (ACSYS) Data Management and Information Panel (DMIP), informed the panel about the results of the first session of the ACSYS DMIP (St.Petersburg, Russia, 10-12 March 1998). The goal of the ACSYS is to determine the role of the Arctic as an interactive component of the global climate system. A high priority objective is the development of the ACSYS Data and Information Service (ADIS), a pro-active monitoring service and clearinghouse of data and information under the paradigm of distributed data centres. ADIS would not contain actual data itself but would contain a metadata base about existing data sets, status of data sets and related information, as well of the status of proposed and planned data collection activities. Terms of References of the ACSYS DMIP were discussed and importance of the free and unrestricted dissemination of ACSYS data for non-commercial purposes was underlined. One of the main goals of the ACSYS DMIP is to co-ordinate data and information flow management with existing data management centres and other appropriate organisations.

D 8 Future Activities

D 8.1 Future Atmospheric Data Management Issues

Mr Atheru reported on the Drought Monitoring Project for Eastern and Southern Africa. There are two operational centres, one in Nairobi, Kenya, and the other in Harare, Zimbabwe. He reviewed the status of the network under this project and some products being prepared and disseminated, including ten-day weather advisories and monthly drought monitoring bulletins. He discussed some problems encountered by the Drought Monitoring Centers, including lack of near-real-time data, poor upper-air network, lack of reliable and efficient communication system for data and products exchange, gaps in climate data sets, and insufficient computer capabilities, especially for data storage. He expected the improvement of communication system with upgraded GTS links and Internet connection, greater use of remotely-sensed data to supplement

observation networks and proxy data to fill the data gaps, and upgrade of the computing facilities with the enhancement of data rescue measures.

Dr Razuvaev presented a report about Russian data centres' activity in the preparation of data sets for monitoring changes in extreme events in Russia. A data set of daily mean, maximum and minimum air temperatures for 223 USSR stations for the period from the onset of records (since 1874) up to 1995 has been prepared. One of the major tasks is to update the data set by including recent data and to extend the data set by increasing the number of stations. The development of data processing techniques and the use of advanced computing facilities and computer-readable data media make it possible to create a baseline daily precipitation data set for Russia. The baseline data set is supposed to contain primarily daily precipitation totals for the period of 1966 up to the present day from the stations included in the WMO list of observational stations (containing about 1000 Russian stations). Provision is also made for augmenting the basic data set by including data for the earlier periods (like the onset of regular precipitation observations) and using additional precipitation data from a number of the stations of the National Meteorological Network. The data set is planned to be created based on pluviograph data for 546 Russian stations (period 1984-1996 is the first stage). In Russia, pluviograph data are processed for the whole rainy period using ten-minute intervals. Precipitation total and mean intensity of rain are calculated for each rain event. The data set includes comprehensive information on rain and on the intervals of equal intensity within the same rain event.

Mr Werscheck briefed the participants on the planned Satellite Application Facility (SAF) on Climate Monitoring, which would be a joint activity of several European Organization for Meteorological Satellites (EUMETSAT) Member States. It will provide quality-controlled data sets extracted from EUMETSAT satellite data for climatological services, climate analyses and model validation. The focus will be put on the determination of consistent parameters of cloud and radiation for Europe and the North Atlantic, on the production of homogeneous global data sets of sea surface temperature and sea ice cover, and on a statistical evaluation of global vertical profiles of temperature and humidity. He envisaged the first pre-operational production in 2003.

Mr Scholefield highlighted some future activities of WMO, including the development of CLIPS in regional products, revision of the Guide to Climatological Practices[13], an ENSO retrospective, evolution of CLICOM software and the development of a WMO data and information management plan.

D 8.2 Future GOOS and Related Oceanographic Data Management Issues

Mr Hasegawa discussed the development of quality control with oceanographic data on GTS, important for the future evolution of NEAR-GOOS. He added that NEAR-GOOS data had limited metadata and therefore the development of the metadata project was of interest.

Mr R. Zöllner presented the WMO Marine Climatological Summary Scheme (MCSS). Global Collecting Centres, hosted by the national weather services of Germany and the United Kingdom, gather marine information. He reviewed in

[13] Publication available at WMO (WMO-No. 100).

particular the dataflow in real-time and delay modes for the marine meteorological observations made by Voluntary Observing Ships (VOS).

Mr Guddal stressed that the cross-cutting issues between ocean and land in coastal zones be further developed.

D 8.3 Future GTOS and Related Terrestrial Data Management Issues

Dr A. Singh discussed UNEP's reports and assessments on the status of the global environment and he pointed out that these reports and assessments suffer from limited data. He reviewed some current terrestrial products including IGBP Global Land Cover Classification, Global Topographic Data, and Drainage Basin Database, and he stressed the huge demands for these data sets by showing statistical figures at the UNEP Global Resources Information Database - Sioux Falls.

Dr G. Szejwach reported that IGBP was engaged in a three-year data integration exercise, starting with a global wetland map, and that IGBP should make maximum use of G3OS, IGOS and CEOS experiences.

D 9. Recommendations and Final Report

D 9.1 Establishment of *Ad Hoc* Working Groups

Based on the earlier discussions, three *ad hoc* working groups were set up to discuss further some of the specific items. *Ad Hoc* Group 1 was formed jointly with AOPC.

- *Ad Hoc* Group 1 (T. Karl, P. Scholefield, M. Werscheck, A. Jose, V. Razuvaev, R. Zöllner, R. Heino, Z. Atheru, N. Hasegawa, P. Zhai, P. Jones, + AOPC participants)
  - GUAN/GSN
  - IPCC
  - Extremes
  - GSN Precipitation
  - ENSO Index

- *Ad Hoc* Group 2 (F. Webster, B. Searle, J. Vande Castle, A. Singh, G. Szejwach, R. Wilson)
  - Metadata
  - Data Set Registration
  - Information Center

- *Ad Hoc* Group 3 (W. Murray, J. Guddal, J. Withrow, G. Martin, L. Moodie, D. Kohnke, K. Suda)
  - WMO Resolution 40
  - World Intellectual Property Organization (WIPO) Database Treaty
  - Data Plan
  - Terms of Reference

D 9.2 Reports of *Ad Hoc* Working Groups

Mr Karl reported to JDIMP on behalf of the *Ad Hoc* Working Group 1, a joint group with AOPC. The group recommended that the monitoring of GUAN and GSN be performed for temperature (including maximum and minimum temperature) in an operational mode and for temperature, precipitation, atmospheric pressure, and wind in a delayed mode. [**Recommendation 1**]

WMO and its Commission for Climatology should write a letter requesting the operating countries to provide historical climate data for GUAN and GSN stations. [**Recommendation 2**]

The group recognised that an Extreme Events Workshop to be held in 1999 would be very important. [**Endorsement 1**]

The Information Centre should secure a close linkage with the IPCC Data Distribution Centre (see A 8.7). [**Action 1**]

Dr Webster and Mr Searle reported on behalf of the *Ad Hoc* Working Group 2. The group felt that a formal procedure would be necessary for the data centres to participate in the metadata-related activities and that a mechanism for the feedback from users should be developed. With regard to the roles of JDIMP and other scientific panels in the data management activities, the former should overview the adequacy of procedure, dataflow, etc., while the latter should identify data sets. [**Recommendation 3**]

The participating data centres in the G3OS data centres workshop, recommended to be held in 1999, should be identified by science panels. Data set registration is closely related to the issue of "What is a G3OS data set?" (see Annex D-II). [**Action 2, Recommendation 4**]

Dr Murray reported on behalf of the *Ad Hoc* Working Group 3. The group proposed that the Data Management Plan be composed of a main part covering matters of all the three observing systems in common and three separate annexes dealing with specific issues for each observing system. A chapter specific to the metadata issue would be necessary. The Plan should be consistent with the "template to guide JDIMP" which was discussed at the last session of JDIMP[14]. [**Action 3**]

The group noted the fact that the GOOS Steering Committee (GSC) had suggested modifications to the JDIMP Terms of Reference which had earlier been renewed by the GCOS JSTC (Annex D-V). However, this should be a matter of the steering bodies of G3OS. The group only briefly discussed the WMO Resolution 40 on the exchange of meteorological data.

D 9.3 JDIMP Data System Processes

Based on the "template to guide JDIMP", a flow chart for the JDIMP data system processes was developed to facilitate the discussion of the Data Management Plan (Annex D-III). Each issue in the sequence of dataflow was identified as "green" for

[14] Report of the GCOS/GOOS/GTOS Joint Data and Information Management Panel, third session, Tokyo, Japan, July 15-18, 1997, (GCOS-39).

primary responsibility of JDIMP, “yellow” for secondary responsibility, or “red” for minimal responsibility. For the issues with secondary responsibility of JDIMP, JDIMP should assist others with primary responsibility.

D 9.4 Establishment of *Ad Hoc* Working Groups for the Data Management Plan

In order to discuss details of the Data Management Plan, four *ad hoc* working groups were newly set up which addressed the respective issues in the flow chart for the JDIMP data system processes (see D 9.3).

- *Ad Hoc* Group I (J. Withrow, L. Moodie, P. Scholefield, A. Singh)
  - Science issues
  - Political issues
  - Applications
  - Variables of G3OS interest
  - Is the system working?

- *Ad Hoc* Group II (D. Kohnke, G. Martin, V. Razuvaev, R. Zöllner)
  - Measurements
  - Collection/data assembly, Integration into database
  - Data archaeology
  - Data product generation

- *Ad Hoc* Group III (R. Wilson, M. Werscheck, J. Guddal, A. Jose, V. Razuvaev, G. Szejwach, Z. Atheru)
  - Data & product distribution to users

- *Ad Hoc* Group IV (B. Searle, F. Webster, R. Heino, N. Hasegawa, P. Zhai, J. Vande Castle)
  - Archiving
  - Metadata products (e.g., inventories)

D 9.5 Reports of *Ad Hoc* Working Groups

Mr Withrow, Prof. Kohnke, Mr Searl and Dr Wilson reported on behalf of the *Ad Hoc* Groups I, II, III and IV, respectively. The reports are summarised in Annex D-IV.

D 9.6 Action Items

Based on the discussions during the individual JDIMP session, the Chairman emphasised some particular action items to be addressed for the inter-sessional period.

Dr Murray will prepare a draft Data Management Plan with the assistance of Mr Withrow, Ms Martin, Mr Searle, Dr Wilson, and Prof. Kohnke. The draft plan should be based on the reports of the *ad hoc* working groups in Annex D-IV. [see **Action 3**]

Dr Webster will secure a linkage to the IPCC Data Distribution Center (http://ipcc-ddc.cru.uea.ac.uk). [see **Action 1**]

Mr Searle and Dr Heino continue as principals for the Metadata Project. The keywords should be endorsed by each related science panel. This project should be put into an operational mode. Mr Withrow and Ms Martin will be contact points for GOOS and GTOS, respectively on this project. Dr Wilson will make a presentation on metadata at the fourth session of TOPC (25-29 May 1998, Corvallis, Oregon, USA). [**Recommendation 5**]

D 10. Closure of the JDIMP Individual Session

The Chairman closed the JDIMP individual session at 10:45, 1 May, 1998.

Annexes

Annex I

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Annex II

Agenda

Annex III

Acronyms and Abbreviations

ACSYS	Arctic Climate System Study
ADIS	ACSYS Data and Information Service
AG	Analysis Group (CEOS)
ALE	Atmospheric Lifetime Experiment
AODC	Australian Oceanographic Data Centre
AOPC	Atmospheric Observation Panel for Climate (GCOS)
APN	Asian Pacific Network for Global Change Research
ASEAN	Association of South East Asian Nations
AWS	Automatic Weather Station
CARDS	Comprehensive Aerological Reference Data Set
CBS	Commission on Basic Systems (WMO)
CCl	Commission for Climatology (WMO)
CDAS	Climate Data Assimilation System
CEOS	Committee on Earth Observation Satellites
CLICOM	Climate Computer software
CLIPS	Climate Information and Prediction Services (WMO)
CLIVAR	Climate Variability and Predictability (WCRP)
CMDL	Climate Monitoring and Diagnostics Laboratory (NOAA/ERL)
CMM	Commission for Marine Meteorology (WMO)
COADS	Comprehensive Ocean-Atmosphere Data Set
COP	Conference of the Parties
DAO	Data Assimilation Office
DWD	Deutscher Wetterdienst
ECMWF	European Centre for Middle-Range Weather Forecasts
ECSN	European Climate Support Network
ENSO	El Niño-Southern Oscillation
EOS	Earth Observing System (NASA)
ERA	ECMWF Re-Analysis
EUMETNET	European Meteorological Network
EUMETSAT	European Organization for Meteorological Satellites
FGGE	First GARP Global Experiment
G3OS	GCOS, GOOS and GTOS
GAGE	Global Atmospheric Gases Experiment
GAIM	Global Analysis, Interpretation and Modelling Program
GARP	Global Atmospheric Research Program
GAW	Global Atmosphere Watch
GCC	Global Collecting Centre
GCOS	Global Climate Observing System
GEWEX	Global Energy and Water Cycle Experiment
GHOST	Global Hierarchical Observing Strategy
GODAE	Global Ocean Data Assimilation Experiment
GOES	Geostationary Operational Environmental Satellites (NOAA)
GOOS	Global Ocean Observing System
GOSIC	Global Observing Systems Information Center

GOSSP	Global Observing Systems Space Panel
GPCC	Global Precipitation Climatology Centre
GPCP	Global Precipitation Climatology Program
GPS	Global Positioning System
GSN	GCOS Surface Network
GT-Net	Global Terrestrial Observing Network
GTOS	Global Terrestrial Observing System
GTS	Global Telecommunication System
GTSPP	Global Temperature-Salinity Pilot Project
GUAN	GCOS Upper-Air Network
HOTO	Health of the Ocean (GOOS)
IC	Information Center
ICSU	International Council for Sciences
IDNDR	International Decade for Natural Disaster Reduction
IGAC	International Global Atmospheric Chemistry
IGBP	International Geosphere-Biosphere Programme
IGOS	Integrated Global Observing Strategy
IGOSS	Integrated Global Ocean Services System
ILTER	International Long-Term Ecological Research
IOC	Intergovernmental Oceanographic Commission
IODE	International Ocean Data Exchange (IOC)
IOS	Initial Operational System
IPCC	Intergovernmental Panel on Climate Change
IPRC	International Pacific Research Center
IRI	International Research Institute for Climate Predictions
ISCCP	International Satellite Cloud Climatology Project
JAMSTEC	Japan Marine Science and Technology Center
JDIMP	Joint Data and Information Management Panel
JGOFS	Joint Global Ocean Flux Studies
JIMAR	Joint Institute for Marine and Atmospheric Research
JMA	Japan Meteorological Agency
JSC	Joint Scientific Committee (WCRP)
JSTC	Joint Scientific and Technical Committee (GCOS)
LBA	Large Scale Biosphere-Atmosphere Experiment in Amazonia
LDEO	Lamont-Doherty Earth Observatory
LIDAR	Light Detection and Ranging
LMR	Living Marine Resources Panel
MC	Monitoring Centre
MCSS	Marine Climatological Summary Scheme
MODIS	Moderate-Resolution Imaging Spectroradiometer
MOZAIC	Measurement of Ozone and Water Vapour by Airbus in-service aircraft
MSU	Microwave Sounding Unit
NASA	National Aeronautics and Space Administration (USA)
NASDA	National Space Development Agency (Japan)
NCAR	National Centre for Atmospheric Research
NCDC	National Climatic Data Center
NCEP	National Centres for Environmental Prediction
NDSC	Network for Detection of Stratospheric Change

NDVI	Normalised Difference Vegetation Index
NEAR	Near East Asian Region
NMHS	National Meteorological and Hydrological Services
NOAA	National Oceanographic and Atmospheric Administration (USA)
OECD	Organisation for Economic Coopeation and Development
OOPC	Ocean Observations Panel for Climate (GCOS)
RA	Regional Associations (WMO)
REWARD	Relating Extreme Weather to Atmospheric circulation using a Regionalised Dataset
SAF	Satellite Application Facility
SBSTA	Subsidiary Body for Scientific and Technological Advice
SIT	Strategy Implementation Team (CEOS)
SLP	Sea Level Pressure
SOEST	School of Ocean and Earth Science and Technology
SOOP	Ship-Of-Opportunity Programme
SPARC	Stratospheric Processes And their Role in Climate
SST	Sea Surface Temperature
TAO	Tropical Atmosphere-Ocean Array
TEMS	Terrestrial Ecosystem Monitoring Site (UNEP)
TIROS	Television Infrared Observation Satellite
TOPC	Terrestrial Observation Panel for Climate (GCOS)
TOVS	TIROS Operational Vertical Sounder
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
VHF	Very-high frequency
WCRP	World Climate Research Programme
WDC	World Data Centre
WGOBS	Working Group on Observations (CBS/WMO)
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment

Annex A-I

Outline of the GSN Quality Control (QC) Expert Meeting

An expert meeting on the GSN monitoring activity was proposed to discuss the initial implementation of the two GSN monitoring centres at DWD and at JMA, and their future development. The expert meeting should be attended by a small number (10 to 12 at most) of experts from the GSN Monitoring centres, WDC, and some other leading climate data centres. The expert meeting agenda should outline the following:

(1) Monitoring/QC proposals for initial implementation

JMA and DWD present their plans for the initial implementation

(2) Collaboration between DWD and JMA on the basic monitoring

The discussion should produce agreed technical details on the data sharing/comparison, on common procedures for format check and on other basic QC. Scope, format, and frequency of the monitoring products should be discussed also.

(3) Collaboration between GSN Monitoring Centres and WDC.

The GSN Monitoring Centres and the WDC should agree on the format, frequency and the means to provide quality checked (flagged) data sets.

(4) Existing monitoring methods

Experts from leading climate data centres should be invited to make presentations on quality control activities at these centres.

(5) Medium term development plan

JMA and DWD should present their plans for the medium term (3-5 years).

(6) Areas not covered by DWD/JMA

The areas which DWD and JMA do not cover, at least for the foreseeable future, should be identified. The expert meeting might develop a recommendation to JDIMP with regard to such areas.

(7) Formalities for QC information delivery

The expert meeting should recommend to JDIMP/CCl/CBS the ways the GSN Monitoring Centres deliver the QC information to the nations concerned. Two different ways have already been identified. One is an informal communication between the Monitoring Centre and the countries, and the other is a formal link through the WMO. These need approval from Member states and others involved in this process.

Annex A-II

Format of AOPC Meetings

- Review of current climatic events
  - Science
  - GCOS performance
  - GCOS implications
- Review of GCOS Systems
  - Status / problems
  - Changes
  - Feedback to operators
- New activities
- Revision of AOPC Plan
- Other issues from JSTC, JSC, OOPC, TOPC, JDIMP
- Task Groups
- Summaries
- Next meeting
- Closure

Annex A-III

Outline of the GCOS Plan for Atmospheric Climate Observations

1. Background - Manton
2. Linkages with Other Activities - Manton
3. Requirements for Atmospheric Observations – Manton
   - 3.1 General principles
   - 3.2 Role of data assimilation- Arkin
   - 3.3 Role of satellite data– Manton

   *.*Monitoring of climate events; e.g., ENSO, volcanoes, solar variability, extreme local events – Harrison/Karl
4. Components of the Observing Systems
   - 4.1 Introduction
   - 4.2 Issues
5. Atmospheric Dynamics and Thermodynamics– Parker
   - 5.1 Introduction
   - 5.2 GCOS Upper-Air Network (GUAN)
   - 5.3 Satellite observations
6. Atmospheric Constituents and Radiative Transfer– Whelpdale
7. Surface Climate– Arkin
   - 7.1 Introduction
   - 7.2 GCOS Surface Network (GSN)
   - 7.3 Products of assimilation systems
   - 7.4 Specialised data sets
     - 7.4.1 Introduction
     - 7.4.2 Normalised Difference Vegetation Index (NDVI)
     - 7.4.3 Snow cover
     - 7.4.4 Soil wetness
     - 7.4.5 Precipitation
     - 7.4.6 Sea ice
     - 7.4.7 Sea surface temperature
8. Air-Sea Interface– Harrison
9. Air-Land Interface
10 Air-Ice Interface, Including Impact on SST Analysis – Harrison
11. Emerging Needs and Technologies– Fleming
12. General Conclusions – Manton

Appendix 1 Goals and Terms of reference of AOPC
Appendix 2 Acronyms

Each component of the Plan (Chapters 5-10) should discuss:

- Purpose of data
- Data users and products
- Design principles
- Current status
- Initial increments to the system
- Network monitoring and quality control
- Data archive and access
- Product generation
- Long-term increments.

Annex A-IV

Recommended Best Practices for GUAN Stations

Members should attempt to comply with the following best practices:

(a) Long-term continuity should be provided for each GUAN station. This requires the provision of the necessary resources, including well-trained staff, and keeping changes of location to a minimum. Changes of bias caused by changes in instrumentation should be evaluated by a sufficient overlapping period of observation (perhaps, as much as a year) or by making use of the results of instrument intercomparisons made at designated test sites.

(b) Soundings should be capable of reaching 5 hPa[15]. Because climate data are needed in the stratosphere to monitor changes in the atmospheric circulation and to study the interaction between stratospheric circulation, composition and chemistry, every effort should be made to maintain soundings regularly up to a level of at least 5 hPa. This threshold height will ensure consistent climate data coverage.

(c) Rigorous quality control should be exercised at each GUAN site. Periodic calibration, validation and maintenance of the equipment should be carried out to maintain the quality of the observations.

(d) Basic checks should be made before each sounding to ensure accurate data. The accuracy of a radiosonde's sensors should be checked in a controlled environment immediately before the flight. Checks should also be made during and/or at the end of each sounding to assure incomplete soundings, or soundings containing errors are corrected before transmission.

(e) Back-up radiosondes should be released in cases of failure. In the event of failure of a sounding instrument, incomplete sounding or resulting from difficult weather conditions, a second release should be made to maintain the record from the GUAN station.

(f) Detailed metadata for each GUAN station should be provided. Up to date records of metadata in a standard format should be provided to the GUAN Data Centre so that shifts in the data will not be mistaken for climate change. The metadata should include detailed information about the station such as location, elevation, operating instruments and their changes over time. Changes to operating and correction procedures should also be recorded. Both the corrected and uncorrected upper air observation should be archived. Climate change studies require extremely high stability in the systematic errors of the radiosonde measurements.

(g) CLIMAT TEMP data should be provided in an accurate and timely manner.

[15] Based on the outcome of the discussion in Section A.9.2, the best practice altitude was agreed to be 5 hPa.

Recommended Best Practices for GSN Stations

Members should attempt to comply with the following best practices:

(a) Long-term continuity should be provided for each GSN station. This requires the provision of the necessary resources, including well-trained staff, and keeping changes of location to a minimum. In the case of significant changes in sensor-devices or station location, Members should provide for a sufficiently long period of overlap with dual operation of old and new systems to enable comparisons to be made and the identification of inhomogeneties and other measurement characteristics.

(b) CLIMAT data should be provided in an accurate and timely manner. CLIMAT reports should be transmitted by the fifth day of the month but not later than the eighth day of the month.

(c) Rigorous quality control should be exercised on the measurements. CLIMAT reports require quality control of the measurements themselves and the coding of the messages to ensure their accurate transmission to national, regional and world centres for their use. Quality-control checks should be made on site and at a central location designed to detect equipment faults at the earliest stage possible.

(d) ***The site layout should follow the recommended form.*** The layout of the site should follow the recommendations in the Guide on the Global Observing System (WMO-No 488).

(e) ***The site should be inspected regularly and maintained according to accepted practices.*** Regular inspection should be made at intervals of not less than two years. The inspections should check the siting and exposure of the instruments. Instruments should be checked regularly against a standard instrument which itself should be checked against a national or regional standard. Maintenance should include regular housekeeping at the site, cleaning of instruments and the recommended checks on automatic instruments.

(f) A national plan should be developed to archive daily data from GSN stations for climate and climate research purposes. The archive should include both observational data and metadata pertaining to each climate station. Metadata should include data concerning a station's establishment, subsequent maintenance, and changes in exposure, instrumentation and staff. The data and metadata should be in its original form as well as digital format.

(g) Detailed meta data and historical climate data for each GSN station should be provided. A GSN data centre should have an up-to-date digital copy of the historical climate data and all types of metadata for GSN stations. A current copy of the long-term series of data and metadata from GSN stations should be made available.

Annex D-I

Key Changes and Talking Points/Issues on the Draft Revised Data Management Plan

Key Changes

Chapter 1 (Introduction and Objectives)

- Stress linkages to science programs
- Text added to provide picture of breadth and complexity of G3OS issues
- Provide for feedback from users
- Addition as specific requirements for IOS
  - to collectors on success of their efforts
  - from users on how well needs are met
  - to science panels so that needed adjustments can be made

Chapter 2 (Data and Information System - Vision and Strategy)

- GCOS data and information management principles
- Updated to reflect G3OS
- Add cross-cutting aspect to scenarios
- Updated first scenario and alternative to reflect cross-cutting programmes
- Added new scenario designed to reflect cross cutting requirement
- Dropped climate specific scenario
- Give example of feed back in scenarios
- Discussed in detail under recommendations, but could be made clearer in the actual scenarios

Chapter 3 (System Design)

- Add section on system performance controls
- Done – includes mention of monitoring and feedback, linkage between components, need to identify and correct problems

Chapter 4 (Management of the Programme)

- Add periodic system reviews
- Add in under implementation strategy

Talking Points and Issues

- Existing systems
  - Adequate inventory
  - Clear picture of contributions
  - Existing agreement with centers of data
- G3OS data sets
  - Need to identify specific types of data as G3OS
  - Will there be core set that will be initial focus?
  - Peer review process
- Commitments to users and policy-makers
  - Need clear statement.

Annex D-II

Report of the *Ad Hoc* Working Group 2
- Metadata Issues -

- A metadata record is an essential part of every G3OS data set
- Distinguish between directory-level & archive-level metadata
  - Directory-level metadata is a subset
- Science programs are responsible for specification of archive-level metadata
  - Provides additional detail
  - Must be "welded" to the data
- Key words (directory level)
  - Definition by the three programs
  - JDIMP responsible for coordination
  - IODE will support implementation
- Continue the JDIMP Metadata Pilot Project
  - Evaluate, with a view to endorsing, the directory-level metadata structure for use in G3OS data management

Metadata Pilot Project

- Enter G3OS data set descriptions
  - Science programs select data sets
  - Information Center will assist
- Make available standalone data-capture & data management software
- Work with other programs in system implementation
  - e.g., IGBP, WCRP, CEOS members, …
  - Participate in IGBP-DIS Focus 2 meeting (May, '98)
  - Information Center evaluate metadata structure for cross-center searches

What is a G3OS data set?

- Meets G3OS needs
  - contains necessary metadata
- Identified by relevant scientific panels
  - e.g., AOPC, HOTO, LMR, OOPC, TOPC, ...
- Includes relevant historical data sets

Information Center

- An activity to develop an operational model for an information center
- Should allow a user to locate and obtain G3OS data and information
  - a navigation tool
  - provide means for a user to evaluate the data stream

- Identify and document end-to-end processes and mechanisms for the G3OS data streams
  - focus on one or two data streams in each of the three programs
  - reveal gaps in the data systems
- Work closely with the data systems of the three programs

G3OS Workshop

- Discuss technical issues
  - metadata, co-ordination, data flow
- Involve representative data centres having G3OS data sets
- Make the issues broadly representative of environmental data needs
- Probably not prepared for a meeting in the near future

Annex D-III

JDIMP Data System Processes

Items	Responsibility of JDIMP	
• Science issues	Red:	Minimal
• Political issues	Red:	Minimal
• Applications	Red:	Minimal
• Variables of G3OS interest	Red:	Minimal
• Is the system working?	Green:	Primary
• Measurements	Red:	Minimal
- observing procedures	Red:	Minimal
- types of instruments	Red:	Minimal
- initial quality control	Red:	Minimal
- *metadata*	*Yellow:*	*Secondary*
• Collection/data assembly, Integration into database	Red:	Minimal
- processing	Red:	Minimal
- *additional metadata*	*Yellow:*	*Secondary*
- quality control	Red:	Minimal
- merging with existing data sets	Red:	Minimal
• Data archaeology	Red:	Minimal
• Data product generation	Red:	Minimal
• Data & product distribution to users	Green:	Primary
• Archiving	Green:	Primary
• Metadata products (e.g., inventories)	Green:	Primary

Annex D-IV

Outline and Issues on the Revised Data Management Plan

- **Group I (Science Issues, Political Issues, Applications, Variables of G3OS Interest, Is the System Working?)**

Overview and Principles

- Should have scenarios but not necessarily three.
- Look at plans for GCOS, GOOS and GTOS for overall objectives and goals.
- Motherhood statements
  - Use of existing programs (para. 2.2.1)
  - Use of international standards (para. 2.2.2).
- Principles of environmental monitoring.
- Data policy principles – compare with GOOS (J. Withrow) and GTOS (G. Martin).
- This plan supports the end-to-end data management strategy and this plan will be laid out along the lines of this strategy.
- There needs to be a diagram in the introduction that shows the end-to-end system. It should work to clarify the responsibility of the JDIMP *vis-a-vis* the science panels in system oversight.
- GTOS already has a list of the terrestrial conventions of interest to JDIMP.

Political Issues

- Need to mention Conventions and other political drivers (e.g. Convention on Biodiversity, Framework Convention on Climate Change, Convention on Desertification). These conventions raise scientific issues and lay the framework for action to resolve these issues.
- The political drivers are the responsibility of the Sponsoring Organizations in co-operation with the Steering Committees.

Science Issues

- Improve understanding of processes influencing global change.
- The international conventions raise scientific issues and lay the framework for scientific action to resolve these issues. The responsibility for responding to these issues lies with the respective G3OS scientific panels and steering committees.

Requirements and Variables

- Respond to G3OS requirements originating from and the responsibility of the science panels. The section should be rewritten to reflect more strongly and clearly that the scientific requirements and associated variables of G3OS interest (both *in situ* and remotely sensed) are established by the science panels of the respective Global Observing Systems and supported by the JDIMP. (para. 2.2.3)
- Recognize that there are external applications and services of importance
- the G3OS such as CLIPS.

Is the System Working?

- Monitor and evaluate the system constantly. (para. 2.2.5)
  - Oversee the implementation of the system even in areas where JDIMP does not have any direct responsibility for action to ensure data system continuity and effectiveness.
  - In co-operation with the science panels, identify gaps and deficiencies in the end to end data system as opposed to gaps in, for example, the observation systems which are not in our terms of reference.
  - Co-ordinate amongst relevant data and information management activities within the G3OS to ensure maximum effectiveness and exchange of relevant information.
- Co-ordinate with other international groups concerned with data and information management (e.g. CEOS, IGBP, WMO).

- **Group II (Measurements, Collection/Data Assembly, Integration into Database, Data Archaeology, Data Product Generation)**

Measurements

- Build on existing systems/expertise.
- Diversity of data and measuring techniques.
- Metadata essential i.e. documentation of observation procedures, types of instrument, initial quality control….
- Carried with data.
- Verify metadata in place (Information Center).
- Interact with programme groups to define necessary metadata requirements.

Collection/Data Assembly, Integration into Database

Clarification - of "steps" in process
- integration/merging

- Distributed process.
- Data centre functions.
- May not involve (hierarchical) centres.
- Metadata (description of data set) to Information Center.

Data Archaeology

- Historical data should be identified where it is of use to G3OS (science programmes).

- Historical data with no metadata should be flagged but not necessarily rejected.

Data Product Generation

- Defined by panels/programmes.

Other

- Quality control/assessment not JDIMP business.
- Integration of G3OS data is required; what is role of JDIMP? Guidelines/recommendations? e.g., time and location data.

- **Group III (Data & Product Distribution to Users)**

  - Timetable and actions items in Annex 1 should be updated regularly.
  - Flow diagram up front based on the Wilson diagram.

  Data and Product Distribution

  - GOLDIS - still required as is GEDS (Guide to Environmental Data Sources), inventory to order data from a centre on an offline medium. There is a question as to whether this is still going to happen as described.
  - There needs to an off-line system and an on-line system. The off-line system should also be available on-line.
  - The names may or may not continue.
  - Is there enough information available to describe these in detail in a plan or only the framework so as not to commit to something that may not be implemented as described?
  - The on-line and off-line systems will cover data, products and metadata.
    - Vision paragraph with technical assumptions still needed. Outlook should be five years and assume capability and capacity will continue to increase. Will have higher communication speeds, cheaper computers, DVD etc.
    - However some will still not have access to the most modern technologies.
    - Principles? Data and information will be provided through state of the art agreed or *de facto* industry standards.
    - Metadata is considered to be an integral part of the data and products and access to the various levels of metadata will be facilitated in the development of the data management systems.
    - Inventories of products will have to be maintained on-line and be available on off-line media.

  Feedback (3/4 to one page on feedback)

  - The scenarios should remain in the plan and be updated as already suggested. (Perhaps in an annex.)

Several kinds of feedback

- Timeliness, completeness of data flows, is the system working?
- Data, data products, algorithms, standardised (if possible) feedback on quality, usefulness, application, consequences (published regularly through some centre).
- Feedback on additional user needs.
- User satisfaction.

- Development of feedback systems should be done in co-operation between JDIMP and the elements of the programs.

Information Center

- The Role of the Center in general terms at this point.
- Contact information.
- Will develop into a distributed virtual center.
- The Information Center provides pointers to all aspects of information on G3OS data management.
- Points to prominent users as a promotional element of the program.

- **Group IV (Archiving, Metadata Products)**

Metadata Issues

- What is metadata?
  - The information about the data contained in data sets which is needed to understand the content and optimise the usefulness of the data set.
- What is a G3OS data set?
  - Meets G3OS needs
    - contains necessary metadata.
  - Identified by relevant scientific panels
    - e.g., AOPC, HOTO, LMR, OOPC, TOPC, ...

Includes relevant historical data sets

- A metadata record is an essential part of every G3OS data set.
- Distinguish between directory-level & archive-level metadata
  - Directory-level metadata is a subset.
- Science programs are responsible for specification of archive-level metadata (JDIMP can assist)
  - Provides additional detail
  - Must be “welded” to the data.
- Key words (directory level)
  - Definition by the three programs

  - JDIMP responsible for co-ordination.
- Stand-alone data-capture & data management software is available.
- Work with other programs in system implementation
  - e.g., IGBP, WCRP, CEOS members.

- G3OS programs should actively encourage the use of directory-level metadata as defined in the guidelines.
- The G3OS Information Center will use the directory-level metadata to aid users in locating and obtaining data sets.

Archiving Issues

- All G3OS data should be regularly forwarded to and maintained by at least one designated archive facility.
- Each facility should as a minimum
  - Guarantee indefinitely:
    - data integrity & long-term survival
    - that metadata are preserved with the data
  - Ensure that critical data are duplicated.
- Data sets should not lose their identity as a result of the archiving process
  - Archive facilities should be able to retrieve data sets and their associated metadata as received at the archive.

Annex D-V

Proposed Terms of Reference for JDIMP

1. Terms of Reference (approved by GCOS JSTC and submitted to GOOS SC)

Recognizing the need for a comprehensive approach to formulate, implement, and oversee data and information management of the global observing systems, the JSTC of GCOS, the GOOS Steering Committee (GSC), and the GTOS Steering Committee (SC) have established a Joint Data and Information Management Panel (JDIMP).

The data and information management system for the global observing systems, G3OS, should be developed, to the degree possible, to accommodate data and products from the various components of the global observing systems. To do so, the JDIMP should consist of a core group of members representing the various global observing communities, as well as representatives from contributing disciplines, programmes, and agencies. The JDIMP should possess a broad range of expertise including research scientists, who use and understand global data sets, and data and information management experts responsible for significant components of existing operational and research global information management systems. The JDIMP should be a highly focused "problem solving" group, concentrating on resolving crucial issues affecting the quality and maintenance of global observing system data sets, and access to them. Particular agenda items may require additional experts be invited.

Terms of Reference:

- In concert with the G3OS science requirements and associated user communities, formulate and develop the G3OS Data and Information Management Plan(s);

- Monitor the overall implementation of the data-related elements of the plans;

- Make reports and present recommendations, as required, to the JSTC, GOOS, and GTOS SC on information management issues.

The JDIMP has the following specific responsibilities:

- Based on requirements from the science panels and user communities, to solicit data sets relevant in meeting the G3OS objectives;

- To identify gaps in available G3OS data sets and co-ordinate efforts to redress data deficiencies;

- To consider and develop a process whereby data sets may be identified and included as "G3OS 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, or standards appropriate for specific applications,
- that the data contain documentation (metadata) of a standard allowing adequate appreciation of the data quality;

- To identify the cross-cutting data and information management themes and establish a practical framework (e.g., metadata guidelines, information centre requirements, etc.) for these activities within the observing systems;

- To review, advise on, and provide oversight of the G3OS information management system(s) to ensure for example:
  - that access to data and products is provided as required,
  - that archiving activities are adequate.

2. Terms of Reference (modified by GOOS SC)

Recognizing the need for a comprehensive approach to formulate, implement, and oversee data and information management of the global observing systems, the JSTC of GCOS, the GOOS Steering Committee (GSC), and the GTOS Steering Committee (SC) have established a Joint Data and Information Management Panel (JDIMP).

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- In concert with the G3OS science requirements and associated user communities, formulate and develop the G3OS Data and Information Management Plan(s);

- Monitor the overall implementation of the data-related elements of the plans;

- Make reports and present recommendations, as required, to the JSTC, GOOS, and GTOS SC on information management issues.

The JDIMP has the following specific responsibilities:

- Periodically review the G3OS data and information management plan(s) and principles of monitoring as required, commission studies needed by specific observing system components,

- Review adherence of G3OS to cross-cutting principles of data and information management,

- Advise on implementation of data and information management as requested by the senior science committees and sub-panels of the G3OS, to ensure that, for example, data and products are provided as required and archiving activities are adequate,

- Act as a G3OS focus in relation to policy issues, e.g., proposals and actions threatening the availability of environmental data;

Consider studies commissioned by specific observing system components and the implications for G3OS data and information management.