Weltdatenbank Abfluß
Bundesanstalt für Gewässerkunde
Koblenz, Deutschland

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Report No. 17

Report on the Third Meeting of the GRDC Steering Committee, Koblenz, Germany, 25 - 27 June 1997

September 1997

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1. Opening of the meeting

1.1 The Third Meeting of the Steering Committee (SC) of the Global Runoff Data Centre (GRDC) convened in the Conference Room of the Federal Institute of Hydrology (FIH) in Koblenz on Wednesday, 25 June 1997 at 9:00 a.m. The meeting was formally opened by the chairman of the GRDC-SC.

1.2 In his welcome address, the President of the Federal Institute of Hydrology, Mr. V. Wetzel, addressed the participants of the SC. Mr. V. Wetzel reiterated the continued support of FIH for the GRDC to further enable the Centre to fulfill its tasks. Staff and budget will remain constant even under the present reorganization process. Mr. V. Wetzel then wished the Steering Committee fruitful deliberations and progress.

1.3 The chairman of the SC, Mr. H.J. Liebscher, highlighted that the GRDC had been operating now since 9 years at the FIH and had rapidly progressed in the past few years. In a review of the progress of the Centre since 1988, Mr. Liebscher noted the growing demand for recent data and data products as a result of the degree of world-wide recognition of the GRDC as a reliable partner for data users which also enjoys confidence by data providers. Global and regional freshwater assessments, research of global change and the development of response strategies require a stream of hydrological information unprecedented in the history of water sciences. The response of the GRDC to these developments is a formidable challenge for the Centre in the near future.

1.4 On behalf of WMO, Mr. A. Askew thanked the FIH for its kindness in hosting the Third Meeting of the GRDC-SC and the continuing committment of FIH towards the progress of the GRDC, which serves a very important purpose in the Operational Hydrology Programme (OHP) of WMO and the hydrology and climatology community in general. In continuation of its past efforts, WMO is further determined to support the GRDC in any possible way and monitors its growing role in water-related programmes of WMO and other United Nations agencies. The Centre, as an active arm of WMO is needed to increase the field-effectiveness of many WMO and interagency water-related programmes.

1.5 On behalf of WHO and UNEP, Mr. R. Helmer welcomed the efforts of GRDC and the Global Environment Monitoring System - Water (GEMS/Water) of UNEP/WHO to link water quantity and quality issues. He cited from a letter the appreciation of UNEP for the efforts of the Centre to bring different relevant water and assessment activites together.

1.6 The representative of UNESCO, Mr. H. Zebidi, noted with satisfaction the progress made in the collaborative efforts between UNESCO's regionally implemented programme Flow Regimes from International and Experimental Network Data (FRIEND) and the GRDC which demonstrates the sincere efforts of UN agencies to make use of synergistic effects between their water-related programmes.

2. Organization of the work and adoption of the agenda

2.1 The meeting was attended by 11 participants representing 11 organizations. The list of participants is given in Annex 1 to this report. Due to shortage of funds, UNEP was unable to attend but sent a comment with regard to the current situation in water-related matters and especially with regard to the future development of GEMS/Water (Annex 2). The World Bank did not attend the meeting.

2.2 The agenda (see Annex 3) was briefly discussed and adopted.

3. GRDC Status Report 1996

3.1 The Head of the GRDC, Mr. W. Grabs, presented the GRDC Status Report 1996. An abridged version of this report is reprinted as Annex 4 and is published in full version as GRDC-Report No. 13. In his report Mr. W. Grabs highlighted four key activities of the GRDC in the previous two years:

3.1.1 Acquisition of hydrological data, where the data flow to the Centre continues in full swing from many countries of the world. The database has almost doubled in the past two years. Several countries however lag behind in data deliveries for various reasons. The GRDC is seeking ways to improve the participation of hydrological services and other insitutions to join the efforts of the Centre to acquire global coverage in hydrological information. Top priority in this respect is the assembly of overlapping time-series for the major rivers of the world and those stations close to the mouth of rivers into the oceans which are needed for global freshwater flux studies.

3.1.2 User services have considerably been expanded. The number of requests is now ten-fold that of from 1993 and the line of products and flexibility to respond to user requests has significantly increased. The improvement of the database system, adjoining software tools and the partial automatization of several database functions, including improvements in handling user requests, have contributed to this success.

3.1.3. The linkage with water programmes and projects of WMO and other UN agencies such as the World Climate Research Programme (WCRP) of WMO, ICSU and IOC, the World Hydrological Cycle Observing System (WHYCOS) of WMO, FRIEND of UNESCO, GEMS/Water of UNEP/WHO and the active participation in a number of projects and freshwater assessments demonstrated the link function of GRDC in this respect. However, the budgetary and manpower capacity of GRDC puts a constraint on the expansion of this important activity area.

3.1.4 Research aspects of GRDC work were pursued noting however the priority areas mentioned above. The publication of a report of freshwater fluxes from the continents to the oceans, calculation of freshwater fluxes to the Arctic Ocean and the support of research with data products rather than only raw data were appreciated in the science community. Due to the setup of the GRDC, research can be pursued further when defined research is outsourced to scientists with the guidance and under the umbrella of GRDC.

3.2 Emerging issues were discussed in detail under subsequent items of the agenda.

4. Resolutions of the WMO Executive Council (EC) relevant to the GRDC

4.1 The decisions of EC-XLIX (June 1997) with regard to the exchange of hydrological data are central to the operation of the GRDC in its role as service provider.

4.2 Mr. A. Askew reported on this subject: The Tenth Session of the WMO Commission for Hydrology (CHy-X), Koblenz, 2-12 December 1996) had prepared a Draft Resolution for the Exchange of Hydrological Data which had subsequently been endorsed by EC-XLIX in May/June 1997. This resolution is formulated in parallel to Resolution 40 (Cg-XII), governing the exchange of meteorological data. The draft resolution together with supporting material is attached to this report as Annex 5. Mr. A. Askew also related the thanks of the Executive Council for the work of GRDC.

4.3 The draft resolution is the basis for the amendment of the GRDC Guidelines for the Dissemination of Data and Costing of Services (see item 5 below).

4.4 The Steering Committee noted with interest the information provided by Mr. A. Askew that the GRDC at present is the only data centre operating under the auspices of WMO which has a defined policy on the acquisition and dissemination of data and that no major change to the policy was necessary as a response to the decisions taken by the Executive Council of WMO and also the Intergovernmental Council of the IHP of UNESCO.

4.5 In discussing the material produced by EC-XLIX, SC discussed at length the "Draft Principles governing access to data held in WMO World Data Centres" (see Annex 5, item 12.1, EC-XLIX/PINK 33, APPENDIX, p.8). Item 2 of the draft principles in particular was not clear to the members of the Steering Committee who raised the following questions:

a) What is the meaning of "Common Ownership"?
b) How is "Common Ownership" exercised?
c) Is the data source/data provider the data owner or not?
d) Does the ownership relate to the data or the entire database?
e) Are WMO Members jointly responsible for each datum? Is it the responsibility of "owners" to correct potential errors, providing additonal information relating to the source, etc.?
f) How is the original data provider recognized?

4.6 In contrast to the term "common ownership", the GRDC's policy is that: "GRDC does not infringe on the ownership rights on the data transmitted to the GRDC by data providers." The GRDC-SC noted, that for the above mentioned reasons, the term "common ownership" is misleading and may dissuade data providers from transmitting data to the GRDC. SC therefore recommended that the GRDC statement be used as an alternative to item 2 of the "Draft Principles".

4.7 SC also commented that in defining principles of data exchange in hydrology, care should be taken of the need to build confidence amongst data providers that their data is not misused for purposes which are not in the interest of the original data providers.

4.8 Mr. H. Zebidi reminded the group that the freshwater assessment is very important in this context. He related this issue to the resolution of the Intergovernmental Council for the International Hydrology Programme (IHP) of UNESCO, where Member States are invited to review their exchange of hydrological data. The establishment of a joint WMO/UNESCO working group on the exchange of hydrological data has been recommended.

4.9 On behalf of the World Climate Research Programme (WCRP), Mr. H. Grassl expressed his firm opinion that the exchange of hydrological data and information will be strongly influenced by space agencies which are already dominating the exchange of meteorological data. Mr. Grassl further expressed the hope that discharge measurements via satellite may be possible in the future, too, in extension of current sensor capability to determine lake and reservoir levels using altimetric methods.

5. GRDC Policy Guidelines for the Dissemination of Data and Costing of Services

5.1 The GRDC Policy Guidelines are central to the operational activities of the Centre as a service provider of discharge data to users.

5.2 Matters of the exchange of hydrological data and related information have gained top importance on all levels as the access to hydrological information on a national, regional and global basis is vital for science, research, monitoring and assessment of hydrological variables, the understanding of the interaction of land - ocean - atmosphere processes and water resources management.

5.3 Opinions range from free and unrestricted access to hydrological data to access with severe restrictions. The GRDC, in its policy guidelines, follows a concept of "controlled access" to hydrological data. In this respect, reference was made to the relevant resolutions of WMO as well as UNESCO and the data policy by IGBP and the World Data Centres of ICSU which are attached to this document in Annex 6.

5.4 The GRDC Policy Guidelines have been prepared following a recommendation of the first meeting of the Steering Committee in 1994 (item 10.10 (GRDC-SC1). The Policy Guidelines were subsequently been endorsed by the Steering Committee in 1995 (item 11.2 (GRDC-SC2) in consent with the WMO Secretariat.

5.5 Noting Resolution 40 (Cg-XII) of WMO Congress with regard to the exchange of meteorological data and Resolution 21 (Cg-XII) on the Global Runoff Data Centre, and recognizing the draft resolution on the exchange of hydrological data prepared by CHy-X (December 1996), the Steering Committee reviewed the existing policy guidelines of the GRDC and recommended necessary amendments.

5.6 The Policy Guidelines were harmonized with the recommendations and resolutions of WMO and UNESCO. The revised GRDC Policy Guideline is contained in Annex 7 of this report.

6. World Climate Programme - Water (WCP-Water)

6.1 The purpose of the WCP is to provide an authoritative international scientific voice on climate and climate change and to assist countries to apply climate information and knowledge to national sustainable development and to the implementation of Agenda 21 and associated instruments in order to achieve the maximum possible benefit for national economies and social welfare. Four major components are embraced by this programme: the global atmosphere, the world ocean, the cryosphere, the land surface of the continents and its surface runoff and groundwaterflow systems.

6.2 The GRDC contributes to this important programme of WMO mainly through two projects: **Project A.5 Collection of Global Data Sets**, and **Project A.8 Detecting Global and Regional Runoff Trends by Monitoring Discharges of Selected Rivers**. In Annex 8, the projects, outputs and future GRDC activities are summarized and the links between WCP-Water and the GRDC illustrated.

6.3 The group was briefed by Mr. A. Askew about the results of the Seventh Planning Meeting of WCP-Water which took place from 13-16 May 1997 in Koblenz. In essence, a panel will discuss the future organization of WCP-Water to make it more efficient in its strive to meet the objectives cited above.

6.4 SC noted the role of GRDC as a key service provider for WCP-Water projects and other WCP - Programmes. In this respect, GRDC has the role of a subprogramme rather than a project within the WCP-Water programme. SC also noted the strong link to GPCC in the programme.

6.5 Mr. W. Grabs commented that the acquisition of data is not only for large rivers but also for important rivers in the context of socio-economy, transboundary issues and research -related issues, e.g. in the case of rivers flowing into wetland areas, closed basins and the oceans. It is therefore necessary to also consider - on a selective basis - the inclusion of smaller river basins into the database.

6.6 Mr. H.-J. Liebscher supported this view with respect to the increasingly better resolution of climate models and decreasing grid-size for meteorological and hydrological modeling as a result of increased computer performance.

6.7 Mr. H. Zebidi remarked that in data deliveries the term "Operational hydrology" could be replaced by the term "catchment hydrology" to avoid ambiguity with regard to the desire to avoid the use of GRDC data for commercial purposes.

6.8 The use of statistical software packages, such as that developed by WMO under WCP-Water Project A.2, was discussed. Several of the current routines should be amended and the software package probably be enhanced. SC took note of a recommendation of the WCP-Water planning meeting to organize a workshop where experts in statistics and hydrology are expected to make necessary recommendations for amendment of the current software package. The Institute of Hydrology, Wallingford is ready to host the meeting which will probably be funded by WMO and UNESCO in 1998. These statistical routines are used by GRDC as standard software in regional/global hydrological assessments.

6.9 The group discussed issues of data rescue. The GRDC incorporates historical data and thus contributes to data rescue efforts, however not in a pro-active way, as GRDC's focus is increasingly to obtain recent hydrological data. Mr. H. Grassl commented that within WCP there is no formal project for the rescue of hydrological data and explained that ideally WCRP could help to collect such data and transfer them to the data centres.

6.10 On behalf of the Government of Japan, Mr. T. Kinosita recommend that increased efforts should be made to intensify comparative hydrological research, for example in the context of WCP and WCRP. This view was welcomed by SC.

7. World Hydrological Cycle Observing System (WHYCOS): Status of regional implementation and participation of the GRDC.

7.1 WHYCOS is a regionally implemented programme, with a thrust to provide near real-time, quality controlled data. WHYCOS is being developed by WMO with the support of the World Bank and other funding agencies. WHYCOS has the potential to serve as a vital data provider for the GRDC in the near future. It is therefore very important for GRDC to participate in WHYCOS activities from early stages onwards. Presently, two WHYCOS components are in advanced stages: In the Mediterranean region (MED-HYCOS) and in the Southern African region (SADC-HYCOS) are in the planning and implementation phase, others (e.g. BALTEX-HYCOS) are in various stages of planning. With regard to MED-HYCOS, GRDC is actively involved; after the tender phase for SADC-HYCOS is closed, GRDC intends to cooperate with SADC-HYCOS from its starting phase onwards. Following the briefing, the SC discussed a strategy how to develop operational, institutionalized links with regional HYCOS projects to ensure the transfer of hydrological data to the GRDC.

7.2 The group shared the view that WHYCOS has great potential as principal source of near real-time hydrological data for GRDC, especially for monitoring global runoff on a daily basis. Backed by Resolution 21 (Cg-XII) which encourages Members:

"to support the GRDC through the provision of hydrological data and related information that it needs, including through the regional components of WHYCOS;.."

the SC requested GRDC to liaise with the WMO Secretariat and the regional HYCOS offices to establish an institutionalized data transfer to the GRDC. The Committee stated that the regional HYCOS projects have a regional priority. However, the GRDC is the ideal link for regional HYCOS projects to become a truly global WHYCOS.

7.3 The potential of WHYCOS is seen as complementary to the efforts of GRDC to obtain data and information from national hydrological services, river basin authorities and other official sources.

7.4 The SC proposed that GRDC (quantitative discharge data) and GEMS/Water (water quality data) can serve as global repositories of data generated through WHYCOS.

8. UNESCO project Flow Regimes from International and Experimental Network Data (FRIEND). Status of Regional Implementation and links with GRDC activities

8.1 The representative of UNESCO, Mr. H. Zebidi, briefed the group about current developments of this programme and stages of its regional implementation. In the case of the recently established FRIEND - Hindu Kush Himalaya project, the GRDC has been tasked to establish the regional database for this FRIEND component. Mr. H. Zebidi emphasized the importance of data generated from FRIEND projects, especially for research and increasingly also in connection with assisted self-help of collaborating national Hydrological Services to improve their professional and research capacity.

8.2 In his function as Secretary of the German National IHP/OHP Committee Mr. K. Hofius informed the SC about the financial and technical support which the German National IHP/OHP Committee is rendering to the FRIEND-Hindu Kush Himalaya project.

8.3 The representative of FRIEND - Northern Europe, Mr. G. Rees, explained the structure of regional FRIEND projects and basic working groups which are established to perform research with FRIEND data. Data are restricted to members of the established FRIEND working groups and are not generally accessible.

8.4 In this respect, the UNESCO Intergovernmental Council for the IHP resolution XII-4 (included in Annex 5 to this report) will possibly alter this approach. The resolution requests the national IHP committees to work with the hydrological services to make hydrological data accessible. Mr. H. Zebidi acknowledged the need to establish a framework for the exchange of data between FRIEND and GRDC and to overcome the constraints of data ownership.

8.5 SC noted the UNESCO resolution and the remarks made by Mr. H. Zebidi and urged UNESCO and WMO to discuss this matter in depth in the joint WMO/UNESCO working group (referred to in 4.8 above) for the benefit of GRDC and FRIEND.

8.6 Discussing a strategy to liaise with regional FRIEND projects to exchange data and other relevant information, UNESCO agreed to back efforts of the GRDC to negotiate with each regional FRIEND project to access regional data through regional FRIEND liaison offices. It is recognized however, that GRDC in many cases may need to obtain data and information directly from the national hydrological services, river basin authorities and other official sources. In any case, FRIEND data which are also published in yearbooks or published in electronic formats should be made accessible to GRDC.

8.7 GRDC has the vision that regional components of FRIEND (in addition to regional HYCOS projects, see above) may contribute to the global picture of discharge monitoring and scientific use of the data within the framework of global hydrological monitoring as envisaged within the Global Terrestrial Observing System (GTOS) and the Global Climate Observing System (GCOS).

9. Cooperation with the Global Terrestrial Observing System (GTOS)

9.1 The SC was briefed about the progress of GTOS by Mr. W. Grabs who is a member of the GTOS Steering Committee. Selected information about GTOS is attached to this report as Annex 9.

9.2 Taking note of the progress so far achieved in GTOS, SC commented on the sound science and information concept of GTOS which was seen as a unique opportunity for innovative information derived from a truly integrative concept of data assimilation and related analysis of terrestrial environmental conditions, processes and the monitoring of trends as part of impact identification under global change conditions.

9.3 Discussing this item further, SC commented that it might be difficult to implement the entire programme with the full (broad) scope; especially because a market analysis for users of the generated products and services provided by GTOS seems not to have been undertaken so far. Such an analysis may be necessary as proof to donors of the need of GTOS. The implementation would seem to be easier, if GTOS would be implemented in several pilot phases/projects and - after a defined time - amending the programme in accordance with the experiences gained in the pilot phase.

9.4 GRDC is of potential value to GTOS, but GTOS has to clearly define its data needs and what GTOS intends to actually do with the data and information. GRDC could support GTOS through WCP-Water Project A.2 through the analysis of long time-series of discharge. GRDC is prepared to actively assist in shaping the surface water component of GTOS in collaboration with other water-related organizations. The GRDC has offered to participate with its hydrological database, especially for global monitoring of discharge. Presently, 161 stations have been identified by GRDC which could serve as a first step to a global monitoring system in hydrology.

9.5 GTOS is requested to be of assistance to the GRDC by promoting the need for the establishment of a global research observing system of surface fluxes into the oceans.

9.6 On the recommendation of Mr. R. Helmer, as representative of GEMS/Water, SC requested GRDC to represent the interests of GEMS/Water with regard to global water quality monitoring in GTOS, where appropriate.

10. Overview of the use of regional/global hydrological data: Past uses and expected trends

10.1 The access to hydrological data, and the emerging policy to disseminate data and related information, affects directly regional and global research projects and freshwater assessments. Increasingly, hydrological data are needed to synthesize regional and global water balances and to identify areas of water surplus and deficit.

10.2 Three areas of main interest for hydrological data are evident: The climate and ocean community, including research in large-scale hydrological modelling; regional and global freshwater assessments, including land-based sources of pollution; and research/work in operational hydrology, on a basin scale and increasingly in transboundary river systems.

10.3 A strong hindrance in the assembling of global assessments is, that most time-series of large rivers are not overlapping and important studies of the variability of surface water fluxes and regional/global availability of freshwater cannot be conducted. The closure of this data gap will be a key priority of the GRDC in the next interim period.

10.4 With regard to the use of data supplied through the GRDC, the table below gives an indication of the change in the use of the data. About 57% of the requests are related to regional and global research and climate and ocean related research, mostly in projects concerned with global change and the understanding of the land-ocean-atmosphere processes which govern largely our living conditions on earth. About 24% of requests are related to catchment scale hydrology, which is here used as another term for "operational hydrology", dealing with regional and global availability and variability of freshwater. 19% were information or advisory requests or related to other issues.

Topic	Requests received
Hydrometeorological modeling	1
Operational hydrology	22
Regional/global hydrological issues	20
Climate and ocean related research	31
Information/advisory requests	12
Others	5
TOTAL	91

Table: User profile of GRDC data 1996

10.5 This user profile underlines the multipurpose necessity for the international exchange of hydrological data and related information.

10.6 The SC noted the following trends in use of discharge data:

- Increased use of hydrological information for hydrometeorological modelling and also requests from GEWEX' Continental Scale Experiments (CSE's) in this regard.
- Rapid increase of user requests for applied and operational hydrology
- Emerging trend for the use of data for commercial purposes.

10.7 The Committee noted, however, that the use of GRDC data for commercial purposes is restricted and precisely regulated in the GRDC "Policy Guidelines for the Dissemination of Data and Costing of Services". Mr. T. Kinosita commented that the use of discharge for military purposes should be excluded. GRDC assured the Steering Committee that the policy of "controlled access" to hydrological data and the feed-back between data providers (e.g. hydrological services) and the GRDC is a reliable safeguard to prevent military misuse of these data.

11. International transfer of hydrological information for scientific and operational uses: Emerging issues

11.1 The increase in regional cooperation projects, for example under the auspices of WHYCOS as well as UNESCO's FRIEND projects, leads to the development of distributed hydrological databases. The access mode to these databases and agreements to transfer data to the GRDC differs and sometimes it seems easier to obtain data directly from the (national) hydrological services than from a regional database.

11.2 SC noted that the increasing demand for hydrological data is by far not matched by access to and availability of these data. For many projects undertaken under United Nations auspices, the global coverage of hydrological information and long overlapping time-series, as well as the institutionalized data transmission similar to that of the World Weather Watch Programme (WWW) of WMO, is an indispensible pre-requisite. The same holds true for global freshwater assessments, e.g. for the Commission for Sustainable Development (CSD) of the UN.

11.3 A prominent issue is the severe restriction which several countries put on the access to and the dissemination of data. SC reviewed relevant resolutions of WMO and UNESCO (with regard to FRIEND) with a view to implementing these resolutions to overcome evident problems in data acquisition.

11.4 In analyzing some of the pertinent problems, SC commented that an effective barrier for national services to participate in hydrological data exchange is the lack of "shareholder recognition" of these services and their governing bodies. In the case of WMO, the transfer of information through official channels of WMO and the water agencies is problematic because of insufficient national communication channels between different ministries under which national meteorological and hydrological services operate.

11.5 The SC recognized an emerging need for awareness and sensitivity campaigns on the levels of hydrological advisors, hydrological services and national governments to participate actively in exchange of hydrological data and information. The adoption of Resolution 40 (Cg-XII) has been a step forward in the direction of an information society in this respect. This trend is underlined by the draft resolution proposed by CHy-X on the "exchange of hydrological data". The GRDC, as an operational service provider for global hydrological data has an important role to spread the word of the necessity for hydrologcal data exchange but needs strong backing by the relevant UN bodies and national governments and services which already participate in the exchange of hydrological data and information.

11.6 The SC felt that this issue should be systematically addressed in a strategic inter-agency approach to information management which offers pragmatic options.

11.7 In line with the high priority of freshwater issues and the dire need for hydrological data, SC commented that it was high time to leave national boundaries in data exchange and think in regions and regional development, and the need for a global outlook on freshwater availability and management.

11.8 Starting points are projects such as WHYCOS and FRIEND, the Continental Scale Experiments (CSE's) of the Global Energy and Water Cycle Experiment (GEWEX), but also working through regional economic bodies such as EU, ECA, ECLAC, ESCAP[1] and others.

11.9 In addition to the past and expected trends for data uses (see item 10 above), the Committee identified several emerging issues for data acquisition and use:

a) In addition to historical time-series of discharge, recent hydrological data are planned to be transferred to the GRDC through WHYCOS and probably through regional FRIEND projects. H. Zebidi noted that regional FRIEND groups have established databases of long-term hydrological data, including in many cases extensive spatial data sets.

b) Near real-time hydrological data are urgently needed for regional hydrological forecasts combined with meteorological information. WHYCOS offers an opportunity for the regional realization of a near real-time hydrological observation system. GRDC has the potential to link information from regional observations to achieve global coverage of hydrological observations.

c) Seasonal climate anomaly predictions and impacts on river flow will soon need hydrological data as input for starting fields (e.g. evaporation, soil moisture, lake levels).

d) In accordance with the objectives of WCP-Water, meteorological and hydrological

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[1]European Union (EU), Economic Commission of Africa (ECA), Economic Commission for Latin America and the Caribbean (ECLAC), Economic and Social Commission for Asia and the Pacific (ESCAP)

data have to be evaluated jointly and GRDC should be a strong contributor.

11.10 Mr. H. Grassl commented that space agencies are already able to deliver hydrological data on a global scale such as flooded areas, lake area and level. The remote sensing capability for data acquisition in hydrology should be closely monitored.

11.11 With respect to ***data holdings*** in GRDC the Committee discussed the need to store data other than discharge data in the GRDC without overloading the Centre's capacity. In concurrence with the opinion of GEMS/Water, the SC recommended that the following data should be held at the GRDC: The discharge and sediment database compiled by MILLIMAN et al. in the IGBP/LOICZ[2] project and the Global River Input (GLORI) database compiled by MEYBECK containing discharge, sediment load and selected chemical parameters. These databases are static and can be released to data users under conditions set by the authors of the databases. GRDC would have a host function for these databases. The databases are stored to guarantee their long-term accessibility after the end of the respective research projects/initiatives.

11.12 Mr. K. Hofius recommended to incorporate pan-evaporation data into the GRDC. This would also be a static archive as a data rescue effort for this kind of data. Mr. K. Hofius will find out the availability of these data and the approximate size of the data set. The SC agreed that these data could be held in a seperate data base within the main GRDC database.

11.13 In the mid- to long-term, the SC recommended that GRDC becomes the home for global data of suspended sediment which is vital for hydrological investigations and the water quality community, especially GEMS/Water for assessments of pollution transport rates. GRDC is requested to cooperate with GEMS/Water to facilitate the incorporation of suspended sediment data in the GRDC. There is a strong common interest for collaboration between GRDC and GEMS/Water as a joint contribution to the Land Based Activities (LBA) efforts of UNEP.

12. The Global Precipitation Climatology Centre (GPCC) and links to GRDC activities

12.1 The representative of the Global Precipitation Climatology Centre (GPCC), Mr. B. Rudolf presented a report on recent activities of the Centre, including product development of gridded global monthly precipitation fields and cooperation with the GRDC with regard to common time-series of precipitation and runoff of large rivers. A summary report of GPCC is attached as Annex 10 to this report. GPCC operates on the basis of 6,000 precipitation stations received daily through the GTS system of WMO and additionally 35,000 stations received from meteorological services worldwide. The acquisition of data in an institutionalized way is becoming difficult especially in view of the continuing debates on the commercial value of meteorological data.

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[2]International Geosphere/Biosphere Project / Land/Ocean Interaction in the Coastal Zone (IGBP/LOICZ)

12.2 As with the GRDC, GPCC is ex-officio member of the GEWEX Hydrometeorological Panel (GHP). For the period 1986-1994, gridded precipitation data products are available on the basis of up to 9,600 stations worldwide, based on daily precipitation. A verification product on the basis of about 40,000 precipitation stations is in preparation. Likewise, a GPCC combined product (station data and satellite observations) is in preparation.

12.3 In order to have a common time-series with a larger portion of the GRDC runoff database, GPCC plans to go backwards with the precipitation analysis, possibly to 1961.

12.4 On the basis of joint collaborative efforts between the GPCC and GRDC, GRDC has made available to GPCC a data set on large rivers of the world. With the use of the gridded catchment areas provided by Dr. Taikan Oki, it is planned to make a comparison between GPCC precipitation and GRDC runoff data for selected catchments. Calculation of area-integrated precipitation on large river basins will be the first step. Water balance studies will be initialized in close collaboration with GRDC and with current research in the FIH, under the scientific guidance of Mr. K. Wilke (see also item 17 below).

13. Strategies to synthesize regional and global hydrological activities and exchange of data and information

13.1 Several activities aim to integrate regional and global hydrological activities and seek the support of major data centres to accomplish this work. These activities are university-based and competitive in their search for support from various organizations. However, the entire process seems not to be well coordinated in a way that a consortium of agencies or data centres is coordinating their activities and that there is a joint authorship of the generated products.

13.2 The SC at this point discussed project exposées for the development of a global river and drainage basin archive series (University of New Hampshire) and the development of a digital hydrological atlas of the world (University of Austin, Texas and FAO) and the possible contribution of the GRDC to these activities. The exposées are attached to this document as Annex 11.

13.3 A first step to synthesize information has been the publication of GRDC-Report No. 14, where abstracts of research undertaken with GRDC data have been reprinted. Collaborative research with research institutions undertaking regional/global research in hydrology and related fields is an especially sustainable way to ensure integration of what would otherwise be fragmented efforts. However, such an approach needs coordination which is at present beyond the personnel capacity of the GRDC. The group recommended that the ACC-SCWR[3] could be used as a forum which could coordinate responses of UN agencies to proposals for global data bases and regional/global research studies. In this

[3]Administrative Committee for Coordination - Sub-Committee on Water Resources (ACC-SCWR)

regard, the follow-up to UNGASS [4] would give an opportunity to launch a coordinated UN data and information system (see remark on a strategic inter-agency approach to information management under item 11.7 above).

13.4 The representative of the FRIEND European Water Archive (EWA), Mr. G. Rees, commented that FRIEND is reluctant to disseminate its dataholdings to several other archives if these efforts aim at the build-up of yet another global data archive. FRIEND EWA recognizes GRDC as single point of contact for global river flow; therefore there is no need to duplicate these efforts. The representative of UNESCO, Mr. H. Zebidi supported this opinion.

13.5 The SC discussed this topic also as a matter of principle and commented that:

a) Item 2.6 of the current Policy Guidelines clearly states that "Requests for the entire database or substantial parts of it cannot be entertained". This stand remains unchanged with the amendment of the Policy Guidelines (see item 5 above). Based on this alone, requests which tend in this direction can be declined.

b) The differentiation between genuine research using global data sets and activities which seek to re-publish global data sets, even if these data sets are slightly aggregated, is in practice a sensitive issue. In general, re-publishing of large data sets even if slightly aggregated, should be discouraged. As no data policy can be elaborated to a degree to fully regulate data flow, confidence between data providers, the GRDC and data users is absolutely essential.

c) The SC recommended that incoming requests to GRDC be screened and classified into categories of justified research projects which serve a specific science objective. These requests should be responded to by GRDC as has been standing practice in the past. Requests which aim at data bank build-ups with no or only "cosmetic" value added should be declined.

13.6 Based on the consideration that projects of a similar nature should be implemented in a coordinated way, the SC discussed the project proposals tabled for the meeting (Annex 11) and made the following remarks:

a) The production of a digital hydrological atlas of the world would require a sound identification of users and the participation of organizations who made themselves a name in previous attempts in this respect such as the State Institute of Hydrology, St. Petersburg, Russia. Possibly under WMO auspices and in conjunction with other participating UN agencies, such an atlas could be produced as a joint project between e.g. the University of Texas, the State Institute of Hydrology, St. Petersburg and the GRDC. The product could then be made publicly available.

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[4] United Nations General Assembly, Special Session (UNGASS)

b) The River Archive proposal in a more dynamic format could also serve a useful purpose, but should be managed with a decentralized structure. Each centre could update the archives regularly in its field of expertise. The River Archive project could be implemented through components (hydrology, water quality, lakes etc.) operated at different centres (GRDC, NWRI, ILEC and others). Products should be defined and these products could be assembled together with aggregated data sets. The University of New Hampshire could serve as a catalyst by providing training and software to collaborating centres. NWRI, as collaborating Centre for GEMS/Water, serves as a very successful role model in this respect.

13.7 To respond to the requirement of global hydrological data sets, the GRDC will perform quality control checks of the data set used for the computation of surface water flux to the oceans, update the time series of the data set (about 160 stations) and provide data products. This data set will then be made available, most likely on CD-ROM. Time line for this activity is the first half of 1998. The SC welcomed this idea and suggested that subsequent aggregated data sets and products are prepared by GRDC and made available on request.

13.8 The SC urged GRDC to make every possible effort to update discharge data for large rivers and stations close to the mouth of rivers into the world oceans and closed seas.

13.9 Mr. H. Grassl commented that, for research and monitoring purposes, the establishment of a research network of gauging stations, based on the 160 gauging stations proposed by GRDC, is a high priority so as to obtain vital daily discharge data in near real-time. The SC supported this opinion.

14. Developments in the GEWEX Hydrometeorological Panel (GHP)

14.1 The group was briefed by the representative of the World Climate Research Programme (WCRP), Mr. H. Grassl, about current developments especially with regard to the Continental Scale Experiments (CSEs) and their contribution to the assembly of global data sets, including hydrological data sets. GRDC as well as the GPCC are ex-officio members of the GHP and are ready to respond to the needs of the GHP community for data products. The meeting discussed the contribution of the GRDC to this important panel and possible ways to enhance its effectiveness.

In this regard GRDC expects further initiatives to follow from the third meeting of the GHP-Panel in Sapporo, September 1997. A summary of CSEs is reproduced as Annex 12 to this report.

14.2 The SC identified a number of collaborative tasks between the GRDC and the CSEs. The SC further urged GRDC to define science projects for GRDC together with CSEs, thus setting the scope for collaborative research. In this resepct, efforts should be intensified to attract scientists (from CSEs) to work with the Centre.

14.3 GRDC should make recommendations to CSEs for optimized hydrological time series from rivers within the regional scope of each CSE. In this regard, each CSE should send to GRDC the regional boundary map. As a first step, CSEs are urged to feed back to GRDC optimized data sets. "Optimized" in this sense means that overlapping long-time series of rivers are assembled which serve as a baseline reference for regional (hydrological) intercomparisons.

14.4 To assist CSEs, GRDC should intensify regional and global trend analyses of discharge/runoff. Manpower constraints to accomplish the task were recognized by the SC and GRDC was urged to seek manpower assistance to speed up this important task, which also contributes significantly to project WCP-Water project A.8 (Detecting Global and Regional Runoff Trends by Monitoring Discharges of Selected Rivers). In this respect the SC recognized the synergy between WCP-Water projects and the scientific interests of WCRP in general and the Continental Scale Experiments in particular.

14.5 The Committee noted the efforts of research projects undertaken at FIH in collaboration with GRDC such as the development of a water balance model for continents as a contribution to closing the water budget. The necessity of a closed water budget as a tool for quality control for climate model validation and application is highlighted in item 17 below.

14.6 With regard to quality control of hydrological data, the SC remarked that this is a common task of both GRDC and the CSEs within their regional domain; see item 22 below.

15. Collaboration between GEMS/Water of UNEP/WHO and GRDC. Status of cooperation with regard to the Global river pollutant discharges to oceans (GEMS/GLORI) and the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities (GPA/LBA)

15.1 The representative of WHO, Mr. R. Helmer informed the group about the developments at UNEP and the progress of GEMS/Water. There is an urgency to get a much closer liaison between water quantity and quality in the future, especially for assessment and monitoring purposes of the availability and quality of freshwater.

15.2 The Deputy-Director of the Water Branch of UNEP, Mr. W. Rast, sent a letter apologizing of not being able to attend or send Mrs. Isabelle Vanderbeck as representative due to severe temporary budget constraints. UNEP however sent an explanatory note highlighting the current and exptected future of UNEP's Freshwater Program. This note is reproduced as annex 2 to this report (item 2.2 above).

15.3 Major developments are taking place in the freshwater sector in 1997. A review of activities will take place during the ACC-SCWR in October 1997, where decisions are expected with regard to the definition of the future role of GEMS/Water. These decisions are expected to lead to an enhanced role of the GRDC. The consequences are planned to be discussed in late 1997.

15.4 The GPA/LBA will need river flux data. Under the collaborative framework GEMS/Water - GPA/LBA, the GRDC should link directly with the new Secretariat in The Hague. The mode of cooperation between GEMS/Water, GRDC and GPA/LBA will be worked out at a later stage.

15.5 GEMS/Water intends to establish the GEMS/GLORI database at the GRDC as entry point into the GEMS/Water data exchange system. The decision on the implementation will be made later in 1997. At present, the final GEMS/GLORI publication is pending; the dissemination of the expected publication will be via electronic media.

15.6 The SC took note that UNEP intends to involve GRDC actively in assessments in its Global Environment Outlook (GEO-2) programme.

15.7 Analyzing the available information the SC noted that the GRDC is becoming a major node for the GEMS/Water Information Exchange System, with responsibility now for river discharges, and recommeded that sediment (suspended solids) fluxes should be added later to the database.

16. Information Exchange Systems between agencies and programmes

16.1 The representative of GEMS/Water, Mr. R. Helmer, briefed the group about the GEMS/Water Information Exchange System. The system is currently being implemented on the World Wide Web on the basis of a non-hierarchical system which cross-links key collaborating institutions and data centres with GEMS/Water. The responsible manager of the information exchange system is scheduled to visit the GRDC in early 1998 to establish direct links and expand on the possibilities and options of such a system.

16.2 Up-to-date communication and information facilities are necessary for the GRDC to maintain its high profile and to expand and optimize its services. This relates to electronic linkages and the exchange of information, electronic publishing and electronic access to GRDC data products, which are currently being planned).

16.3 The Committee recommended that GRDC expand on its Web-page facilities, offering also certain data products and insert a News Bulletin which informs users of recent developments.

16.4 During a recent workshop of the International Geosphere-Biosphere Project - Data and Information Systems / World Data Centres (IGBP-DIS/WDC) of the International Council of Scientific Unions (ICSU) in Boulder, U.S.A. it became apparent that no reference data centre for hydrology exists for the IGBP core projects. The IGBP-DIS participants at the workshop recommended that a World Data Centre Hydrology should be created. The GRDC seems an ideal partner for IGBP-DIS. IGBP-DIS will approach WMO to negotiate the cooperation of GRDC as a World Data Centre.

16.5. Mr. A. Askew informed the SC that no formal approach has yet been made by IGBP-DIS to WMO on this matter. The SC took note of this development and recommended that GRDC keeps upreast of the situation. Without pre-empting the negotiations, GRDC should be open to forthcoming discussions in this direction.

17. Research issues of the GRDC in collaboration with existing and planned programmes of WMO and other organizations

17.1 Two research projects are executed at the Federal Institute of Hydrology which are briefly discribed below. Abstracts of the research undertaken are reprinted as Annex 13 to this report:

a) **Transformation of measured flow data to grid points:** The final report of this project has been submitted to the responsible Ministry and an executive summary is being prepared in English. Using the Weser and Elbe (Labe) catchments in Germany, monthly discharge values for the period 1971 to 1980 have been computed on a grid net. A Geographic Information System (GIS) is used as a tool for the computation of these data. Data input to the GIS consists of image processed data sets (soils, landuse etc.) from internationally available sources as well as from a digital elevation map of the cited catchments. The grid size can be customized for projects in climatology and hydrology on regional and global scales. Though the results are encouraging, one of the methods which is based on measured discharge data, requires a station density which is not available in many countries. Another method consists of a water balance model combined with measured discharge data of selected stations.

- Mr. H. Grassl commented that observed discharge is a very valuable dataset because it is observed independantly from meteorological variables and thus is of special value for the verification of Global Circulation Models. Mr. H. Grassl acknowleded that the method presented above can be produced only in regions with sufficient data coverage. However, the research approach presented should be applied in these regions as this would will be of great value for climate modellers.

- The SC encouraged FIH to continue this research approach in collaboration with GRDC and expand it into other regions where the database is adequate.

- The Committee discussed the presentation and noted that the method as described in Annex 13 should be favoured to obtain global scale coverage of gridded-runoff.

b) **The Development of a GIS-supported Water Balance Model as a Tool for the Validation of Climate Models and Hydrometeorological Datasets:** In the ongoing study, a grid-based water balance model is proposed to calculate long term mean monthly and monthly water balance components on a 0.5° x 0.5° grid. Discharge data are used in several steps for parameter estimation as well as validation and verification of the water balance components. The water balance model has so far been applied for a 0.5° x 0.5° grid covering Central Europe. Model validation was carried out for the rivers Rhine, Weser, Ems, Elbe (Labe) and the German part of the River Danube for the period 1971 - 1980. This work is continuing.

o The meeting encouraged the researchers to liaise closely with the GHP - community and FRIEND in particular to progress further in this project.

c) A software tool **"Global Runoff Monitor"** has been developed at the GRDC and is now utilized. The tool allows the visualization of the contents of the entire GRDC database on a continental or global scale using a 1.5° and 2.5° grid, respectively. Classifcation of runoff occuring within grids which contain hydrological information allows the comparison of hydrological time-series in a visual way and serves to identify areas of water surplus and deficit on a comparative basis.

o The group noted the great potential of this tool for comparative monitoring purposes until more sophisticated tools may become available in the future. On the basis of this tool, WMO has asked GRDC to prepare two comparative reports in WMO Regions II and V before the end of the year.

o Mr. A. Askew commented on the valuable work of the projects undertaken, where WCP-Water provided a useful umbrella for the definition of the scope of the research. He mentioned, that the water community had a keen interest in the results of these projects.

18. Review of membership of the Steering Committee, including the possibility of a revolving membership

18.1 Since the Steering Committe has been established in 1994, the modalities of membership have not been explicitly reviewed. Organizational representation, membership of personal members, rotation of members, status of ex-officio members and invited observers were therefore reviewed by the SC in the light of the increased scope of activities of the GRDC and its membership in collaborating programmes and organizations. The current list of members is attached as Annex 14 to this report.

18.2 In discussing this subject the Committee noted that, based on Recommendation 13.2 (GRDC-SC2), ICSU has nominated the Chairman of the GEWEX Hydrometeorology Panel, this time represented by Mr. Grassl to represent ICSU at the Steering Committee meetings of GRDC. The SC then recommended that:

a) GRDC prepares an annotated list of the current membership of the Steering Committee identifying the role of each member and also the role of members speaking for the data providers such as ICSU, and data providers working with the WMO Commission for Hydrology (CHy). GRDC should include also proposals for additional members bearing in mind however, that the Committee should be small enough to be manageable and to produce results directly related to the work of GRDC.

b) It seems important that a representative of WHYCOS and - depending on the outcome of planned negotiations - IGBP-DIS be members of the Steering Committee. IAHS and IWRA were also mentioned as potential members.

c) The annotated list of members and proposals for additional members to be compiled by GRDC should be brought to the attention of WMO, in particular CHy, which would then inform the organizations as appropriate.

18.5 The membership of Prof. Kaczmarek as a personal member should be reviewed at the next Steering Committee. The SC further recommended that GRDC writes a letter to the World Bank asking whether the Bank wishes to retain its seat in the Steering Committe as the Bank has not been able to participate in any of the previous meetings.

19. Situation of co-funding of the GRDC

19.1 The group was informed about the current status of funds and the origin and use of the funds. While the core funding is secured through the support of the Federal Institute of Hydrology, a number of very important activities - including country missions for data acquisition - are mainly financed through third party funds. WMO and WHO have been especially responsive to co-fund GRDC activities on a contract basis with defined deliverables from the GRDC. However, these funds have been insufficient to add manpower to the GRDC on even a temporary basis.

19.2 Based on this situation, the Committee recognized the need to attract third-party funds. It was emphasized, however, that operational activites of the Centre could not be funded with research funds on a long-term basis. In this respect, the Steering Committee reminded GRDC that in 1994, the Secretary-General of WMO had written a letter to the German Federal Ministries of Transport and Environment, acknowledging the generous core support for the Centre and emphasizing that additional funds were needed to enable the Centre to adequately respond to the growing international requirements. This communication line should be taken up again.

19.3 GRDC should continue to approach WMO, WHO, UNEP and other organizations for support of specific activities, such as country missions, support of GEMS/Water, and the preapration of special reports.

20. Research and the issue of seconded experts and collaborating institutions

20.1 The main role of the Centre is that of an operational service provider for river discharge data and related data products for science and research. A balance has to be found between this main function and research undertaken at the Centre. It is clear that, under the present circumstances, full research activities can only take place with an expansion of the manpower base and collaborative efforts with research institutions. The SC discussed at some length the role of seconded experts and collaborating institutions in GRDC-relevant tasks, issues of contracted works and the financing of seconded experts and made the following suggestions:

a) With regard to research, use should be made of the synergy with the FRIEND community in research and capacity building of hydrological services.

b) Research undertaken in the CSEs of GEWEX also offers great potential for scientific work in collaboration with the Centre. The CSEs are therefore invited to take the lead in proposing concrete sub-projects and activities.

c) As regards GRDC's own principle areas of research, these should be identified by the GRDC. The two research projects undertaken in the FIH (see item 17 above) are valuable starting points which can be expanded for the benefit of projects related to WCP-Water, WCRP (mainly through support of GEWEX) and specific meso- and macroscale hydrological modelling research projects including the development, validation and application of coupled land-ocean-atmosphere models. Research which contributes to the improvement of quality control of hydrological data is also of high importance.

d) Along its present efforts, visiting scientists should be actively encouraged to work with the GRDC in Koblenz. This should be widely announced e.g. through the Internet, specifying various research topics.

e) The SC concluded that a combination of service provision, own research, collaborative research and the outsourcing of research to collabortaing institutions and visiting experts could support the GRDC and also FIH in its efforts to build up a role as a "Centre of Excellence".

f) In his function as Head of Section "Water balance computations and hydrological forecasts" at the FIH, Mr. K. Wilke expressed his committment to further encourage and guide GRDC-related research in his section. He also commented on the technical backstopping of the GRDC with manpower from his section and the fruitful results of this intra-agency cooperation.

21. From discharge data to hydrological information: The GRDC between requirements and operational constraints

21.1 Typical data requests ask for data sets of a few up to several dozen data sets, in very few exceptional cases up to about 200 station datasets all over the world. There is pressing need to develop a larger array of data products which is of use for the user-community. One of the ever-present requests is to release large data sets. This is, for various reasons, problematic and is currently not possible. However, data products as an aggregation of the raw data could allow the release of valuable hydrological information. Hence the GRDC should develop global hydrological information products without releasing the entire database. Increasingly, hydrological information will be based on Geographic Information Systems. Acknowledging the "Controlled Access" mode for hydrological data (see item 5.3 above), the SC took a pragmatic view on this issue and made the following recommendations:

a) GRDC should define an expanded suit of standard data products which can be made available. Certain data products such as annual hydrographs including tables, mean flows, flow duration curves, summary statistics for single stations etc. could be advertised on the Web and made accessible.

The problem of security and data misuse/abuse has to be tackled prior to active advertisment under the umbrella of the adjusted Policy Guidelines (see item 5 above).

b) The Deputy Head of GRDC, Mr. M. Hils, recommended that global data sets should be announced and disseminated upon written request in order to continue GRDC's stand of controlled access to data and information. After quality check of the data set, an announcement should be made in the GRDC homepage that a standard data set of 160 stations of rivers discharging into the world oceans (e.g. monthly values) is available on request which is supplemented by data products. This view was shared by the SC.

21.2 Mr. W. Grabs informed the meeting that data products to supplement the global data set are currently being produced. These include for example flow duration curves and variability diagrams.

21.3 The application of Geographical Information Systems for the generation of information should be used more widely in the GRDC. The augmentation of time-series of discharge with spatial data has also an important research aspect. The SC however acknowledged the shortage of the present capacity (manpower and resources) of the GRDC to achieve a breakthrough in this matter.

21.4 Mr. W. Grabs informed the SC of the extensive use by GRDC of the GIS- based RAISON system, developed by the GEMS/Water collaborative Centre in Burlington, Canada. RAISON is routinely used for the generation of informative data products.

21.5 In research projects of regional and global nature, GRDC should intensify its role as cooperative partner rather than as data provider to projects. In this respect the GRDC could be made more attractive to users. A balance should however be found between the GRDC being an operational centre (service provider) and a research centre.

22. Quality control of GRDC data

22.1 A presentation was made by GRDC about the status of quality control at the GRDC, using a plausibility check tool for the graphic assisted recognition and correction of data errors. An in-depth quality control of hydrological data is, however, not possible without full information about the gauging station, the rating curve of the station and the primary data processing procedures of each data provider. The assignment of "Error Bars" on the basis of this information would be unique for each station. However, the definition of error bars for a gauging station will be almost impossible in many cases. Every point of the discharge rating curve would have to be checked. GRDC is not in a position to obtain all necessary information to perform this task.

22.2 The Committee discussed difficulties in quality control of hydrological data in comparison with point data in meteorology. For any given catchment, the flow measured at the gauging station is the only direct measurement of water resources within the catchment. Point measurements (e.g. precipitation) are subject to areal interpretation and unless the network is truly representative (e.g. in terms of altitude, exposure, etc.) the margin of error will be considerably higher than measurements of riverflow.

22.3 The SC recommended that the present pragmatic approach should be followed where the responsibility for data quality lies with the data providers at the level of each station. Data providers should be encouraged to supply station information and rating curves and a qualitative rating of the data quality of each station. Further steps for quality control can be the expansion of useful functions added to the plausibility tool and also the reaction to errors flagged by data users. The latter option has been useful in the past to detect and correct data errors. With the progress of the development of the Grid-based validation model for hydrometeorological data (see item 17 above), modelling offers another effective approach to detect data errors. In this approach quality control is expected to go a long way forward towards obtaining a closed water budget for regions, continents and the globe. *To achieve a closed water budget is a topmost priority of WCRP projects, meso- and macroscale modelling (hydrology and climatology) and a large number of activities aiming at the spatial and temporal assessment of the availability of water resources.*

22.4 The SC noted that quality control is a task for GRDC and CSEs where CSEs are in a position to feed back to GRDC more complete and quality-checked data sets. The Committee further recommended that CSEs should play an important role in data checking while modelling and also in flagging errouneous or suspicious data.

22.5 Based on item 10.3 of the report of its second meeting, the Committee suggested that GRDC and FRIEND make available to each other experience and software to cooperate in the quality control of data and furthermore in the analysis of hydrological data. In the latter respect the meeting noted the interest of GRDC in using the HYDATA for WINDOWS software of the Institute of Hydrology, Wallingford in a collaborative undertaking.

22.6 Considering the issues discussed above, the SC agreed that the establishment of a special working group for quality control of hydrological data, which has been recommended under item 10.6 (GRDC-SC2), may not yield the results desired. However, if need arises, e.g. for special projects or more prominently in the progress of work of the CSEs, GRDC should call for an ad-hoc meeting of experts in the field to discuss quality assurance issues.

23. Establishment of a "transmission belt" between national hydrological services and regional/global freshwater programmes: Conceptional and implemention issues

23.1 Hydrological services of the world are, with a few exceptions, not involved in regional/global assessments. Only through a participatory approach can the interest of these services be won to actively contribute to regional/global programmes. The linkage of the services themselves e.g. through e-mail and Internet (where available!) and, more specifically, the linkage of the services with regional/global programmes is a high-priority objective in this respect.

If a change of perception can be generated among the Hydrological Services, they will become partners in an evolving service-based hydrology community.

23.2 Compared with Meteorological Services, the SCnoted that hydrological services are still lagging far behind in the recognition of regional and global linkages of hydrological processes and the access to hydrological data and information. These basic difficulties are also evident in European hydrological services which, in many cases, are still committed to local rather than regional and international links and exchange of information. Mr. H. Grassl commented that an indicator for this rather general picture is that, even in Europe, there is no operational river forecast on a regional level for examaple through TV or other media.

23.3 It is in this context that initiatives and programmes such as WHYCOS and FRIEND provide "chain links" to the transmission belts connecting national with regional and global interests.

23.4 Linking scientific hydrology with the regional and global energy and water cycle is a key activity of the Continental Scale Experiments (CSEs) of GEWEX which are expected to establish close links with (national) data providers. In this context, CSEs are expected to establish operational modes of transferrability of data and information for scientific and research purposes.

23.5. CSEs are important to link science with services on the regional level and across the boundaries between meteorological and hydrological boundaries. In this respect the Committee noted that an important criteria for the acceptance of a regional project as a CSE is that numerical weather forecast centres must be involved. Stepping-stones to build transmission belts are, inter alia:

- Digitization of data and advanced quality control
- Improvement of forecast capacity
- Linkage with atmospheric models of high resolution
- Assistance in the establishment of observational research networks which could later be taken over as part of national/regional operational observation networks across national and institutional boundaries.

23.6 The SC was of the opinion that the establishment of a transmission belt requires that the service capacity of hydrological services be increased. Mr. W. Grabs cited a successful example from Nepal, where workshops have been held to establish the service requirements of user groups ranging from science to road-building to develop service-oriented products by the Department of Hydrology and Meteorology. The meeting noted that the liaison with water resources management groups as a principal user community is one requirement for projects to qualify as a CSE within GEWEX.

24. Outreach of the activities of the GRDC 1997-1999

24.1 Based on the discussions of the previous agenda items, the Steering Committee formulated ***PRIORITY*** activities for the period 1997-1999 and ways for implementation:

a) Systematic region-by-region missions should be further undertaken to strenghten ties with data providers.

b) Closure of data gaps of time series for important rivers and the development of GIS-facilities at the GRDC are seen as top priority activities at the operational level of the GRDC.

c) Determined efforts are necessary to maintain and update the GRDC database system and its hard- and software facilities. Considering the pivotal role and responsibility of the GRDC as the only provider of global hydrological data, the maintenance of the databank facilities are essential for the continued success of the Centre.

d) As a step to strengthen the research capacity of the GRDC, a priority list of research projects should be developed on which visiting scientists can work for a limited period of time with the GRDC.

e) The active participation of GRDC in WHYCOS regional projects is necessary to ensure the delivery of near real-time data for monitoring purposes. In this regard, GRDC can be seen as the link between regional HYCOS projects and thus provide the platform for the global aspects of WHYCOS.

f) The linkage with regional FRIEND projects should be intensified with regard to data exchange and the use of the data, both for research and for application; the latter as a contribution to capacity building of hydrological services. This needs close cooperation with UNESCO and the Institute of Hydrology, Wallingford.

g) The GRDC is encouraged to engage actively in the implementation of the GEMS/Water Information Exchange System that is currently under development.

f) With regard to the data set of 160 stations for the computation of surface water flux to the oceans, WCRP in collaboration with GRDC should propose a research observing system to CLIVAR. This proposal received the strong support from all members of the Steering Committee and should be advertised actively.

g) In their cooperation efforts, CSEs and GRDC, both of which are represented in the GHP should develop active relationships with regard to data exchange, but also in the field of research. It should be considered, whether hydrological research results from several CSEs could be published as GRDC publication(s) under the umbrella of GEWEX - GHP.

h) As surface water fluxes to the coastal areas and the world oceans gain importance on the research agenda, GRDC should strive for a closer collaboration with the Secretariat of UNEP's Global Plan of Action (GPA) and Land Based Activities (LBA).

i) In this regard, a monitoring and assessment workshop on global river flux to oceans could be organized in collabration with GEMS/Water 2nd GPA/LBA on the occasion of the 20-years anniversary of GEMS and the tenth anniversary of GRDC. A possible date for such a workshop would be April or May 1999.

j) The GRDC brochure, currently available in the English language only should be published in French and Spanish as soon as possible. The WMO Secretariat has recently provided the translations. A Chinese, Russian and perhaps a Japanese translation could then follow as an insert into the English version of the brochure.

k) In addition to the use of the "routine" options of GEMS-RAISON software used by the GRDC, the Expert-System of GEMS-RAISON should be implemented to facilitate the generation of "intelligent products" adapted to specific user needs and requirements.

l) The GRDC is encouraged to consider the publication of a booklet on the occasion of its tenth anniversary at the Federal Institute of Hydrology in 1997/98. A wide range of readers should be targetted. In the booklet, the results and achievements should be reviewed, the data-related activities highlighted and the use of the data for research be stimulated. GEWEX and the CSE's are invited to contribute to the publication. The UNEP GEMS/Water booklets could serve as a sample for layout and appearance. Mr. H. Grassl offered the assistance of the WMO layout group for the design and publication of the booklet.

m) The "Gridding-Report" published by the FIH should be re-published in an English language abridged version as a GRDC publication and thus as a direct contribution to WCP-Water.

n) Likewise, a two page + graph summary of GRDC activities should be produced for the WCRP Newsletter and the same material can be used for UNESCO's "WATERWAYS" and IAHS's "Newsletter".

o) Depending on the outcome of expected negotiations between IGBP and WMO, GRDC should establish data exchange mechanisms with IGBP-DIS in the future.

25. Summary of results and principal recommendations

25.1 Results of the discussions and recommendations summarized above were reviewed and adopted. The conclusions made during the session and the recommendations as to the on-going and planned activities of the GRDC will be used as working guidelines in the interim period until the next meeting. The results and recommendations will also be cited in letters and documents to data providers, users, organizations and institutions which collaborate with the GRDC.

25.2 The Head of GRDC will inform the WMO Secretariat of the recommendations of the SC with special emphasis of

- Membership of the GRDC-SC including an annotation to the membership
- Revised Guidelines for the Dissemination of Data and Costing of Services
- Objectives and Terms of Reference of the GRDC

26. Date and location of next meeting

26.1 The date of the fourth meeting was scheduled for June 1999 in Koblenz, Germany, after the thirteenth WMO Congress. The duration should be three days, possibly accompanied by a one or two day workshop highlighting the use of GRDC data. Advance notice of the meeting will be circulated to all members of the SC in the second half of 1998.

27. Closure of Third Meeting of the Steering Committee

27.1 The Chairman, Mr. H.J. Liebscher, thanked the participants for their active role in the discussions of important issues of the GRDC and wished all a good farewell and safe journey home. The session adjourned on Friday, 27 June at 03:00 p.m.

Annex 1

List of Participants

3rd Meeting of the GRDC Steering Committee
Koblenz, 25 - 27 June 1997

List of Participants

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Annex 2

Agenda of the Meeting

Global Runoff Data Centre (GRDC)

Third Meeting of the Steering Committee of the GRDC

GRDC-SC 3

Date : 25 - 27 June 1997
Venue: Federal Institute of Hydrology
Kaiserin-Augusta-Anlagen 15-17
56068 Koblenz, Federal Republic of Germany

Provisional Annotated Agenda

Wednesday, 25 June 1997

9:00 a.m. Formal opening of the third meeting of the GRDC Steering Committee.

Welcome adress by the President of the Federal Institute of Hydrology, V. Wetzel.

Opening remarks by the chairman, Prof. Dr. H.J. Liebscher.

Adoption of the Agenda.

9:30 a.m. **Presentation of the GRDC Status Report 1996.**

Basis for discussion is the GRDC Status Report 1996 which has been circulated earlier. Past activities of the GRDC since 1995 are outlined and emerging issues will be highlighted. These emerging issues can then be discussed in detail under the agenda items below.

9:50 a.m. **Report of resolutions of the WMO Executive Council relevant to the GRDC by a representative of WMO and the President of the WMO Commission for Hydrology (CHy).**

The main topic here is the future policy direction for the access to hydrological data from hydrological services and the dissemination of data to users through the GRDC. The range of opinions tends from free and unrestricted access to hydrological data to access with severe restrictions. The GRDC in its policy guidelines follows a concept of free but regulated access to hydrological data. Relevant resolutions of WMO as well as UNESCO and the data policy by IGBP and the World Data Centres of ICSU are attached to this document in annex 1.

10:10 a.m. Coffee-Break

10:30 a.m. Report about the World Climate Programme - Water (WCP-Water) of WMO. GRDC linkages and contributions.

The group will be briefed about the results of the WCP-Planning session taking place 13-16 May 1997 in Koblenz. The GRDC contributes to the WCP mainly through two projects: **Project A.5 Collection of Global Data Sets**, and **Project A.8 Detecting Global and Regional Runoff Trends by Monitoring Discharges of Selected Rivers**. In annex 2, the projects and outputs are summarized. A point of discussion will be the use of statistical software packages such as the WMO set of programmes which has been updated by GRDC and which can be used. Recommendations are sought which statistical routines should be used by GRDC as a standard in regional/global hydrological assessments.

10:50 a.m. General discussion of the reports.

The discussion is expected to serve as a brainstorming of impressions and ideas of the participants. The consequences of the decisions of the WMO Executive Council on the operation of the GRDC should be discussed. Consequences are likely to centre on the exchange of data and related information.

12:15 a.m. Overview of the use of regional/global hydrological data: Past uses and expected trends.

The access to hydrological data and the emerging policy to disseminate data and related information affects directly regional and global research projects and freshwater assessments. Increasingly, hydrological data are needed to synthesize regional and global water balances and to identify areas of water surplus and deficit. Three areas of main interest for hydrological data are evident: The climate and ocean community including research in large-scale hydrological modeling, regional and global freshwater assessments including land-based sources of pollution and research/work in operational hydrology (on a basin scale and increasingly in transboundary river systems). A strong hindrance in the assembly of global assessments is, that most time-series of large rivers are not overlapping and important studies of the variability of surface water fluxes and regional/global availability of freshwater cannot be conducted. The closure of this data gap will be a key priority of the GRDC in the next interim period.

12:30 a.m. Discussion

12:45 a.m. Lunch

02:00 p.m. The World Hydrological Cycle Observing System (WHYCOS) of WMO, the World Bank and other donors: Status of regional implementation and participation of the GRDC. Links to other global observing systems.

WHYCOS is a regionally implemented programme, jointly developed by WMO and the World Bank. It may serve as a vital data provider for the GRDC in the near future. The group will be briefed about recent developments of WHYCOS. Presently, two WHYCOS components are in advanced stages: One HYCOS in the Mediterranean region and a HYCOS in the South African region are in the planning and implementation phase, others are in various stages of planning. The group is invited to discuss a strategy how to develop operational, institutionalized links with regional HYCOS projects to ensure the transfer of hydrological data to the GRDC.

02:30 p.m. Coffee - Break

02:45 p.m. UNESCO's FRIEND project (Flow Regimes from International and Experimental Network Data). Status of Regional Implementation and links with GRDC activities.

The representative of UNESCO will brief the group about current development of this programme and stages of its regional implementation. The group is invited to discuss strategies to liaise with FRIEND programmes to exchange data and other relevant information. The GRDC has the vision that regional components of FRIEND may contribute to the global picture in the frame of a global hydrological monitoring system envisaged under GTOS and GCOS mentioned above. In this respect, the UNESCO Intergovernmental Council for the IHP resolution XII-4 is of interest which requests the national IHP comittees to work with the hydrological services to make hydrological data accessible (see also annex 1).

03:15 p.m. Cooperation of the GRDC with regard to the Global Terrestrial Observing Programme (GTOS). Role of the GRDC in global river flow monitoring using its database information.

The group will be briefed about the progress of GTOS. The GRDC has offered GTOS to participate with its hydrological database, especially for global monitoring of the discharge situation. Presently, 161 stations have been identified by GRDC which could serve as a first step to a global monitoring system in hydrology. GRDC is also member of the Steering Committee of GTOS. The group is invited to discuss the possible contributions of the GRDC to global observation and monitoring programmes such as GTOS and the Global Climate Observing System (GCOS).

03:45 p.m. International transfer of hydrological information for scientific and operational uses: Emerging issues.

The increase in regional cooperation projects for example under the auspices of the World Hydrological Cycle Observing System (WHYCOS) of WMO and the World Bank and UNESCO's FRIEND projects leads to the development of distributed hydrological databases.

The access mode to these databases and agreements to transfer data to the GRDC differs and sometimes it seems easier to obtain data directly from the hydrological service than from a regional database. Another issue are restrictions which several countries put on the access to and the dissemination of data. The group will review recommendations of WMO (with regard to WHYCOS) and UNESCO (with regard to FRIEND) in a view to implement these recommendations and may wish to recommend appropriate action for the GRDC to overcome evident problems in data acquisition.

04:15 p.m. Current and planned activities of the Global Precipitation Climatology Centre (GPCC) and links to GRDC activities.

The representative of the GPCC will present a report about recent activities of the Centre including product development of gridded global monthly precipitation fields and cooperational links with the GRDC with regard to common time-series of precipitation and runoff of large rivers.

04:35 p.m. Summary of the day's results.

The mainstream discussion is summarized and principal decisions to each of the agenda items tabled for inclusion in the meeting report.

05:00 p.m. End of session.

06:00 p.m. Evening Programme

It is planned to have a Get-Together Dinner at a typical location in or near Koblenz.

Thursday, 26 June 1997

08:30 a.m. Strategies to synthesize regional and global hydrological activities and exchange of data and information.

Several activities aim to integrate regional and global hydrological activities and seek support of major data centres to accomplish this work. However, these activities are university-based and competitive. The activities get support from various organizations. However, the entire process seems not to be well coordinated in a way that a consortium of agencies or data centres is coordinating their activities and that there is a joint authorship of the generated products. The group may wish to discuss project proposals for the development of a global river and drainage basin archive series (University of New Hampshire) and the development of a digital hydrological atlas of the world (University of Austin, Texas and FAO) and the possible contribution of the GRDC to these activities. The proposals are attached to this document as annex 3.

09:15 a.m. Review of the GRDC Policy Guidelines for the Dissemination of Data and Costing of Services.

In the light of the agenda items discussed on Wednesday, the group is expected to review the existing policy guidelines of the GRDC and recommend amendments where necessary. The recommendations should be harmonized with the recommendations and resolutions of WMO, UNESCO and - where possible - with the data policy of ICSU and IGBP. Necessary documentation is provided in annex 1.

09:30 a.m. Coffee - Break

09:45 a.m. Review of the GRDC Policy Guidelines for the Dissemination of Data and Costing of Services (continued).

11:00 a.m. Developments and further actions in the context of the GEWEX Hydrometeorological Panel (GHP).

The group will be briefed about current developments especially with regard to the development of the Continental Scale Experiments (CSEs) and their contribution to the assembly of global data sets including hydrological data sets. GRDC as well as the GPCC are ex-officio member of the GHP and are ready to respond to the needs of the GHP community for data products. The group is invited to discuss the contribution of the GRDC to this important panel and possible ways to enhance its effectiveness.

11:30 a.m. Collaboration between GEMS/WATER of UNEP and GRDC. Status of cooperation with regard to the Global river pollutant discharges to oceans (GEMS/GLORI) and the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities (GPA/LBA).

A representative of WHO will inform the group about the developments at UNEP and the progress of GEMS/Water. There is an urgency to get a much closer liaison between water quantity and quality in the future, especially for assessment and monitoring purposes of the availability and quality of freshwater. Considerations are made to merge GEMS/GLORI with the GRDC and further ideas aim at merging information from the GEMS/Water water quality data bank and the GRDC. The group will discuss the issue and may recommend a plan of action to achieve the envisaged close interaction between quantity and quality issues.

12:00 a.m. **Information Exchange Systems between agencies and programmes: a) Linkages with GEMS/WATER information exchange system and b) the World Data Centre system of ICSU.**

a) The representative of GEMS/Water will brief the group about the GEMS/Water information exchange system. The system is currently being implemented in the World Wide Web on the basis of a non-hierarchical system which cross-links key collaborating institutions and data centres with GEMS/Water. b) During a recent workshop of the International Geosphere-Biosphere Project - Data and Information Systems / World Data Centres (IGBP-DIS/WDC) of the International Council of Scientific Unions (ICSU) it became apparent that no reference data centre for hydrology exists for the IGBP core projects. The group recommended that a World Data Centre Hydrology should be created. The GRDC seems an ideal partner for IGBP-DIS. IGBP-DIS will approach WMO to negotiate the cooperation of GRDC as a World Data Centre. The Steering Committee is invited to dicuss the proposal and give guidance as to possible steps for the negotiations.

12:15 p.m. **General discussion and consequences for the activities of the GRDC.**

Up-to-date communication and information facilities are necessary for the GRDC to maintain its high visibility profile and to expand and optimize its services. This relates to electronic linkages and the exchange of information, electronic publishing and the electronic access to GRDC data products. The group may wish to give guidance to the GRDC in its future activities with regard to these issues.

12:45 p.m. **Lunch**

02:00 p.m. **Research issues of the GRDC in collaboration with existing and planned programmes of WMO and other organizations. Brief presentation of the activities on the transformation of measured flow data to grid points, a gridded water balance model for central Europe and the Global Runoff Monitor software.**

Two research projects are executed at the Federal Institute of Hydrology which are briefly discribed:

(a) A nationally funded research project: **"Transformation of measured flow data to grid points"**.: The final report of this project has been submitted to the responsible Ministry and an executive summary is being prepared in English. Using the Weser and Elbe (Labe) catchments in Germany, monthly discharge values for the period 1971 to 1980 have been computed on a grid net. A Geographic Information System (GIS) is used as a tool for the computation of these data. Data input to the GIS consists of image processed data sets (soils, landuse etc.) from internationally available sources as well as from a digital elevation map of the cited catchments. The grid size can be customized for projects in climatology and hydrology on regional and global scales.

Though the results are encouraging, one of the methods being only based on measured discharge data requires a station density which is not available in many countries. Another method consistes of a water balance model combined with measured discharge data of selected stations. (b) **The Development of a GIS-supported Water Balance Model as a Tool for the Validation of Climate Models and Hydrometeorological Datasets.:** In the ongoing study, a grid-based water balance model is proposed following the THORNTHWAITE-MATHER-procedure to calculate long term mean monthly and monthly water balance components on a 0.5° x 0.5° grid. Discharge data are used in several steps for parameter estimation as well as validation and verification of the water balance components. The water balance model has so far been applied for a 0.5° x 0.5° grid covering Central Europe. Model validation was carried out for the rivers Rhine, Weser, Ems, Elbe (Labe) and the German part of the River Danube for the period 1971 - 1980. This work is continued. c) A software tool "Global Runoff Monitor" has been developed at the GRDC and is now utilized. The tool allows the identification of areas of water surplus and deficit on a comparative basis. The group is invited to comment on these projects and possible extension of these works.

03:00 p.m. Summary of the day's results.

The mainstream discussion is summarized and principal decisions to each of the agenda items tabled for inclusion in the meeting report.

03:15 p.m. End of Session

03:30 p.m. Afternoon Programme

Visit of the cellars of a famous champagne producer in Koblenz followed by a dinner hosted by GRDC.

Friday, 27 June 1997

08:00 a.m. Review of membership of the Steering Committee, including the possibility of a revolving membership.

Since the Steering Committe has been established in 1994, the modalities of membership have not been explicitly reviewed. Organizational representation, membership of personal members, rotation of members, status of ex-officio members and invited observers should be reviewed in the light of the increased scope of activities of the GRDC and its membership in collaborating programmes and organizations. The group is expected to define and document the membership and related issues.

08:30 a.m. Situation of co-funding of the GRDC and the issue of seconded experts and collaborating institutions.

The group will be informed about the status of funds and the origin and use of the funds. The role of seconded experts and collaborating institutions in GRDC-relevant tasks will be outlined. The group is expected to consider possible sources of co-funding, issues of contracted works and the financing of seconded experts.

08:50 a.m. From discharge data to hydrological information: The GRDC between requirements and present operational constraints.

There is pressing need to develop a larger array of data products which is of use for the user-community. One of the ever-present requests is to release large data sets which is difficult under the adopted policy and problematic if it were handled otherwise. However, data products as an aggregation of the raw data could allow the release of large quantities of information. Hence the GRDC has to develop global hydrological information without releasing the entire database. Increasingly, hydrological information will be based on Geographic Information Systems (tools). The group may wish to discuss this issue in depth and give guidance how to scope with these requirements.

09:20 a.m. Coffee Break

09:35 a.m. Quality control of GRDC data.

A presentation is made about the status of quality control at the GRDC, using a plausibility check tool for the graphic assisted recognition and correction of data errors. The group may discuss further needs for quality control of data and methods to assess data quality.

10:00 a.m. Establishment of a "transmission belt" between national hydrological services and regional/global freshwater programmes: Conceptional and implemention issues.

Hydrological services of the world are usually not involved in regional/global assessments with a few exceptions. Only through a participatory approach the interest of these services can be won to actively contribute to regional/global programmes. The linkage of the services themselves e.g. through e-mail and Internet (where available!) and - more specifically - the linkage of the services with these regional/global programmes is a high-priority objective in this respect. The group may wish to discuss issues such as: Which are common interests between programmes and services? What can the services gain from a participation? How could the in-depth-expertise of services be utilized? What concept would be appropriate to establish an information and linkage system (Hydrological Services as partners in an evolving service-based hydrology community)? How could an outlined concept be implemented?

11:00 a.m. Outreach of the activities of the GRDC 1997-1999.

From the past and present activities of the GRDC, the following subject areas seem apparent:
Further contributions to the WCP-Water Programme of WMO, GEWEX and GEMS/Water, closer linkage with regional activities (WHYCOS, FRIEND) including freshwater assessment and monitoring activities e.g. of UNEP, closure of data gaps of time series for important rivers, development of GIS-facilities at the GRDC. Based on the discussions of the previous agenda items, the Steering Committee is invited to formulate priority activities for the period 1997-1999 and ways for implementation.

12:30 a.m. Lunch

01:30 p.m. Summary of results and principal recommendations of the third GRDC Steering Committee Meeting.

The conclusions made here and the recommendations as to the on-going and planned activities of the GRDC will be used as working guideline in the interim period until the next meeting. The results and recommendations will also be cited in letters and documents to data providers, users, organizations and institutions which collaborate with the GRDC.

02:30 p.m. Date and location of next meeting.

After three meetings of the GRDC Steering Committee in Koblenz, the group may wish to consider where the next meeting shall take place and set a data for it.

02:45 p.m. Closure of third meeting of the Steering Committee.

03:30 p.m. - 09:00 p.m. Local Excursion by bus or ship followed by dinner (on request).

The participants will be asked on the first day of the meeting whether they wish to join a local excursion. Minimum number of participants is five persons. The excursion and dinner are not sponsored.

Notes to the Agenda

Most of the agenda items allow for exchange of opinion/brief discussions. Blocks of discussion times are outlined below.

To make the most of the time, all participants are requested to note important statements on the cards for display and discussion.

Discussion Blocks

Wednesday, 25 June

10:50 - 12:15 a.m.	Status Report '96, WMO-EC resolutions, WCP-Water
12:30 - 12:45 a.m.	Use of regional/global hydrological data - (Expected) Trends
04:35 - 05:00 p.m.	Summary of day's results

Thursday, 26 June

09:15 - 11:00 a.m.	Review of GRDC policy guidelines, harmonization of activities with WHYCOS, FRIEND, GTOS
12:15 - 12:45 a.m.	GEWEX-GHP, GEMS/Water, World Data Centre System
03:00 - 03:15 p.m.	Summary of day's results

Friday, 26 June

08:50 - 09:20 a.m.	Data products and global data sets
11:00 - 12:30 a.m.	Outreach of activities 1997 - 1999
01:30 - 02:30 p.m.	Summary of results and recommendations

Annex 3

Letter of Freshwater Unit of UNEP for the Meeting

UNEP BRIEFING NOTE FOR GRDC MEETING
(25-27 June 1997; Koblenz)

I. General Observations

As all GEMS/Water partner agencies and collaborating centres are aware, UNEP currently is still experiencing financial constraints within its 1996-97 Biennium workprogramme, including funding available for UNEP's GEMS/Water Programme. However, there is every indication that this financial situation will improve significantly in the coming months, particularly with the beginning of UNEP's 1998-99 Biennium Workprogramme.

There are several reasons for this optimism, as follows:

- UNEP's Governing Council at its 19th session directed that all activities and programmes in the 1996-97 Biennium which were not implemented, due to the funding constraints, would receive funding priority for implementation in the 1998-99 Biennium;

- In its decision 19/4, the Governing Council requested UNEP's Executive Director to improve the use of the GEMS/Water and GEMS/Air Programmes, and the Global Resource Information Database in the preparation of the GEO assessments;

- In decision 19/14(A), the Governing Council requested the Executive Director to take note of the important linkages between freshwater and marine environment in applying the Global Plan of Action for the Protection of the Environment from Land-based Activities (GPA), and requested the Executive Director to establish links with other regional plans, programmes and conventions for protection of the marine and freshwater environment, in order to ensure their participation in implementation of the GPA;

- In decision 19/14(D), the Governing Council requested the Executive Director to place a higher priority on freshwater in the next biennium and to make more effective use of the UNEP-coordinated inter-agency GEMS/Water Programme;

- In decision 19/26, the Governing Council called for strengthened collaboration among UN agencies and bodies and other institutions in the future activities of the GEO process

II. Global Programme of Action for the Protection of the Environment from Land-based Activities (GPA)

Due to the same financial constraints, it was necessary to establish priorities in regard to the activities of all UNEP units for the 1996-97 Biennium. the Water Branch for the 1996-97 Biennium. Given UNEP's selection as Secretariat of the Global Programme of Action (GPA), an obvious priority was support for implementation of the GPA. It is noted, however, although protection of coastal and marine waters is the primary goal of the GPA, the action programmes to achieve this goal will be implemented primarily within freshwater basins draining to the coastal and marine waters. Thus, there is a fundamental and logical linkage between the activities of GEMS/Water and the goals of the GPA. Accordingly, the GEMS/Water environmental monitoring network (i.e., baseline, trend and flux stations) is uniquely suited to assist in assessing the potential impacts of land-based activities on the coastal/marine environment. This latter activity is identified in the current GPA workprogramme. Of particular relevance to the GRDC meeting, and importance to the GPA goals, is the GRDC efforts to maintain a global database of continental freshwater fluxes to the world's oceans. Also important is the data on suspended solids in rivers. These activities should receive constant support from the GEMS/water programme, and it is anticipated that these activities could be the basis for additional priorities at the onset of UNEP's 1998-99 Biennium. UNEP's Assessment Division is being consulted on this possibility.

III. Global Environment Outlook (GEO-2)

The first issue in UNEP's Global Environment Outlook (GEO-1), in identifying global and regional environmental problems and their underlying socio-economic root causes, provided a snapshot of an ongoing world-wide environmental assessment process. Further, in calling for global action on freshwater, the GEO-1 noted that freshwater would be the major impediment for further development in many regions of the world. In response to this initial identification of the importance of freshwater issues around the world, it is anticipated that relevant assessment activities involving freshwater resources will be undertaken in the preparation of GEO-2. To this end, and as noted above, UNEP 19th Governing Council decision 19/4 called upon the Executive Director to make greater use of the GEMS/Water Programme in future GEO assessments. Accordingly, UNEP will make every effort to involve the relevant collaborating centres in the GEMS/Water Programme, including GRDC, in such assessments.

IV. Global International Waters Assessment (GIWA)

UNEP is one of the three Implementing Agencies for the Global Environment Facility (GEF). The GEF Council provides funds for eligible activities addressing global and regional impacts of environmental degradation, including those in its International Waters Portfolio. Among the activities being developed by UNEP is a "Global International Waters Assessment" (GIWA). The purpose of the assessment is to provide the GEF Council with a means of assigning priority to the many water-related projects presented to it by its Implementing Agencies. The GIWA proposal is currently under final stages of development. Two expert workshops have been held; the first focused on specific water-related issues to be addressed in the assessment, while the second focused on the relative importance of these issues, as seen from a regional perspective. The five primary issues identified by the expert groups include (i) freshwater scarcity; (ii) pollution; (iii) habitat modification/destruction; (iv) over-exploitation of fisheries and other aquatic living resources; and (v) global change. It is anticipated that the GEMS/Water collaborating centres might be able to participate in this global assessment (to be synthesized on the basis of regional assessments). Although it cannot be considered until completion and approval of the GEF proposal, the involvement of GEMS/Water collaborating centres in specific components of the GEF assessment will be explored.

Annex 4

Abridged GRDC Status Report 1996

GRDC STATUS-REPORT 1996

(Summary of GRDC-Report No. 13, 2/1997)

1. General
2. Major issues in 1996 - Summary
3. Database Development
4. User Services
5. Communication with Data Providers and Users
6. Feedback on Data Use
7. Data Acquisition and Dissemination Emerging Issues
8. Research and Development
9. Participation in major programmes and projects
10. Regional activities
11. Reports and Public Relations
12. Country missions and visits to the GRDC
13. GRDC Outreach 1997

1. General

GRDC Status Reports are an important link between data providers, data users and collaborating Centres and institutions since the first of these reports was published in 1993.

2. Major issues in 1996 - Summary

First priority remained the expansion and update of the database which includes the direct contact with data providers. Hydrological services of Latin America and the Caribbean were the priority of the year.

Contributions to the Global Freshwater Assessment of the UN Commission for Sustainable Development (CSD)

An operational linkage with UNESCO`s programme Flow Regimes from International and Experimental Network Data (FRIEND) has been established for the Hindu Kush-Himalayan region.

The cooperation with the Global Energy and Water Cycle Experiment (GEWEX), the ex-officio membership in the GEWEX Hydrometeorological Panel (GHP), the membership in the Steering Committee of the Global Terrestrial Observing Programme (GTOS) and the contributions to the Arctic Climate System Study (ACSYS) have been highlights.

Based on GRDC observational data, a report about the freshwater fluxes from the continents into the oceans has been finalized. The GRDC Global Runoff Monitor is now operational as well as the Plausibility Check tool of the GRDC.

3. Database Development

Two events contributed significantly to the expansion of the database in 1996:

The Secretary-General of WMO sent a letter to the Hydrological Advisors of Members of WMO requesting the advisors for further support to the GRDC. The number of positive responses to this initiative of the Secretary-General has encouraging.

Mean daily and mean monthly discharge data from 493 gauging stations have been received from 15 countries. While 234 station records could be updated, 259 stations have been newly included into the database.

The homogeneity of time-series for a larger number of rivers remains a problem: It is presently not possible to develop a dataset of major rivers of the world with the same reference period. This problem has to be adressed as a matter of priority. It can be solved only by active contributions from data providers who are requested to contribute the data needed in this respect.

4. User Services

A total of 93 requests have been handled at the GRDC; this does not include mere database contacts via Internet (see below). The user development is shown in table 1:

Year	Requests
1992	10
1993	24
1994	61
1995	66
1996	93

Table 1: Development of data requests

While in earlier years data requests for climate research had been in prominent, there is now a clear shift towards data requests for operational hydrology and regional and global hydrological research.

Topic	Requests received
Hydrometeorological modeling	1
Operational hydrology	22
Regional/global hydrological issues	20
Climate and ocean related research	31
Information/advisory requests	12
Others	5
TOTAL	91

Table 2: User profile of GRDC data 1996

5. Communication with Data Providers and Users

A closed feed-back loop has top priority in the work of the GRDC .

6. Feedback on Data Use

To obtain an overview of research undertaken with GRDC data, GRDC has launched a "Feed-back" activity. 56% of the contacted users responded to the request.

7. Data Acquisition and Dissemination

The policy of the GRDC adequately considers the interests of both: Data providers and data users. The data holdings of the GRDC do not infringe on the ownership rights of data transmitted to the GRDC by data providers. In particular, the GRDC does not usually provide value-added and costed services to data users which fall in the domain of national hydrological services. The Commission of Hydrology decided to present the Executive Council of WMO and Congress with a draft resolution on the exchange of hydrological data, as a complement to resolution 40 adopted by Twelfth Congress with regard to the free and unrestricted exchange of meteorological and related data.

The draft resolution of the CHy-X will be discussed at the Fortyninth session of the Executive Council of WMO.

8. Research and Development

Research and development of GRDC is focussed to:

- Respond to user requirements and research needs of international programmes and

- Enhance the effectiveness of the database operation and the generation of basic data products for research programmes and other users.

Demand for research products: A continued demand for hydrological research and research products can be observed. From the staffing of the Centre it is evident that the Centre cannot respond fully to the growing demand. On several occasions therefore, the GRDC has solicited scientific support to the GRDC by third-party financed researchers who are invited to work as seconded experts with the GRDC in Koblenz.

Calculation of freshwater fluxes into the oceans

The calculation of surface water discharges from the continents into the oceans has been published as GRDC report No.10.

Development of a grid-based water balance model

GRDC supports a study undertaken at the Federal Institute of Hydrology:

The Development of a GIS-supported Water Balance Model as a Tool for the Validation of Climate Models and Hydrometeorological Datasets.

Development of the Global Runoff Monitor

This tool enables the GRDC to supply map-based graphic displays of the continental or global runoff situation for any month and for all stations where data are available.

Plausibility check of hydrological data

With the introduction of a plausibility software tool, GRDC has taken up steps to enhance its capability for quality control of daily and monthly hydrological data.

Statistical tests and time-series analysis

GRDC offers a range of statistical tests in line with the WMO WCAP-3 Project: "Analysis of long time series of hydrological data". The statistical programmes are based on the WMO-publication WMO/TD No.224 (1988) and have been updated to interface them with graphical display capabilities.

Geographical Information Systems

GRDC is using now the updated version of RAISON for WINDOWS. This GIS-based tool is commonly used in UNEP's GEMS-Water programme and offers in its updated version a variety of useful statistical routines together with time-series analysis.

Participation in major programmes and projects

Arctic Climate System Study (ACSYS)

The compilation of a comprehensive database for the ACSYS project allows the computation of surface water runoff into the Arctic Ocean.

ACSYS felt the need for the development of a data and management information plan. The GRDC is co-chairing the ACSYS panel on Data Management and Information (ACSYS-DMI) which is in its formation state.

Flow Regimes from International and Experimental Network Data (FRIEND)

As a result of the cooperation with FRIEND, the GRDC is entrusted with the database generation for the Hindukush Himalaya region. A first data catalog has been presented.

A planned mission to India and Myanmar in 1997 is expected to yield results inter alia also with respect to the extension of the database and cooperative efforts with respect to the cross-boundary transfer of regional hydrological information.

Global Environment Monitoring System - Water (GEMS/WATER)

The calculation of freshwater fluxes to the oceans is an important contribution to GEMS/WATER and is collateral to the efforts of the International Geosphere/Biosphere Project (IGBP)/ Land-Ocean Interaction in the Coastal Zones (LOICZ) which concentrates on smaller rivers with a high pollution transport into coastal zones and the research undertaken by Meybeck et al. in the GEMS/GLORI (Global River Input) project.

GRDC proposed a merger of the GLORI database with the GRDC which would ensure long-term professional and institutional support for the data brought into the system.

GRDC has agreed to actively participate in the GEMS/WATER Information Exchange System through the INTERNET. The objective of that system is to enhance the communication and information exchange between GEMS/WATER partners in an efficient, non-hierarchical way.

Global Observing Systems

The Centre participated in an expert meeting on hydrological data needs for Global Observing Systems organized by WMO, April 1996.

GRDC has offered to Global Observing Systems to make available and maintain a global set of 160 gauging stations which have been identified as being representative for the surface freshwater flux from continents into the oceans.

GRDC is represented in the Steering Committee of GTOS and participates in the working group "Earth Science".

Global Water Resources Assessment

The UN Commission for Sustainable Development (CSD) has tasked WMO, UNESCO and UNEP inter alia to execute an assessment of the Global Water Resources. The Centre has participated in two planning sessions of the programme, participated in the strategic considerations to carry out the assessment and contributed data and information. The report has since been produced and submitted to the CSD.

Global Energy and Water Cycle Experiment (GEWEX)
GEWEX Hydrometeorological Panel (GHP)

As for GEMS/WATER, the calculation of freshwater fluxes to the oceans is an important contribution to GEWEX and the GEWEX Hydrometeorological Panel (GHP) where GRDC is an ex-officio member.

By monitoring the freshwater fluxes into the oceans GRDC expects that this information can be used for the quantification and validation of ocean-atmosphere exchange processes and the closure of the global hydrological cycle. Representative continental gauging stations have been identified for this purpose.

Through its collaborative activities, GHP has recognized that the GRDC is an important provider of global surface water budget information for the WCRP. GHP agreed on a more formal cooperation between GHP, GRDC and GPCC. Areas of collaboration have been defined to:

- Undertake joint initiatives of mutual benefit,
- Coordinate contributions to the global observing systems (e.g. GCOS and GTOS),
- Develop a near real-time global monitoring network for surface water budget parameters.

International Association for the Promotion of Cooperation with Scientists from the Independant States of the Former Soviet Union (INTAS)

In collaboration with the Institute of Hydrology in Wallingford, United Kingdom, the GRDC assists in the identification of suitable datasets, digitization and processing of the data as an INTAS reference database. The data is also stored in the GRDC database. GRDC in 1996 has provided an interim report on the project.

World Hydrological Cycle Observing System (WHYCOS)

WHYCOS aims at improving cooperation at river basin, regional and global levels to support the establishment of consistent and reliable water data information systems. WHYCOS is implemented on the basis of regional Hydrological Cycle Observing System components (HYCOS).

The regional implementation of WHYCOS will make it probably the most important provider of near real-time data for the GRDC.

GRDC has been involved in planning meetings as an observer.

10. Regional activities

Three regional events have been of major importance for the GRDC:

Regional Workshop on the Hydrology of the Hindu Kush-Himalaya (Kathmandu, Nepal, March 1996)

Main purpose of this workshop has been to establish a FRIEND-type water information system for the eight countries which share the Hindu Kush-Himalaya.

The GRDC was tasked to undertake the data collection for the region and to assist in the establishment of a regional database in close collaboration with the participating countries.

Conference on Water Resources Assessment and Management in Latin America and the Caribbean (San José, Costa Rica, May 1996)

The conference was designed to explore strategies to ensure that national water resources agencies play a full part in national and regional development.

GRDC provided a report "Assessment and Monitoring of Fresh Water Resources in South America - A View from the Global Runoff Data Centre (GRDC)".

Regional Workshop on Sustainable Development in the ESCAP region (Bangkok, Thailand, July 1996)

The meeting reviewed the water resources availability in the region and the demands by various users.

GRDC contributed a report: "Sustainable Development of Water Resources in the ESCAP Region -A Discussion Paper by the GRDC". The report includes a detailed overview of the availability of hydrological data in the ESCAP region.

Reports and Public Relations

15 Reports have been published since 1993 and Report No. 16 is in ist final draft stage. Due to the growing demand for these reports, some reports are currently being reprinted.

In public relation activities, the publication of a color brochure about the aims, objectives and services of the GRDC has been widely distributed. The translation of the brochure in languages other than English is planned.

12. Country missions and visits to the GRDC

A mission to Nepal was executed in June 1996 with the objective to prepare and reach agreement on a Memorandum of Understanding to establish and implement a country component of the GEMS-Water Programme in Nepal and to review a data acqusition monitoring and quality control system which has been established earlier with GRDC's assistance in the Department of Hydrology and Meteorology in Kathmandu. The mission was used to identify a strategy to compile a regional hydrological database envisaged under the FRIEND-type Hindu Kush-Himalaya project mentioned above.

Japan is a key partner in terms of technology, regional cooperation and financial as well as technical assistance to countries in the region. In this capacity, Japan is represented in the Steering Committee of the GRDC. To become acquainted with the approaches, cooperative strategy and ways of implementation of bi- and multilateral technical and financial assistance, a mission to Japan was conducted in July 1996. One focus of the mission had been to become acquainted with the Japanese approach to regional and global cooperation in hydrology and water resources and the progress so far made in the Asian FRIEND project which is strongly promoted by Japan.

On various occasions, the Centre welcomed visitors to its facilities. Amongst others, visitors were received from: Canada, Croatia, Germany, India, Japan, Nepal, Netherlands, Nigeria, Papua New-Guinea, Russia, South Africa, United Kingdom, Usbekistan, Zambia.

13. GRDC Outreach 1997

In addition to the routine services of the GRDC some of its activities are high-lighted for 1997:

Database technology

Installation of the database system on a WINDOWS-NT Server. New functionalities will be implemented for database tools.

Database extension

Intensified direct contacts with hydrological services. Regional priority in 1997 will be Asia. The acquisition of data for selected datasets e.g. the freshwater flux stations and ACSYS will also be prioritized.

Data Quality checks:

Plausibility control for data collected for ACSYS and stations identified as key stations for the computation of continental runoff into the oceans

Science and applications:

Application of the Global Runoff Monitor for regional data sets in Africa, Latin America and Asia as part of GRDC`s regional activities. Publications are expected in mid-1997.

Computation of the variability of freshwater fluxes into the oceans from GRDC data in continuation of report No.10.

Statistical analysis for selected stations/data sets including time-series analysis. GRDC will execute statistical analysis in line with the WMO WCAP-3 Project: "Analysis of long time series of hydrological data" (WMO/TD-No.224 (1988)). Priority is laid on the 160 global flux stations.

WHYCOS

The operationalization of the information exchange with WHYCOS has a high priority. 1997 is the year where first operational transmission of relevant data will take place from the Mediterranean HYCOS system. Subsets of HYCOS data are expected to be transferred to the GRDC in a near real-time mode.

Annex 5

Draft Resolution for the Exchange of Hydrological Data and supporting materials

ANNEXES

ANNEX I

Annex to paragraph 3.3.2 of the general summary

DRAFT RESOLUTION ON THE EXCHANGE OF HYDROLOGICAL DATA

THE CONGRESS,

NOTING:

(1) Resolution 40 (Cg-XII) — WMO policy and practice for the exchange of meteorological and related data and products including guidelines on relationships in commercial meteorological activities,

(2) The inclusion of dedicated observations of the climate system, including hydrological phenomena, as one of the four main thrusts of *The Climate Agenda*, which was endorsed by Twelfth Congress,

(3) That the *Technical Regulations*, in section [D.1.1] 8.3.1(*k*), record that, in general, the routine functions of national Hydrological Services (NHSs) should include, *inter alia*, "making data accessible to users, when, where, and in the form they require" and that the *Technical Regulations* also contain a consolidated list of data and product requirements to support all WMO Programmes[1],

(4) That the Intergovernmental Council of the International Hydrological Programme of UNESCO adopted at its twelfth session Resolution XII-4 which dealt with the exchange of hydrological data and information needed for research at the regional and international levels,

CONSIDERING:

(1) The significance attached by the International Conference on Water and the Environment (Dublin, 1992) to extending the knowledge base about water and enhancing the capacity of water sector specialists to implement all aspects of integrated water resources management,

(2) The call of world leaders at the United Nations Conference on Environment and Development (UNCED) for a significant strengthening of, and capacity building in, water resources assessment, and the request of the United Nations Commission on Sustainable Development (CSD) for a comprehensive assessment of the freshwater resources of the world,

(3) The requirements for water-related terrestrial monitoring specified by the Convention on Biological Diversity, the United Nations Framework Convention on Climate Change, and the Convention to Combat Desertification,

(4) The requirement for the global exchange of hydrological information in support of scientific investigations of global change and the global hydrological cycle, and the contribution to such programmes and projects as the Global Climate Observing System (GCOS), the Global Terrestrial Observing System (GTOS), the International Geosphere-Biosphere Programme (IGBP), the Global Runoff Data Centre (GRDC), the Global Precipitation Climatology Centre (GPCC), the World Hydrological Cycle Observing System (WHYCOS) and the Flow Regimes from International Experiments and Network Data (FRIEND),

(5) The opportunities for more efficient management of water resources and the need for cooperation in mitigating water-related hazards in transboundary river basins and their water bodies which depend on the international exchange of hydrological data and information,

RECOGNIZING:

(1) The responsibility of Members and their NHSs to provide for the security and well-being of the people of their countries, through mitigation of water-related hazards and sustainable management of water resources,

(2) The continuing need for strengthening the capabilities of NHSs, particularly in developing countries,

(3) The right of Governments to choose the manner by which, and the extent to which, they make hydrological data and products available domestically and internationally,

(4) The requirement by some Members that their NHSs earn revenue from users, and/or adopt commercial practices in managing their businesses,

(5) The long-established provision of some hydrological products and services on a commercial basis and in a competitive environment, and the impacts, both positive and negative, associated with such arrangements,

[1] To be reviewed and amended, as appropriate, to reflect the decisions of Thirteenth Congress.

ADOPTS a stand of committing to broadening and enhancing, whenever possible, the free and unrestricted[2] international exchange of hydrological data, in consonance with the expanding requirements for WMO's scientific and technical expertise;

FURTHER ADOPTS the following practice on the international exchange of hydrological information:

(1) Members shall provide on a free and unrestricted basis those hydrological data which are necessary for the provision of services in support of the protection of life and property and for the well-being of all nations;

(2) Members should also provide additional hydrological data and products, where available, which are required to sustain WMO and other international programmes and projects, such as under **CONSIDERING** (4), related to operational hydrology and water resources research at the global, regional and national levels and, furthermore, to assist other Members in the provision of hydrological services in their country;

(3) Members should provide to the research and education communities, for their non-commercial activities, free and unrestricted use of all data and products under the auspices of WMO;

(4) Respecting (2) and (3) above, Members may place conditions on the re-export[3] for commercial use of these hydrological data and products, outside the receiving country or group of countries forming a single economic group for reasons of national laws or costs of production, for example;

(5) Members should make their best efforts to ensure that the conditions placed by the originator on the additional hydrological data and products are made known to initial and subsequent recipients;

URGES Members, in respect of the operational and scientific use of hydrological data and products, to:

(1) Make their best efforts to implement the practice on the international exchange of hydrological data and products, as described in **FURTHER ADOPTS** (1) to (5);

(2) Assist other Members, to the extent possible, and as agreed upon, by providing hydrological data and products in support of time-sensitive operations regarding the protection of life and property;

REQUESTS the Executive Council to:

(1) Invite the Commission to provide advice and assistance on technical aspects of the implementation of the practice on the international exchange of hydrological data and products;

(2) Keep the implementation of this resolution under review and report to Fourteenth Congress;

DECIDES to review the implementation of this resolution at Fourteenth Congress.

2 "Free and unrestricted" means non-discriminatory and without charge. "Without charge", in the context of this draft resolution means at no more than the cost of reproduction and delivery, without charge for the data and products themselves.

3 "Re-export" means, in the context of this draft resolution, to redistribute, physically or electronically, outside the receiving country, group of countries forming a single economic group, or regional and global data centres, directly or through a third party.

ANNEX II

Annex to paragraph 7.1.14 of the general summary

IMPLEMENTATION PLAN FOR HOMS: 1997–2000

1. This plan was adopted by the Commission, in fulfilment of its task of establishing the detailed programme for HOMS (see Resolution 22 (Cg-XI) — Hydrology and Water Resources Programme). The plan comprises two parts: institutional strengthening of HOMS operations, including support to the network of HOMS National Reference Centres (HNRCs), and technical development of HOMS components and sequences.

Institutional strengthening of HOMS operations

2. It is proposed to keep the present arrangement of HOMS National Reference Centres, coordinated by the HOMS Steering Committee (the Commission Advisor Working Group) with Secretariat support provided by th HOMS Office. The practice of appointing a member (the Advisory Working Group with special responsibili for HOMS has proved to be a valuable coordinatir mechanism and should be continued. The liaisc between this member and the rapporteurs on HOMS the regional associations' working groups on hydrolo is particularly important.

3. The inter-sessional period (1992–1996) saw strong growth in the number of HNRCs, particula from the Newly Independent States who are usi

Distr.: RESTRICTED

WORLD METEOROLOGICAL ORGANIZATION

EC-XLIX/Doc. 22
(3.III.1997)

EXECUTIVE COUNCIL

ITEM 12.1 (1)

FORTY-NINTH SESSION, GENEVA, 1997

Original: ENGLISH

ACTION DOCUMENT

INTERNATIONAL EXCHANGE OF DATA AND PRODUCTS

Exchange of hydrological data

(Submitted by the president of the Commission for Hydrology)

GUIDANCE SOUGHT:

On the further development of material on the exchange of hydrological data and the onward submission of the draft resolution on the subject prepared by CHy-X.

References:

1. EC-XLIX/Doc. 23 - Hydrology and Water Resources Programme
2. Commission for Hydrology - Abridged final report of the tenth session, WMO-No. 852, 1997

Appendices:

A. Draft text for inclusion in the general summary of EC-XLIX

B. Draft resolution on the exchange of hydrological data

C. Explanatory note on commercialization and the international exchange of hydrological data.

Financial Summary

This document does not contain any substantive proposals which modify programme activities requiring shifting of resources from the budget as approved by EC-XLVII.

DRAFT TEXT FOR INCLUSION IN THE GENERAL SUMMARY OF EC-XLIX

12. MAJOR ISSUES FACING WMO *(agenda item 12)*

12.1 International exchange of data and products *(agenda item 12.1)*

Hydrological data

12.1.1 The Council recalled that Cg-XII and EC-XLVIII had invited the president of CHy to continue work on the issue of commercialization and the international exchange of hydrological data and products. The president of the Commission reported on the work of the CHy Advisory Working Group (AWG) in preparing an aide memoire on commercialization, a position paper on the exchange of data, and a draft resolution. It was noted that, although neither Congress nor the Executive Council had specifically requested the CHy to prepare such a resolution, CHy-X had considered that that would indeed be the best course of action and accordingly had devoted considerable effort to developing the original draft into a resolution which, while referring specifically to hydrological data, faithfully reproduced both the spirit and the structure of Resolution 40 (Cg-XII).

[CHy-X was held in Koblenz, Germany in December 1996. The Council will discuss the outcome of the session under agenda item 7 (see reference 1). The draft resolution prepared by CHy-X is contained in Annex I to the report of the session (see reference 2) and is reproduced as Appendix B to this document.]

12.1.2 In considering the draft resolution, the Council took account of the explanatory note on the subject prepared by the CHy AWG at the request of the Commission.

[The explanatory note is contained in Appendix C to this document]

DRAFT RESOLUTION ON THE EXCHANGE OF HYDROLOGICAL DATA

THE CONGRESS,

NOTING:

(1) Resolution 40 (Cg-XII) — WMO policy and practice for the exchange of meteorological and related data and products including guidelines on relationships in commercial meteorological activities,

(2) The inclusion of dedicated observations of the climate system, including hydrological phenomena, as one of the four main thrusts of *The Climate Agenda*, which was endorsed by Twelfth Congress,

(3) That the *Technical Regulations*, in section [D.1.1] 8.3.1(*k*), record that, in general, the routine functions of national Hydrological Services (NHSs) should include, *inter alia*, "making data accessible to users, when, where, and in the form they require" and that the *Technical Regulations* also contain a consolidated list of data and product requirements to support all WMO Programmes[1],

(4) That the Intergovernmental Council of the International Hydrological Programme of UNESCO adopted at its twelfth session Resolution XII-4 which dealt with the exchange of hydrological data and information needed for research at the regional and international levels,

CONSIDERING:

(1) The significance attached by the International Conference on Water and the Environment (Dublin, 1992) to extending the knowledge base about water and enhancing the capacity of water sector specialists to implement all aspects of integrated water resources management,

(2) The call of world leaders at the United Nations Conference on Environment and Development (UNCED) for a significant strengthening of, and capacity building in, water resources assessment, and the request of the United Nations Commission on Sustainable Development (CSD) for a comprehensive assessment of the freshwater resources of the world,

(3) The requirements for water-related terrestrial monitoring specified by the Convention on Biological Diversity, the United Nations Framework Convention on Climate Change, and the Convention to Combat Desertification,

(4) The requirement for the global exchange of hydrological information in support of scientific investigations of global change and the global hydrological cycle, and the contribution to such programmes and projects as the Global Climate Observing System (GCOS), the Global Terrestrial Observing System (GTOS), the International Geosphere-Biosphere Programme (IGBP), the Global Runoff Data Centre (GRDC), the Global Precipitation Climatology Centre (GPCC), the World Hydrological Cycle Observing System (WHYCOS) and the Flow Regimes from International Experiments and Network Data (FRIEND),

(5) The opportunities for more efficient management of water resources and the need for cooperation in mitigating water-related hazards in transboundary river basins and their water bodies which depend on the international exchange of hydrological data and information,

RECOGNIZING:

(1) The responsibility of Members and their NHSs to provide for the security and well-being of the people of their countries, through mitigation of water-related hazards and sustainable management of water resources,

(2) The continuing need for strengthening the capabilities of NHSs, particularly in developing countries,

(3) The right of Governments to choose the manner by which, and the extent to which, they make hydrological data and products available domestically and internationally,

(4) The requirement by some Members that their NHSs earn revenue from users, and/or adopt commercial practices in managing their businesses,

(5) The long-established provision of some hydrological products and services on a commercial basis and in a competitive environment, and the impacts, both positive and negative, associated with such arrangements,

ADOPTS a stand of committing to broadening and enhancing, whenever possible, the free and unrestricted[2] international exchange of hydrological data, in consonance with the expanding requirements for WMO's scientific and technical expertise;

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1 To be reviewed and amended, as appropriate, to reflect the decisions of Thirteenth Congress.

2 "Free and unrestricted" means non-discriminatory and without charge. "Without charge", in the context of this draft resolution means at no more than the cost of reproduction and delivery, without charge for the data and products themselves.

FURTHER ADOPTS the following practice on the international exchange of hydrological information:

(1) Members shall provide on a free and unrestricted basis those hydrological data which are necessary for the provision of services in support of the protection of life and property and for the well-being of all nations;

(2) Members should also provide additional hydrological data and products, where available, which are required to sustain WMO and other international programmes and projects, such as under **CONSIDERING** (4), related to operational hydrology and water resources research at the global, regional and national levels and, furthermore, to assist other Members in the provision of hydrological services in their country;

(3) Members should provide to the research and education communities, for their non-commercial activities, free and unrestricted use of all data and products under the auspices of WMO;

(4) Respecting (2) and (3) above, Members may place conditions on the re-export[3] for commercial use of these hydrological data and products, outside the receiving country or group of countries forming a single economic group for reasons of national laws or costs of production, for example;

(5) Members should make their best efforts to ensure that the conditions placed by the originator on the additional hydrological data and products are made known to initial and subsequent recipients;

URGES Members, in respect of the operational and scientific use of hydrological data and products, to:

(1) Make their best efforts to implement the practice on the international exchange of hydrological data and products, as described in **FURTHER ADOPTS** (1) to (5);

(2) Assist other Members, to the extent possible, and as agreed upon, by providing hydrological data and products in support of time-sensitive operations regarding the protection of life and property;

REQUESTS the Executive Council to:

(1) Invite the Commission to provide advice and assistance on technical aspects of the implementation of the practice on the international exchange of hydrological data and products;

(2) Keep the implementation of this resolution under review and report to Fourteenth Congress;

DECIDES to review the implementation of this resolution at Fourteenth Congress.

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3 "Re-export" means, in the context of this draft resolution, to redistribute, physically or electronically, outside the receiving country, group of countries forming a single economic group, or regional and global data centres, directly or through a third party.

EXPLANATORY NOTE

COMMERCIALIZATION AND THE INTERNATIONAL EXCHANGE OF HYDROLOGICAL DATA

Purpose:

1. To respond to the request by Cg-XII for EC (EC-XLVII) to invite the president of the Commission for Hydrology (CHy) to continue "work on the issue of commercialization and the international exchange of hydrological data and products".

Background:

2. Cg-XII adopted Resolution 40 in which it confirmed WMO's on-going commitment to the principle of free and unrestricted exchange of meteorological and related data and products. CHy saw the need for WMO to commit itself to broadening and enhancing the free and unrestricted international exchange of hydrological data, adopting a policy and practice in this regard which matched as closely as possible with that set out in Resolution 40 (Cg-XII). When Resolution 40 (Cg-XII) was adopted, hydrological data and products were explicitly excluded from coverage at that stage.

Procedure:

3. CHy-X decided that the preferred course of action would be to present EC and Congress with a draft resolution on the exchange of hydrological data, as a complement to Resolution 40 (Cg-XII). CHy-X further decided that the draft resolution should be accompanied by this Explanatory Note which outlines the similarities and differences between the situations pertaining to meteorological and hydrological data and products, and the reasoning behind the draft resolution. In developing the draft resolution, the Commission took account of the "Position paper on exchange of hydrological data and technology" and the draft resolution on the subject that had been prepared by the CHy Advisory Working Group.

Discussion:

4. Resolution 40 (Cg-XII) was a reaffirmation of historical practice, which was based on a clearly definable need for the exchange of meteorological data and related products. Hydrology, in contrast, does not have a similarly unique and distinguished history regarding the global exchange of data and information. Traditionally, hydrological data were primarily required for operational forecasting and for ascertaining water availability and apportionment. River basins, or water bodies within a basin, may be transboundary; however, the issues associated with the basin have tended to be of a lesser concern beyond the boundary of the basin. Hydrological models also tended to be applied locally, using historical data for calibration. The model's products and their analyses tended to be site-specific. This has lead to very few, if any, hydrological "products" being distributed globally. To further complicate matters and as a result of various local needs, hydrological data are often collected by a combination of one or more national, state, regional, basin, or private organizations. This is in contrast to meteorological data, which follow internationally agreed to codes and practices normally overseen by one national agency. It should also be noted that the currently promoted economic principles of cost recovery and "user-pays" have been more fully implemented within the water sector than for meteorology in many countries, and private engineering consultancies have had a long established role in undertaking hydrological studies.

5. Within the past few years, hydrology, along with other disciplines, has recognized and responded to the need for development which is environmentally, socially and economically sustainable. Global commons issues, the emergence of a multitude of water-related problems such as those referred to in Agenda 21, the advancement of science and our knowledge of the importance of the hydrological cycle in addressing water-related problems have led to an increased awareness and recognition for the need for broadening and enhancing the exchange of hydrological data. When compared to the rich history of sharing data in meteorology, the concept of sharing hydrological data at the global level is in its infancy. Considerable thought and effort are required to advance the concept of exchanging hydrological data similar to that attained in meteorology. The preparation of a list, specifying the minimum set of hydrological data which Members shall exchange without charge and with no conditions on use, is a formidable task.

6. The inherent differences between meteorology and hydrology and their respective needs for the global exchange of data have led to similar, yet distinct, resolutions. Table 1 shows the correspondence between the draft resolution developed during CHy-X and Resolution 40 (Cg-XII). The following discussion provides supporting information for the similarities and differences between the resolutions.

7. Within NOTING and CONSIDERING, the primary differences between the draft resolution and Resolution 40 (Cg-XII) reflect specific references to hydrology rather than meteorology. The key clauses within the remainder of the draft resolution more closely match those of Resolution 40 (Cg-XII).

8. Within NOTING of the draft resolution, reference is made to Resolution XII-4 from the twelfth session of the Intergovernmental Council of the International Hydrological Programme of UNESCO. The main difference with respect to Resolution 40 (Cg-XII), is that unlike meteorological research, hydrological research at the international level is not conducted within WMO. The primary focus of the International Hydrological Programme (IHP) of UNESCO is research into hydrological sciences at the international level. There is close co-operation and co-ordination between the IHP of UNESCO and WMO's Operational Hydrology Programme. The IHP Resolution recognizes the need for exchange of hydrological data and information for research at regional and international levels. The requirements of the research and education communities for data should be safeguarded and yet account must be taken of the potential for unacknowledged or commercial use.

9. Within CONSIDERING (1) of the draft resolution, reference is made to deliberations of the International Conference on Water and the Environment (Dublin, 1992) where it is stated that: "In many cases, the integrated water resources development and management of transboundary water resources will raise the need for international co-operation and mechanisms at international or regional levels to facilitate inter-country agreement on the co-ordination of the management of such resources in an economically and environmentally sound manner. A coherent approach by all international organizations is also needed."

10. Within CONSIDERING (2) of the draft resolution, reference is made of the call of world leaders at the United Nations Conference on Environment and Development (UNCED) for a significant strengthening of, and capacity building in, water resources assessment. Reference is also made to the request of the United Nations Commission on Sustainable Development (CSD) for a comprehensive assessment of the freshwater resources of the world.

11. Within CONSIDERING (3) of the draft resolution, reference is made to the requirements for water-related terrestrial monitoring specified by various mentioned Conventions, while CONSIDERING (4) of the draft resolution refers to the requirement for the global exchange of

hydrological information in support of various scientific investigations of global change and the global hydrological cycle.

12. The differences between CONSIDERING (5) of the draft resolution and RECOGNIZING (3) of Resolution 40 (Cg-XII) underscore the differences in the operational need and use of data and information by NHSs for hydrology and NMSs for meteorology. Within meteorology, the cooperative international exchange of meteorological and related data and products is imperative for discharging the responsibilities of the NMSs. Within hydrology, it is recognized that international exchange of hydrological data and information and an increase in the level of cooperation are required for more efficient management of water resources and the mitigation of water-related hazards in transboundary river basins.

13. Within the ADOPTS of the draft resolution, reference is made only to "data", while Resolution 40 (Cg-XII) refers to both "data and products". With respect to the overall issue of exchange of data and products, private sector firms in the hydrological and water resources community have provided a range of hydrological products and services for many years, particularly in areas of hydrological technology and added-value services and consultancies. Private sector provision of basic hydrological services - routine monitoring - has been much less common, although in a few countries there are private sector providers which compete for contracts to install and maintain hydrological monitoring stations and archive data. An additional issue in relation to hydrological data is that, unlike operational meteorological data where collection is usually overseen by one national agency, responsibility for hydrological data is often diffused through a combination of one or more national, state, regional, basin, local, or private organizations. In contrast with meteorological products, hydrological products tend to focus on site- or region-specific issues and tend not to be as generic in their make-up or use as meteorological products. Therefore, CHy recognized that the basic need of the international hydrological community was for data, and that products as presented in Resolution 40 (Cg-XII) at this point in time are not widely needed or exchanged in hydrology and water resources.

14. Within FURTHER ADOPTS (1) to (5), the Commission used terminology of "shall" versus "should" to emphasize the requirement versus the desirability of the practices on international exchange of hydrological information at different levels.

15. Resolution 40 (Cg-XII) contains URGES in addition to those within the draft resolution. These additional URGES refer to conditions either related specifically to meteorology or are related to the data list and the annexes.

Further Action:

16. CBS has been requested by Cg-XII to compile and keep under continuous review a consolidated list of products required to support WMO Programmes. CHy has requested its AWG to compile during the next year the hydrological elements within the consolidated list, such that the president of CHy might present the views of the Commission to the next session of CBS.

17. The Commission recommended that during the review phase, which is referred to under REQUESTS (2) of the draft resolution, consideration be given to experience gained on the relations between NHSs themselves and between NHSs and the commercial sector to reflect issues similar to those covered by Annexes 2 and 3 of Resolution 40 (Cg-XII). The Commission foresaw that various technical aspects of the implementation of the policy would need to be studied in some detail and recommended that other interested international organizations, such as UNESCO, be invited to join in these studies.

TABLE 1

CORRESPONDENCE BETWEEN CHy-X DRAFT RESOLUTION AND RESOLUTION 40 (Cg-XII)

DRAFT RESOLUTION 3/1 (CHy-X)		RESOLUTION 40 (Cg-XII)
Noting:	(1)	Resolution 40 itself
	(2)	Considering: (4)
	(3)	Considering: (1), (3)
	(4)	See discussion (Research in UNESCO IHP)
Considering:	(1)	See discussion (Dublin Conference)
	(2)	Considering: (4)
	(3)	Considering: (5)
	(4)	Considering: (2)
	(5)	See discussion (Transboundary basins)
Recognizing:	(1)	Recognizing: (2)
	(2)	Recognizing: (5)
	(3)	Recognizing: (7)
	(4)	Recognizing Further: (1), (2)
	(5)	Recognizing Further: (4)
Adopts:		Adopts: See discussion (Data only)
Further Adopts:	(1)	Adopts: (1)
	(2)	Adopts: (2)
	(3)	Adopts: (3)
	(4)	Adopts: (2), (3)
	(5)	Urges: (7)
Urges:	(1)	Urges: (5)
	(2)	Urges (3)
Requests:	(1)	Requests: (1)
	(2)	Requests: (3)
Decides:		Decides: (1)

time-sensitive operations, such as during natural and human-made disasters, as well as complex emergencies so that the fullest support can be provided for humanitarian relief activities. The Council requested CBS to study ways of achieving the availability of these data and products in support of public safety in accordance with Resolution 40 (Cg-XII).

12.1.17 The need for continuing consultation, coordination and cooperation in connection with the implementation of Resolution 40 (Cg-XII) with other relevant international organizations was also underscored.

12.1.18 The Council expressed appreciation to the Permanent Representative of USA with WMO for the holding of the Forum on International Data Exchange (Long Beach, 2 February 1997), which provided an opportunity for improved mutual understanding by all parties concerned. The Council agreed that further fora of this type might be useful in the future and encouraged the holding of similar events in other regions especially for the benefit of developing countries.

12.1.19 Concerning the exchange of climate data and products, the Council requested CCl to give special attention to this matter to help clarify those aspects of Resolution 40 (Cg-XII) pertaining to climate data and products; taking into consideration the development of GCOS, the requirements for climate data and products for IPCC assessments, and negotiations on the implementation of the UN Framework Convention on Climate Change. In view of the importance of the Internet for the exchange of climate data and products, the Council encouraged Members to have Internet access as soon as possible.

Exchange of Hydrological Data

12.1.20 The Council recalled that Cg-XII and EC-XLVIII had invited the president of CHy to continue work on the issue of commercialization and the international exchange of hydrological data and products. The president of the Commission reported on the work of the CHy Advisory Working Group (AWG) in preparing an aide memoire on commercialization, a position paper on the exchange of data, and a draft resolution. It was noted that, although neither Congress nor the Executive Council had specifically requested the CHy to prepare such a resolution, CHy-X had considered that would indeed be the best course of action and accordingly had devoted considerable effort to developing the original draft into a resolution which, while referring specifically to hydrological data, faithfully reproduced both the spirit and the structure of Resolution 40 (Cg-XII).

12.1.21 The Council expressed its appreciation to CHy for the work done in preparing the draft resolution, which represented a major step forward. The Council considered that the eventual adoption of such a resolution would be of great importance for providing international cooperation in the exchange of data needed, such as for combatting the threats of floods and droughts, as well as in encouraging the establishment of data bases for use in fundamental and applied research at regional and global levels.

12.1.22 In considering the draft resolution, the Council took account of the explanatory note on the subject prepared by the CHy AWG at the request of the Commission which, among others, addressed the differences between the situation relating to the exchange of meteorological data and that on the exchange of hydrological data.

12.1.23 The Council also noted the comments of its Advisory Group on the Exchange of Meteorological and Related Data and Products on this topic and the Group's endorsement of the draft resolution prepared by CHy-X.

12.1.24 The Council recalled that the WMO Technical Regulations identified the routine functions of NHSs as including "making data accessible to users, when, where, and in the form they require", but that such data were often collected and disseminated by a diversity of agencies in addition to NHSs and might also be obtained from satellites. It therefore encouraged Members to consider the consolidation of relevant functions and activities under one national body. It also considered that it was important to clarify the types of data to be exchanged under the draft resolution and for what purposes they would be exchanged.

12.1.25 The Council requested the president of CHy to take the above comments into consideration in the further work to be done in relation to the draft resolution, in preparation for its eventual submission to Congress, using the resources of both the Commission and the Regional Associations' Working Groups on Hydrology. It also recommended that further consultation be made with other international organizations involved in the exchange of hydrological data, most notably UNESCO, ICSU and the International Association of Hydrological Sciences. It also requested the president of CHy to report to EC-L on progress made.

Proposed WIPO Treaty on Databases

12.1.26 The Council noted the developments relating to the proposed mechanism for the protection of databases being pursued under the aegis of the World Intellectual Property Organization (WIPO). It is of interest to the WMO because of its potential impacts on the implementation of its Resolution 40 (Cg-XII). The Council recognized the importance of this issue and its relationship to the various other issues of interest to WMO.

12.1.27 The Council recognized both the legitimate concern of database producers, and the need to reflect the interests of the other sectors, including those in the scientific, education and research communities, in general, and the WMO community, in particular.

12.1.28 The Council expressed appreciation of the various actions taken by the Secretary-General to draw attention of WIPO and countries to the views of the Organization vis-à-vis this issue. In particular, the regular flow of information and advice to Permanent Representatives of Members of WMO and the latters' actions were highly useful. The Council noted the action taken by the Secretary-General to coordinate with ICSU and other relevant UN organizations such as UNESCO and its IOC. The Council thanked IOC for alerting ICSPRO agencies including WMO in September 1996, concerning the potential impact of the proposed WIPO Database Treaty.

12.1.29 The Council requested the Secretary-General to continue to inform and advise Members on relevant developments, particularly to assist in further clarifying the issues involved, to improve awareness of these issues and to enable the NMHSs to take appropriate and timely action.

12.1.30 The Council agreed that this issue provides a challenge and an opportunity for WMO, and that it must be carefully and sensitively handled in order to maintain the unity within the Organization in promoting the free and unrestricted international exchange. While there are risks involved, deliberation on this topic could provide an opportunity for the explicit recognition of the principle of free and unrestricted data exchange expounded in Resolution 40 (Cg-XII) as part of an overall legally binding instrument on database protection.

12.1.31 The Council agreed that WMO should not oppose protection of databases. The Council also felt that it would be desirable to seek the explicit recognition, and/or the

incorporation of the essence, of Resolution 40 (Cg-XII) in any database protection legal instrument. This would be a way to ensure the principle enunciated in Resolution 40 (Cg-XII) achieved an enhanced legal standing (see also paragraph 12.1.9).

Data access policy for meteorological research experiments

12.1.32 The Council stressed the importance of ensuring the consistency of the data policy for WMO-sponsored research experiments with Resolution 40 (Cg-XII).

12.1.33 While noting and emphasizing the importance of ADOPTS (3) of WMO Resolution 40 (Cg-XII) in providing free and unrestricted access to all data and/or products exchanged under the auspices of WMO for non-commercial use by the research and education communities, the Council agreed that with respect to meteorological research experiments, "all data and products" in ADOPTS (3) should encompass:

(a) Those meteorological data and/or products which are "essential" and/or "additional" under Resolution 40 (Cg-XII);

(b) All meteorological and related data resulting from special observing periods within the experiment.

12.1.34 The Council confirmed that the release of data and/or products under 12.1.33 (a) and (b) above, for research and education purposes, are covered by Resolution 40 (Cg-XII). The Council urged that best efforts should be made by Members to ensure that the concerned members of their research and education communities are made aware of the relevant clauses of Resolution 40 (Cg-XII).

12.1.35 The Council felt that for a particular WMO research experiment, where supplemental data and/or products which would not normally come under the ambit of Resolution 40 (Cg-XII) form part of a research database, the originator's terms for the provision of such supplemental data and/or products should be agreed to by the requesting researchers before access is permitted. The acceptance of these conditions would allow a greater database to be made available to the research and educational communities, than would otherwise be the case.

World Data Centres Data Policy

12.1.36 The Council noted that most of the WMO World Data Centres do not have a formal policy governing access to their data holdings. However, in practice, these Centres distribute their data on the basis of the principle of free and open exchange.

12.1.37 The Council recalled that WMO Resolution 40 (Cg-XII) urges Members to "strengthen their commitments to the WMO and ICSU WDCs in their collection and supply of meteorological and related data and products on a free and unrestricted basis."

12.1.38 The Council was of the view that WMO World Data Centres' current data distribution practice was implicitly embodied not only in Resolution 40 (Cg-XII), but also in earlier decisions of Congress, the Executive Council and Technical Commissions. In the light of recent and foreseeable developments in the relevant WMO Programmes, a formal, explicit policy on access to data held at WMO World Data Centres needs to be formulated, in association with the relevant Technical Commissions.

12.1.39 The Council agreed that a set of general principles should be developed consistent with Resolution 40 (Cg-XII). The Council reviewed a preliminary set of such guidelines for WMO World Data Centres to use in developing their data access policies (see Annex). In this

connection, the Council was of the view that the World Data Centres, ICSU and other organizations such as IOC should be involved in the formulation of any future policy guidelines.

12.1.40 The Council also agreed that, to the extent possible, the WMO Data Centres should provide information (e.g., location) on other related data that they may not actually hold (i.e., serve as meta data centres).

12.1.41 The representative of IOC expressed his organization's appreciation for the work done and the cooperation extended by WMO in connection with the international data exchange and related topics discussed under this agenda item. He reiterated his organization's desire and willingness to further strengthen this collaboration.

ANNEX

Annex to paragraph 12.1.39 of the general summary

Draft Principles governing access to data held in WMO World Data Centres

The overall purpose of these principles is to facilitate the full, open and prompt availability of quality assured data. They were prepared in consonance with the goals of the relevant WMO Programmes, and the WMO policy on international data exchange, as set out in Resolution 40 (Cg-XII).

1. WMO World Data Centres are coordinated through the relevant WMO bodies. The Centres themselves are established, organized, supported and managed entirely within national and international entities, as their contribution to the relevant WMO Programmes.

2. WMO Members have a common ownership of the data held in the WMO World Data Centres.

3. WMO World Data Centres should provide data on a free and unrestricted basis, at the lowest possible cost which should be no more than the cost of reproduction and distribution. No charge will be made for the data themselves.

4. WMO World Data Centres shall not accept in their holdings data for which there are restrictions for free and open access.

5. Members participating in the relevant WMO Programmes are urged to endeavor to submit data to the relevant WMO World Data Centre(s) as promptly as possible in accordance with the procedures defined by the Centres.

6. Procedures and criteria for data reporting to the WMO World Data Centres should be developed by each of the Centres.

7. Data archives of WMO World Data Centres must include readily accessible and comprehensive information describing the data sets, including quality assessments.

8. WMO World Data Centres should, to the greatest extent possible, use media as well as processing and communication systems which are compatible with internationally accepted standards and protocols.

9. Long-term preservation of all data submitted to the WMO World Data Centres should be ensured.

Annex 6

Examples of Data Policies other than the Data Policy of GRDC

WORLD METEOROLOGICAL ORGANIZATION

TWELFTH

WORLD METEOROLOGICAL CONGRESS

GENEVA, 30 MAY–21 JUNE 1995

ABRIDGED FINAL REPORT WITH RESOLUTIONS

WMO-No. 827

Secretariat of the World Meteorological Organization - Geneva - Switzerland
1995

RESOLUTION 19 (Cg-XII)

STRATEGY AND ACTION PLAN FOR MONITORING AND ASSESSING WATER RESOURCES OF AFRICA

THE CONGRESS,

NOTING:

(1) The findings and recommendations of the World Bank/UNDP Sub-Saharan Africa Hydrological Assessment Project and the WMO/UNESCO Evaluation of Water Resources Assessment Activities,

(2) The principles of UNCED Agenda 21, in particular those in Chapter 18,

(3) The report and recommendations of the Conference on Water Resources: Policy and Assessment (Addis Ababa, March 1995) convened by WMO and the United Nations Economic Commission for Africa (UN/ECA),

(4) That the strategy and action plan for the monitoring and assessment of the water resources of Africa, adopted by the Conference on Water Resources, had been subsequently adopted by the Conference of Ministers of UN/ECA by its Resolution 800 (xxx) in May 1995,

CONSIDERING:

(1) The rapidly increasing demand for hydrological and water resources data and information for the development and management of water projects of Members,

(2) That Regional Association I (Africa), at its eleventh session (1994), had restructured its Working Group on Hydrology so that it would function in close collaboration with the subregional economic and political groupings and international river basin authorities in developing plans for water resources assessment,

DECIDES that WMO should take the leadership role, in collaboration with other United Nations organizations and external agencies as well as national, subregional, and regional organizations involved in the water sector, to:

(*a*) Actively promote the "African Water Resources Assessment Programme — Policy, Strategy and Action Plan" adopted by the African Conference on Water Resources: Policy and Assessment in the context of a comprehensive approach to sustainable development;

(*b*) Mobilize the political and financial support for the implementation of the Strategy and Action Plan;

URGES national Governments and regional and subregional agencies to incorporate the Strategy and Action Plan developed by the Conference into their water resources assessment, development, and management programmes and to ensure their implementation;

REQUESTS the president of the Regional Association for Africa:

(1) To arrange for the incorporation of the Strategy and Action Plan developed by the Conference into the RA I hydrology and water resources programme for the African region;

(2) To arrange, through the RA I Working Group on Hydrology, the development of detailed action proposals for the implementation of the Strategy and Action Plan for assessing the water resources in Africa, in collaboration with the constituent bodies of the subregional political and economic groupings, such as the Economic Community of Central African States (ECCAS), the Economic Community of West African States (ECOWAS), the Inter-governmental Authority on Drought and Development (IGADD), the Southern African Development Community (SADC), and the Arab Maghreb Union (AMU);

REQUESTS the Secretary-General:

(1) To invite UN/ECA to join with WMO in the leadership role mentioned under **DECIDES**;

(2) To invite other agencies involved in the field of water resources and external support agencies (donors), particularly the World Bank, UNDP, the African Development Bank, the European Union, and other multilateral and bilateral funding agencies, to incorporate the Strategy and Action Plan into their programmes of assistance for water resources assessment and integrated water resources development and management to countries in the Region;

REQUESTS the Executive Council and the Secretary-General, as appropriate and within the available budgetary resources, to take all necessary actions to assist the Regional Association for Africa and all bodies concerned in implementing the Strategy and Action Plan for monitoring and assessing the water resources of Africa as a regional component of the HWRP.

RESOLUTION 20 (Cg-XII)

WORLD HYDROLOGICAL CYCLE OBSERVING SYSTEM (WHYCOS)

THE CONGRESS,

NOTING:

(1) That WHYCOS has already been endorsed by the Commission for Hydrology at its ninth session (1993),

(2) That the Executive Council, at its forty-sixth session (1994), expressed the view that WHYCOS was potentially of great importance to water resources assessment on the global, regional, and national scales,

(3) That the eleventh session (1995) of the Intergovernmental Council of the International Hydrological Programme of UNESCO adopted a resolution which called upon the Director General of UNESCO to arrange, in cooperation with WMO, for the planning and implementation of WHYCOS,

(4) That the World Bank, as part of its water resources strategies, has specifically recommended the

establishment of a Hydrological Cycle Observing System (HYCOS),

(5) The financial support already given by the World Bank for the implementation of the Mediterranean Hydrological Cycle Observing System (MED-HYCOS), a subregional component of WHYCOS, and the interest shown by other donors for similar subregional components,

CONSIDERING:

(1) That WHYCOS is one of the basic WMO responses to the recommendation of the United Nations Commission on Sustainable Development to strengthen efforts towards a comprehensive assessment of freshwater resources, notably by providing timely, reliable, and consistent data to regional data centres. Certain of these data could, then, be made available at the international level through centres, such as GRDC for runoff data,

(2) That WHYCOS has a vital role to play in several new programmes, such as GCOS, GTOS and GOOS,

(3) That the WHYCOS concept is in line with the spirit of international cooperation in which WWW was established and has since operated,

ENCOURAGES Members:

(1) To participate in the development of a global conceptual basis for providing a framework and general guidance for the establishment of WHYCOS;

(2) To facilitate the establishment of WHYCOS through the implementation of national, subregional and regional components of the system;

REQUESTS the president of the Commission for Hydrology to ensure that the Commission provides WHYCOS with the technical advice that it requires;

REQUESTS the Secretary-General:

(1) To invite other international organizations to cooperate with WMO to establish WHYCOS, contribute to its implementation, and make use of it;

(2) To provide all possible support to WHYCOS from available resources and to seek additional resources for this purpose from external sources.

RESOLUTION 21 (Cg-XII)

GLOBAL RUNOFF DATA CENTRE (GRDC)

THE CONGRESS,

NOTING:

(1) That the GRDC has its origins in support to the WCRP and to studies of large-scale hydrological processes,

(2) The generous support that has been provided by Germany over many years for the establishment and maintenance of the Centre,

(3) That the GRDC is now widely-recognized as the principal source of global data on river flows, providing an effective service to an increasing range of users,

(4) That the Centre already cooperates in a number of major international projects,

(5) That through its Resolution 11 (EC-XLV) — Report of the ninth session of the Commission for Hydrology, the Executive Council had approved Recommendation 2 (CHy-IX) — Support to global data centres,

CONSIDERING:

(1) That new and increased demands are now being put on the Centre, in particular in relation to the global assessment of the world's water resources requested by the second session of the United Nations Commission on Sustainable Development (1994), the need for a global data centre in relation to WHYCOS, and for various climate studies,

(2) That the Centre will need considerably more resources if it is to meet these new demands effectively,

RECOGNIZING that the GRDC is a major component of WMO's HWRP, serving also the WCRP and other programmes of the Organization,

ENCOURAGES Members:

(1) To support the GRDC through the provision of the hydrological data and related information that it needs, including through the regional components of WHYCOS;

(2) To consider also providing support to the Centre in the form of staff, funding, and other resources;

REQUESTS the president of the Commission for Hydrology to ensure that the Commission provides the GRDC with the scientific and technical advice that it requires;

REQUESTS the Secretary-General:

(1) To invite other international organizations to cooperate with the GRDC, to make use of the services that it offers and to contribute both data and other resources in support of its operations;

(2) To provide all possible support to the GRDC from available resources and to seek additional resources for this purpose from external sources.

so that all countries have the capacity to benefit from and contribute to the implementation of WMO Programmes, by continuing a comprehensive programme of technical publications, and by assisting in the incorporation of advances in marine science into marine observing systems and the provision of services.

These responsibilities exclude those aspects specifically handled by other WMO constituent bodies.

COMMISSION FOR CLIMATOLOGY (CCl)

The Commission shall be responsible for matters relating to climate and its relationship with human well-being, human activities and sustainable development, including:

(*a*) The coordination and consolidation of general data requirements, including those for observations, data collection, supply and exchange, for all components of the WCP and its associated activities such as GCOS (in cooperation with other relevant bodies) as the Commission having the lead role in the World Climate Data and Monitoring Programme (WCDMP);

(*b*) The identification and promotion of best practices in the collection, quality control, archiving, access and further management of climate data, proxy data, remote sensing data and metadata, taking into consideration that some of these aspects are also the responsibility of other commissions;

(*c*) The development and promotion of objective statistical methods for describing and interpreting climate data, including assessment of representativeness and reliability, spatial and temporal interpolation, extreme value analysis, homogeneity analysis and trend detection in climatological series, taking into consideration that some of these aspects are also the responsibility of other commissions;

(*d*) The analysis and monitoring of climate, its spatial and temporal variations and the issue of climate data and products in support of research, applications and impact assessments;

(*e*) The evaluation and review of operational climate predictions;

(*f*) The preparation of authoritative statements on climate;

(*g*) As lead Commission in the World Climate Applications and Services Programme (WCASP), the development and improvement of services and applications methodologies in cooperation with other relevant commissions, particularly for the use of climate information in the fields of:

(i) Energy;
(ii) Land use, urban planning and building design;
(iii) Transportation (especially on land) and communication;
(iv) Tourism and recreation;
(v) Drought management and combat of desertification;
(vi) Environmental management, including air quality;
(vii) Retail trade, commerce and law;

(*h*) Identification of priority areas for investigation of human effects on local and regional climate and for promotion of existing knowledge and methods for alleviating problems;

(*i*) The promotion of capacity building and technology transfer in respect to climatological practices and activities in support of WMO Programmes;

(*j*) The development of methods, in particular for the purposes of the WCASP, for effective presentation to users of climatological information, and for the promotion of climatological services and their value, including cost-benefit information;

(*k*) The development of methods for application of climate predictions to socio-economic activities;

(*l*) Advising the appropriate WMO bodies of issues and scope of commercialization of climatological data and services.

NOTE: The terms of reference of CHy and CAgM remain unchanged.

RESOLUTION 40 (Cg-XII)

WMO POLICY AND PRACTICE FOR THE EXCHANGE OF METEOROLOGICAL AND RELATED DATA AND PRODUCTS INCLUDING GUIDELINES ON RELATIONSHIPS IN COMMERCIAL METEOROLOGICAL ACTIVITIES

THE CONGRESS,

NOTING:

(1) Resolution 23 (EC-XLII) — Guidelines on international aspects of provision of basic and special meteorological services,

(2) Resolution 20 (EC-XLVI) — WMO policy on the exchange of meteorological and related data and products,

(3) Resolution 21 (EC-XLVI) — Proposed new practice for the exchange of meteorological and related data and products,

(4) Resolution 22 (EC-XLVI) — WMO guidelines on commercial activities,

(5) The report to Twelfth Congress of the chairman of the Executive Council Working Group on the Commercialization of Meteorological and Hydrological Services,

established at the request of Eleventh Congress by the Executive Council in Resolution 2 (EC-XLIII) — Working Group on the Commercialization of Meteorological and Hydrological Services,

RECALLING:

(1) The general policies of the Organization, as set down in the Third WMO Long-term Plan (1992–2001) adopted by Eleventh Congress, which include, *inter alia*, that Members should reaffirm their commitment to the free and unrestricted international exchange of basic meteorological data and products, as defined in WMO Programmes (*Third WMO Long-term Plan*, Part I, Chapter 4, paragraph 127),

(2) The concern expressed by Eleventh Congress that commercial meteorological activities had the potential to undermine the free exchange of meteorological data and products between national Meteorological Services,

CONSIDERING:

(1) The continuing fundamental importance, for the provision of meteorological services in all countries, of the exchange of meteorological data and products between WMO Members' national Meteorological or Hydrometeorological Services (NMSs), WMCs, and RSMCs of the WWW Programme,

(2) Other programmes of world importance such as GCOS, GOOS, WCRP, and IGOSS, which are sponsored and implemented in cooperation with other international organizations,

(3) The basic role of WMO Members' NMSs in furthering applications of meteorology to all human activities,

(4) The call by the world leaders at UNCED (Brazil, 1992) for increasing global commitment to exchange scientific data and analysis and for promoting access to strengthened systematic observations,

(5) The provision in the UN/FCCC committing all Parties to the Convention to promote and cooperate in the full, open, and prompt exchange of information related to the climate system and climate change,

RECOGNIZING:

(1) The increasing requirement for the global exchange of all types of environmental data in addition to the established ongoing exchange of meteorological data and products under the auspices of the WWW,

(2) The basic responsibility of Members and their NMSs to provide universal services in support of safety, security and economic benefits for the peoples of their countries,

(3) The dependence of Members and their NMSs on the stable, cooperative international exchange of meteorological and related data and products for discharging their responsibilities,

(4) The continuing requirement for Governments to provide for the meteorological infrastructure of their countries,

(5) The continuing need for, and benefits from, strengthening the capabilities of NMSs, in particular in developing countries, to improve the provision of services,

(6) The dependence of the research and education communities on access to meteorological and related data and products,

(7) The right of Governments to choose the manner by, and the extent to, which they make data and products available domestically or for international exchange,

RECOGNIZING FURTHER:

(1) The existence of a trend towards the commercialization of many meteorological and hydrological activities,

(2) The requirement by some Members that their NMSs initiate or increase their commercial activities,

(3) The risk arising from commercialization to the established system of free and unrestricted exchange of data and products, which forms the basis for the WWW, and to global cooperation in meteorology,

(4) Both positive and negative impacts on the capacities, expertise and development of NMSs, and particularly those of developing countries, from commercial operations within their territories by the commercial sector including the commercial activities of other NMSs,

REMINDS Members of their obligations under Article 2 of the WMO Convention to facilitate worldwide cooperation in the establishment of observing networks and to promote the exchange of meteorological and related information; and of the need to ensure stable ongoing commitment of resources to meet this obligation in the common interest of all nations;

ADOPTS the following policy on the international exchange of meteorological and related data and products:

As a fundamental principle of the World Meteorological Organization (WMO), and in consonance with the expanding requirements for its scientific and technical expertise, WMO commits itself to broadening and enhancing the free and unrestricted[1] *international exchange of meteorological and related data and products;*

ADOPTS the following practice on the international exchange of meteorological and related data and products[2]:

(1) Members shall provide on a free and unrestricted basis essential data and products which are necessary for the provision of services in support of the protection of life and property and the well-being of all nations, particularly those basic data and products, as, at a minimum, described in Annex 1 to this resolution, required to describe and forecast accurately weather and climate, and support WMO Programmes;

(2) Members should also provide the additional data and products which are required to sustain WMO Programmes at the global, regional, and national levels and, further, as agreed, to assist other Members in the provision of meteorological services in their countries. While increasing the volume of data and products available to all Members by providing these additional data and products, it is understood that WMO Members may be justified in placing conditions on

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1 "Free and unrestricted" means non-discriminatory and without charge [Resolution 23 (EC-XLII) — Guidelines on international aspects of provision of basic and special meteorological services]. "Without charge", in the context of this resolution means at no more than the cost of reproduction and delivery, without charge for the data and products themselves.

2 See Annex 4 to this resolution for definitions.

their re-export for commercial purposes outside of the receiving country or group of countries forming a single economic group, for reasons such as national laws or costs of production;

(3) Members should provide to the research and education communities, for their non-commercial activities, free and unrestricted access to all data and products exchanged under the auspices of WMO with the understanding that their commercial activities are subject to the same conditions identified in **ADOPTS** (2) above;

STRESSES that all meteorological and related data and products required to fulfil Members' obligations under WMO Programmes will be encompassed by the combination of essential and additional data and products exchanged by Members;

URGES Members to:

(1) Strengthen their commitment to the free and unrestricted exchange of meteorological and related data and products;

(2) Increase the volume of data and products exchanged to meet the needs of WMO Programmes;

(3) Assist other Members, to the extent possible, and as agreed, by providing additional data and products in support of time-sensitive operations regarding severe weather warnings;

(4) Strengthen their commitments to the WMO and ICSU WDCs in their collection and supply of meteorological and related data and products on a free and unrestricted basis;

(5) Implement the practice on the international exchange of meteorological and related data and products, as described in **ADOPTS** (1) to (3) above;

(6) Make known to all Members, through the WMO Secretariat, those meteorological and related data and products which have conditions related to their re-export for commercial purposes outside of the receiving country or group of countries forming a single economic group;

(7) Make their best efforts to ensure that the conditions which have been applied by the originator of additional data and products are made known to initial and subsequent recipients;

FURTHER URGES Members to comply with:

(1) The Guidelines for Relations among National Meteorological or Hydrometeorological Services Regarding Commercial Activities as given in Annex 2 to this resolution;

(2) The Guidelines for Relations between National Meteorological or Hydrometeorological Services and the Commercial Sector as given in Annex 3 to this resolution;

INVITES Members to provide explanation of the WMO policy, practice, and guidelines to the commercial sector and other appropriate agencies and organizations;

REQUESTS the Executive Council to:

(1) Invite the president of CBS, in collaboration with the other technical commissions as appropriate, to provide advice and assistance on the technical aspects of implementation of the practice;

(2) Invite the president of CHy to continue his work on the issue of commercialization and the international exchange of hydrological data and products;

(3) Keep the implementation of this resolution under review and report to Thirteenth Congress;

REQUESTS the Secretary-General to:

(1) Keep Members informed on the impacts of commercialization on WMO Programmes and to facilitate the exchange of relevant information on commercialization among NMSs;

(2) Report on a timely basis to all Members on those meteorological and related data and products on which Members have placed conditions related to their re-export for commercial purposes;

(3) Maintain effective coordination with IOC and other involved international organizations in respect of joint programmes during WMO's implementation of the practice;

DECIDES to review the implementation of this resolution at Thirteenth Congress.

ANNEX 1 TO RESOLUTION 40 (Cg-XII)

DATA AND PRODUCTS TO BE EXCHANGED WITHOUT CHARGE AND WITH NO CONDITIONS ON USE

Purpose

The purpose of this listing of meteorological and related data and products is to identify a minimum set of data and products which are essential to support WMO Programmes and which Members shall exchange without charge and with no conditions on use. The meteorological and related data and products which are essential to support WMO Programmes include, in general, the data from the RBSNs and as many data as possible that will assist in defining the state of the atmosphere at least on a scale of the order of 200 km in the horizontal and six to 12 hours in time.

Contents

(1) Six-hourly surface synoptic data from RBSNs, e.g. data in SYNOP, BUFR or other general purpose WMO Code;

(2) All available *in situ* observations from the marine environment, e.g. data in SHIP, BUOY, BATHY, TESAC codes, etc.;

(3) All available aircraft reports, e.g. data in AMDAR, AIREP codes, etc.;

(4) All available data from upper air sounding networks, e.g. data in TEMP, PILOT, TEMP SHIP, PILOT SHIP codes etc.;

(5) All reports from the network of stations recommended by the regional associations as necessary to provide a good representation of climate, e.g. data in CLIMAT/CLIMAT TEMP and CLIMAT SHIP/CLIMAT TEMP SHIP codes, etc.;

(6) Products distributed by WMCs and RSMCs to meet their WMO obligations;

NOTE:

The draft resolution on the exchange of hydrological data of the WMO Executive Council (EC) for WMO Congress will be presented during the meeting. The EC convenes just about one week prior to the GRDC-Steering Committee.

UNITED NATIONS EDUCATIONAL,
SCIENTIFIC AND CULTURAL ORGANIZATION

International Hydrological Programme (IHP)

TWELFTH SESSION OF THE INTERGOVERNMENTAL COUNCIL

Paris, 23 - 28 September 1996

Final Report

UNESCO, Paris 1996

SC-96/CONF.207/CLD.31

RESOLUTION XII-4

Exchange of Hydrological Data and Information

The Intergovernmental Council of the International Hydrological Programme

Recognizing that following increased emphasis on environmental issues, freshwater has been identified as a priority area for joint action among the agencies of the UN system,

Noting that a number of recently adopted international conventions call for the compilation and international exchange of environmental data,

Recognizing the existence of a number of valuable international hydrologically related data sets such as those established for the FRIEND projects and for the World Climate Programme - Water,

Noting that a number of global and large scale international projects have been established, or are evolving, such as WHYCOS, GCOS, GTOS,

Endorsing the joint statement of the chairpersons of the IOC, MAB, IHP, IGCP and MOST that sound decision making in the field of environment and development must be based on scientifically sound information, with respect to both the analysis of the problems and the search for solutions,

Recognizing that sound information on global water matters can only be drawn from accurate and consistent hydrological data compiled on a global basis,

Noting that, in 1995, the international meteorological community reached agreement on the international exchange of meteorological and related data and products by adopting Resolution 40 of the twelfth WMO Congress and that the WMO Commission for Hydrology has been requested to consider the question of the exchange of hydrological data at its tenth session in Koblenz in 1996,

Invites Member States to review their polices for the international exchange of hydrological data so that they may be supportive of the research being undertaken on major global issues,

Requests the IHP National Committees to work with their national Hydrological Services to provide the scientific community with access to the hydrological data and information needed for research at regional and international levels and to do so as appropriate under the auspices of the established global observing systems using the internationally recognized international data centres,

Invites the WMO Commission for Hydrology to establish a joint working group consisting of representatives from UNESCO, WMO and other interested international agencies to develop a proposal for consideration by UNESCO and WMO for the international exchange of hydrological data, including such issues as property, classification and circulation.

ICSU

World Data Center System

Principles

Locations

Data

Services

Guide

Geophysical, Solar, and Environmental Data

International Council of Scientific Unions

1996

Panel on World Data Centres

APPENDIX D

PRINCIPLES AND RESPONSIBILITIES OF WDCs
1987 VERSION

GENERAL PRINCIPLES

1 World Data Centers (WDCs) operate under the auspices of the International Council of Scientific Unions (ICSU) for the benefit of the international scientific community and provide a mechanism for international exchange of data in all disciplines related to the Earth, its environment, and the Sun.

2 World Data Centers in the United States are designated as WDC-A. Those in the Soviet Union are designated WDC-B. The WDC-C centers, C1 and C2, are located in other countries. An individual WDC may treat one or several of the disciplines or programs covered in the *Guide to the World Data Center System.*

3 World Data Centers, to the extent their resources allow, acquire and store data from national and international sources, in accordance with procedures and standards recommended by various international scientific bodies in the ICSU family, or other appropriate international organizations, and approved by the ICSU Panel on World Data Centres. These procedures are published periodically in the *Guide to the World Data Center System.*

4 World Data Centers exchange data among themselves on a mutually agreed, reciprocal basis.

5 Data held by a World Data Center must be completely accessible by scientists in all countries, upon written request or personal visit. Charges may be imposed to cover the costs of providing services to users.

6 The resources required for the activities of a World Data Center are the responsibility of the host country or institution. In order to provide continuity, the host country is expected to provide these resources on a long-term basis.

7 The coordination of WDC activities within a country is the responsibility of the appropriate national committee or scientific institution under which it is established.

8 The designation of institutions as WDCs is normally the responsibility of the host country acting with the approval of the ICSU Panel.

9 A WDC which for some reason may not be able to continue its activities and services is invited to make its holdings and records available to another WDC in the same discipline, and to notify the ICSU Panel through the A, B, C1 or C2 representative.

10 Each WDC is expected to report on its activities as requested by ICSU.

RESPONSIBILITIES OF A WORLD DATA CENTER

1 In accord with the General Principles, World Data Centers will fulfil data exchange requirements set out in the current version of the Guide to the World Data Center System. To the extent possible they will also respond to resolutions and recommendations from appropriate international organizations.

2 Duplication of data collections between WDCs may be specified in some disciplines.

3 Whenever possible the exchange of data between World Data Centers will take place without charge.

4 The provision of WDC data to an individual scientist or institution will normally require a charge to cover the costs of duplication and handling. This charge may be waived when the individual or institution is a contributor to the WDC concerned.

5 A WDC may also provide a mechanism for a scientist to request data not explicitly described in the Guide to the World Data Center System. In response to a bona fide request for such data, the WDC will attempt to obtain the data or forward the request to another WDC for action.

6 Where a WDC maintains a data collection, it must provide proper facilities for data storage and maintenance, and ensure that data copies are subject to adequate standards of accuracy, clarity and durability.

7 World Data Centers will explore the utilization of modern technology for data storage, data communications and user access.

8 Each World Data Center must be open to visitors and guest workers from any country and all data held under WDC auspices must be accessible to such visitors and workers.

9 Each World Data Center has a responsibility to make available to other WDCs and the scientific community a detailed description of the data available through the WDC.

10 Where more than one WDC holds or has access to data in a given discipline, joint data catalogs or inventories should be compiled.

11 World Data Centers endeavor to coordinate their activities, standardize data formats and cooperate in international projects and to this end visits by WDC staff to other WDCs and to international scientific meetings are encouraged.

12 World Data Centers receive data from many sources. While every attempt will be made to assure reasonable standards of data quality and related documentation, the ultimate responsibility for data reliability lies with the data contributor, not the WDC.

Data Policy for the IGBP

by John Townshend

Data policy has become an increasingly important topic for the IGBP as more of its Core Projects and Framework Activities move from planning to implementation stages. As a programme of the International Council of Scientific Unions (ICSU) various principles and guidelines already apply implicitly to the IGBP.

Since the International Geophysical Year (1957/58), ICSU has maintained a World Data Center (WDC) system, which serves to collect, store, process as appropriate, and redistribute data. ICSU lays down responsibilities on its constituent programs to ensure the free and open international exchange of data: in summary these are as follows.

ICSU programmes shall include data management plans that provide details on which data, and in which formats, shall be submitted by participants to the WDCs so that all data may be shared not only by participants but by all scientists.

It is implicit in the agreements by adhering bodies to the ICSU that national participation in an ICSU programme includes the agreement to submit data according to the data management plan.

In 1990, in accordance with established ICSU policies on open and unrestricted data and information exchange, data policies were proposed for IGBP-DIS. These include the statements:

> *"The IGBP places high priority on establishment, maintenance, validation, description, accessibility, and distribution of high-quality, long-term global data sets, including the synthesis or generation of new global data sets,"* and, *"Full and open sharing of the full suite of global data sets, and other data sets needed for global change studies, is the primary objective of the IGBP-DIS"* (IGBP Report No. 12).

Relying on the ICSU and WDC principles the following more detailed data policy principles were proposed and accepted at the IGBP's Scientific Committee Meeting in Australia in December 1994.

i) The IGBP requires an early and continuing commitment to the establishment, maintenance, validation, description, accessibility, and distribution of high-quality, long-term data sets.

ii) Full and open sharing of the full suite of global data sets for all global change researchers is a fundamental objective.

iii) Preservation of all data needed for long-term global change research is required. For each and every global change data parameter, there should be at least one explicitly designated archive. Procedures and criteria for setting priorities for data acquisition, retention, and purging should be developed by participating agencies, both nationally and internationally. A clearing-house process should be established to prevent the purging and loss of important data sets.

iv) Data archives must include easily accessible information about the data holdings, including quality assessments, supporting ancillary information, and guidance and aids for locating and obtaining the data.

v) International and where appropriate suitable national standards should be used to the greatest extent possible for media and for processing and communication of global data sets.

vi) Data should be provided at the lowest possible cost to global change researchers in the interest of full and open access to data. This cost should, as a first principle, be no more than the marginal cost of filling a specific user request. Agencies should act to streamline administrative arrangements for exchanging data among researchers.

vii) For those programmes in which selected principal investigators have initial periods of exclusive data use, data should be made openly available as soon as they become widely useful. In each case the funding agency should explicitly define the duration of any exclusive use period.

IGBP needs to adhere to principles of open access to data sets and availability at low cost, because it is part of ICSU and because if it inhibits the availability of its own data, this could seriously undermine the arguments used to obtain data at lower than normal costs from others.

Data sets falling under the above principles will likely include a wide variety of products including field data, processed remotely sensed data and model outputs. This places major responsibilities on IGBP scientists in terms of making data sets accessible.

The IGBP with the assistance of DIS is considering the following issues in assessing the full implications of these policies:

i) How will Core Projects decide which data sets will be made available and in what form they will be distributed?

ii) What are the cost implications of making data available? It would be prohibitively costly for any Core Project or Framework Activity to make literally all of its data available.

iii) What mechanisms will be used to ensure adequate data distribution?

iv) How will long term archiving be achieved? This includes not merely technical issues but also those concerned with how responsibility is assumed and maintained.

v) What will be the relative roles of IGBP-DIS and the Core Projects in these activities?

vi) What other agencies/organisations might be involved to take on some of these responsibilities (*e.g.* World Data Center System, WMO Data Centre System etc.).

vii) What are the responsibilities of IGBP with respect to data supplied by others which have usage or copyright restrictions?

viii) There may be significant problems associated with IGBP projects and activities using data whose distribution may be restricted by copyright: specifically to what extent can IGBP carry out its scientific programme if it has to rely on data, which can not be freely distributed to substantiate the scientific conclusions?

ix) What should be the privileges of IGBP scientists and programmes with respect to any periods of exclusive use for data collected in the name of IGBP?

x) What will be the process by which we obtain agreement from the IGBP community that they agree to and will adhere to these principles and policy?

In DIS we have been taking steps to address these questions, but clearly it will be a long-standing responsibility of IGBP-DIS to make sure that the IGBP's data policy principles are implemented. Currently IGBP-DIS is conducting an analysis of IGBP's activities to assess the implications of these data policies.

John Townshend, Department of Geography, University of Maryland, Lefrak Hall, room 1113, College Park, MD 20742-8225, USA

Annex 7

Revised GRDC Policy Guidelines for the Dissemination of Data and Costing of Services

GRDC in the Federal Institute of Hydrology,
Kaiserin-Augusta-Anlagen 15-17, D-56068 Koblenz

GLOBAL RUNOFF
DATA CENTRE

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POLICY GUIDELINES FOR THE DISSEMINATION OF DATA AND COSTING OF SERVICES

Preamble

The Global Runoff Data Centre (GRDC) operates under the auspices of the World Meteorological Organization (WMO), on the advice of its international Steering Committee and in cooperation with organizations such as UNESCO, UNEP, WHO and ICSU. These Guidelines regulate the acquisition and dissemination of hydrological data and the costing of services by the Global Runoff Data Centre under the Terms of Reference stipulated during the First Session of the Steering Committee of the GRDC and the committments of WMO made at its Twelfth Congress in 1995.

At its Twelfth Congress, the World Meteorological Organisation (WMO) adopted Resolution 40 (Cg-XII) and thus committed itself, as a fundamental principal, "to broadening and enhancing the free and unrestricted international exchange of meteorological and related data and products." In this context, "free and unrestricted" means non-discriminatory and without charge, the latter with the meaning "at no more than the cost of reproduction and delivery, without charge for the data and products themselves." With regard to the Global Runoff Data Centre, Congress also adopted Resolution 21 (Cg-XII) which encourages Members (countries) "to support the GRDC through the provision of the hydrological data and related information that it needs".

WMO Congress also adopted the practice that countries "should provide to the research and education communities, for their non-commercial activities, free and unrestricted access to all data and products exchanged under the auspices of WMO" with the understanding that the commercial use of these data may be subject to conditions." Resolution XII-4 (Paris, September 1996) of the UNESCO Intergovernmental Council for the International Hydrological Programme (IHP) "Invites Member States to review their policies for the international exchange of hydrological data so that they may be supportive of the research being undertaken on major global issues" and further "Requests the IHP National Committees to work with their national Hydrological Services to provide the scientific community with access to hydrological data and information needed for research at regional and international levels... using the internationally recognized international data centres".

GRDC operates with the support of the Federal Republic of Germany under the auspices of the World Meteorological Organization (WMO)

These Guidelines do not infringe on the ownership rights of the data transmitted to the GRDC by Members (countries and their national agencies) and other data providers. In particular, the GRDC does not usually provide to data users value-added and costed services which would normally fall in the domain of Members and other data providers, in particular national Hydrological Services.

1. Principles of data acquisition and access

1.1 The GRDC operates on the WMO principal mentioned above with the aim of encouraging the widespread use of the data for national, regional and global studies.

1.2 Members and other data providers are encouraged to transfer to the GRDC unrestricted, quality controlled, selected hydrological data, together with station history information. The transfer of daily discharge data is preferred.

2. Dissemination of GRDC-Data

2.1 GRDC data are available to users free and unrestricted under the conditions specified in 2.2 to 2.6 below.

2.2 Requests for data must reach the GRDC in written form: letter, facsimile, telex or email. A proforma is attached for use in this respect (Annex 1).

2.3 The data user agrees in writing that the data received are not transferred to third parties without the written consent of the GRDC. GRDC data are released upon receipt of a signed User Declaration (Annex 2).

2.4 GRDC data shall not be used for commercial purposes without the prior consent of Members and other providers of data to the GRDC. The GRDC will request such consent on behalf of a potential user.

2.5 The data user agrees that the GRDC may inform the Members and other data providers of data about the use to which their data have been put and will transfer the names and addresses of the data users to Members and other data providers concerned.

2.6 The GRDC makes available subsets of the GRDC database on request, as stated above. Requests for the entire database or substantial parts of it cannot be entertained.

3. Cost of services

3.1 Information about the GRDC, including the yearly status reports and the database catalogue, are provided free of charge upon request.

3.2 To enhance the services of the GRDC, the GRDC charges data users on a non-profit base for the time used for carrying out services and for costs of material, handling and mailing.

3.3 Standard GRDC services (Annex 3) are free for agencies and institutions which contribute data to the GRDC, as well as for the secretariats of international organizations which are the principal clients of the GRDC, such as WMO, UNESCO, UNEP and WHO.

3.4 For all other users, the cost for databank queries, diskettes, mail and all other overheads is based on the current price for services charged by the Federal Institute of Hydrology, Koblenz (Annex 4).

3.5 Under special arrangements, the cost for database queries may be waived for data users of developing countries.

4. Disclaimer

While the GRDC makes every effort to eliminate errors from the data base, there may be errors in the data unknown to the GRDC. Neither the GRDC nor its sponsors can be held responsible for the consequences of the use of GRDC data.

Annex 1

Format for Data Request from GRDC

Any request for data should provide the following information:

a) Origin of the request, including name, postal and/or e-mail address, phone and fax number of the individual person or institute making the request; where an institute, the name and the position of the responsible officer should also be provided.

b) Specification of request (e.g. which rivers, stations or regions, monthly or mean daily data, time series).

c) Rationale for the data request.

d) Detailed description of the use to be made of the data. A summary of the research or study project should be added to the request.

e) Signature of the person or responsible officer referred to in a) above.

Annex 2

Declaration of the Data User

The undersigned declares that he/she is cognizant of the GRDC Policy Guidelines for the Dissemination of Data and Costing of Services and is responsible for the use of the data provided by the GRDC. The undersigned agrees to use the data under the following conditions:

1. The GRDC data are not transferred either in part or total to third parties or to the general public (e.g. by electronic media), without the written consent of the GRDC.

2. The data will not be used for commercial purposes without the written consent of the GRDC. The GRDC itself will obtain clearance from the respective Members or other data providers prior to the release of data for commerical purposes.

3. The data set will be not accessible to unauthorized persons and, after completion of the specified studies, the data set will be kept separate from the general data processing facilities on diskette, tape or CD.

4. After completion of the studies and parts thereof, two copies of the results will be made available for the GRDC, as well as publications arising from the use of the data set or parts thereof.

5. In all publications, the source of the data will be fully cited as: "The Global Runoff Data Centre, D - 56068 Koblenz, Germany".

6. The GRDC operates on a non-profit basis. In certain cases, however, the GRDC may charge the data user a nominal amount for data queries and handling or an amount which has been agreed upon between the requesting agency and the GRDC prior to data delivery. The undersigned confirms his/her capacity to pay bills presented by the GRDC for services.

7. Disclaimer

   While the GRDC makes every effort to eliminate errors from the data base, there may be errors in the data unknown to the GRDC. Neither the GRDC nor its sponsors can be held responsible for the consequences of the use of GRDC data.

I, as principal researcher/representative of the requesting organization, agree to the conditions stated above.

Place and date : _____

Signature : _____

Annex 3

Standard Services of GRDC

The following standard services are rendered on a routine basis and are distinguished from specialized services to data users:

- Production and dissemination of catalogues and yearly status reports
- Database queries and response to data requests including advisory services with regard to the use of the database
- Compilation of project/programme related sub - databases
- Production of tables and graphs to illustrate and enhance the understanding of the content of the database
- Production of reports in the GRDC - Report series for example on global/regional hydrological issues, in the interest of projects/programmes of, inter alia, WMO, UNEP and UNESCO

The GRDC holds the right to change the extend and scope of standard services without notice.

Examples of specialized services would be: detailed statistical analyses of regional time-series for specific studies; assessment reports; production of graphical displays; monitoring of global/regional runoff on a comparative basis; production of reports on special request; etc.

Annex 4

Cost of GRDC Services

1. Staff time is based on a per hour rate which in June 1997 was set at DM 75,--. This includes all overheads and mail services.

2. To give an indication of the approximate costs of databank services, the following can serve as a guide:

a) Simple queries, such as a search for all stations of three major rivers and the extraction of mean daily discharge data:

Estimated time for completion:	1.5 hours
Approximate cost (June 1997) :	DM 112,50

b) Complex queries, such as the selection of daily discharge time series of at least 20 years for 20 stations from three major rivers, with maximum overlap of time series:

Estimated time for completion:	5 hours
Approximate cost (June 1997) :	DM 375,--

3. For complex tasks where data products (statistical evaluations, graphics, etc.) are also requested, a cost estimate is made and agreed upon in advance.

4. Services for projects which require extensive work at the GRDC or the establishment of an own database are agreed upon in a Memorandum of Understanding (MoU) between the project partners. In these cases, the financial contribution for the services of the GRDC are costed and incorporated in the MoU.

5. Payment for services is by bank transfer to the credit of the GRDC:

BUNDESKASSE KOBLENZ, LANDESZENTRALBANK KOBLENZ
BLZ: 570 000 00, ACCOUNT: 570 010 01, credit: 1203/11902 GRDC

Cheques sent by registered mail and made payable to "GRDC" are also acceptable.

Annex 8

Contribution of GRDC to WCP-Water

Information on the status of WCP-Water projects with GRDC input

Project A.5 Collection of Global Data Sets

1. Background

A global data base of hydrological data is considered necessary for estimating land surface related hydrological inputs of general circulation models (GCM), for testing grid oriented estimation techniques for such inputs and validation of GCMs. Increasingly, these data are also required for macro- and mesoscale hydrological modeling, global and regional water balances, investigation of regional and global trends, regional studies and assessments, estimation of surface water discharges into the oceans and coupling of hydrological and meteorological models. Project A.5 provides a general service for the collection, storage and dissemination of internationally available hydrological data and the generation of data products. This task is performed by the permanent Global Runoff Data Centre (GRDC) (see also appendix to this project description).

2. Output

(a) Global data base for surface water discharge from a growing station array of presently 3.630 stations; daily and monthly values

(b) Support for the development of GCMs

(c) Service to other activities requiring such data

(d) Reports of GRDC

3. Past activities

(a) Institutionalization of the GRDC as an internationally accepted Centre since 1993 as a continued effort to the activities since its formal setting-up in the Federal Institute of Hydrology in Koblenz, Germany in 1988

(b) Upgrade of the staffing of GRDC to presently 5 staff

(c) Development and operation of a PC-based state-of-the-art databank system on INFORMIX

(d) Development of a series of user tools for the selection of data and a line of data products as input for above mentioned activities

(e) GIS-assisted visualization of the database and information processing

(f) Establishing direct contacts with national hydrological services of the world

(g) Establishing close working relationships with GPCC, GEMS/WATER, WHYCOS, FRIEND, GTOS, GCOS, ACSYS and regional Economic Commissions such as EU, ESCAP, ECA, ECOSOC

(h) Development of a global runoff monitoring tool for the comparative assessment of regional and global areas of water surplus and water deficit.

(i) Development of a software tool for plausibility check of hydrological data

(j) Upgrade of the WMO set of statistical routines in hydrology

(k) Publication of 14 reports since 1993 and the establishment of a Web-page on the WMO WWW-server

(l) Establishment of a an international Steering Committee for the GRDC in 1994 and two meetings of the Steering Committee in 1994 and 1995

(m) Development of policy guidelines for the acquisition and dissemination of data in 1995

(n) Adoption of resolution 21 of XII Congress in 1995 urging Members to support the GRDC with data and other needed inputs

(o) Letter of the Secretary-General of WMO in July 1996, requesting Members to support the GRDC

4. Further implementation

(a) Update routinely existing and add new data sets

(b) Seek closer linkage to national hydrological services and regional associations relevant for the GRDC

(c) Intensify working relations with FRIEND, WHYCOS, GEMS/WATER and GPCC

(d) Seek overlapping time-series for the 160 largest rivers of the world

(e) Monitor continental surface water discharges into the oceans (continuation) using selected gauging stations

(f) Establish the variability of surface water discharge on a global scale for different time-series

(g) Check plausibility of the quality of datasets on a project basis

(h) Time-series and statistical analysis of discharge data on a project basis

(i) Network with the science community to create more information from the available datasets

(j) Communicate with data users and develop further additional data products

(k) Communicate with data providers for feed-back of research results

(l) Monitor the use of GRDC data

(m) Complete the Geographical Information System (GIS) on the basis of available global data sets including digitized basin boundaries of major rivers

(n) Acquire meta-data for GRDC data sets

(o) Derive grid-based values of runoff and generation of maps

The yearly GRDC status reports provide detailed information about past, on-going and planned activities.

5. Organizations/bodies involved

Based on (a) to (n) above:

GRDC in close cooperation with WMO and relevant UN agencies

6. Tentative time schedule:

Continuing activity

1997 - 1999 for projects (d) and (m)
1997 - 2000 for project (o)

7. Comments

Liaison necessary with projects A.1, A.2, A.8 and B.3 with regard to the derivation of grid-based values

ANNEX:

GLOBAL RUNOFF DATA CENTRE (GRDC)

1. Collection of discharge data at global scale

Discharge data are collected under the following criteria:

- large rivers with annual discharge greater than 100 m^3/s
- basins with catchment areas greater than 1 000 000 km^2
- basins with more than 1 000 000 inhabitants and basins of high socio-economic importance

- Basins with internal drainage
- long time series of runoff (WCP-Water Project A.2)
- undisturbed areas up to 5 000 km^2
- runoff into the oceans (WCP-Water Project A.8, GEWEX, GEMS/Water, GCOS, GTOS)

Aside from these criteria, discharge data are collected on a project basis, e.g. for regional hydrological analysis such as the ACSYS project.

Status of the data bank as of March 1997:

- 3.680 stations from 146 countries
- 2.854 rivers
- 71.109 data sets with monthly discharge
- 389.693 data sets with daily discharge

Contribution to Project B.3 (Development of grid-related estimates of hydrological variable):

The Federal Institute of Hydrology, in connection with the GRDC continues its efforts to contribute to this project with two research activities with the following rationale:

Climatologists work with grids of various sizes, the geo-referenced gridding of runoff is a possibility for linking GCM outputs with runoff. Based on grids, the GCM outputs can be validated, using gridded runoff based on the same grid size.

Likewise, global gridded datasets of the individual components of the water cycle are needed as long term monthly means as well as monthly time series for the validation of General Circulation Models of the atmosphere and oceans (AGCM's) and the assessment of water resources and their possible change of availability with regard to global warming.

The two research projects are briefly discribed:

(a) A nationally funded research project: **"Transformation of measured flow data to grid points".**

The final report of this project has been submitted to the responsible Ministry and an executive summary is being prepared in English. Using the Weser and Elbe (Labe) catchments in Germany, monthly discharge values for the period 1971 to 1980 have been computed on a grid net. A Geographic Information System (GIS) is used as a tool for the computation of these data. Data input to the GIS consists of image processed data sets (soils, landuse etc.) from internationally available sources as well as from a digital elevation map of the cited catchments. The grid size can be customized for projects in climatology and hydrology on regional and global scales. Though the results are encouraging, one of the methods being only based on measured discharge data requires a station density which is not available in many countries. Another method consistes of a water balance model combined with measured discharge data of selected stations.

(b) **The Development of a GIS-supported Water Balance Model as a Tool for the Validation of Climate Models and Hydrometeorological Datasets.**

In the ongoing study, a grid-based water balance model is proposed following the THORNTHWAITE-MATHER-procedure to calculate long term mean monthly and monthly water balance components on a 0.5° x 0.5° grid. Discharge data are used in several steps for parameter estimation as well as validation and verification of the water balance components. The water balance model has so far been applied for a 0.5° x 0.5° grid covering Central Europe. Model validation was carried out for the rivers Rhine, Weser, Ems, Elbe (Labe) and the German part of the River Danube for the period 1971 - 1980. This work is continued.

Project A.8 Detecting Global and Regional Runoff Trends by Monitoring Discharges of Selected Rivers

1. Background

It is expected that changes in climate will affect the river runoff regime. Therefore it is important to review on a regular basis updated time series of runoff from selected rivers. For this reason runoff data should be collected from suitable stations on a routine basis soon after they are observed. Stations for this purpose were selected on the basis of the following criteria:

(a) 160 stations close to the mouth of rivers into the oceans which represent the discharge from each continent into the oceans.

(b) 160 stations near the head-waters of the aforementioned rivers which represent the continental situation inland of the continents

2. Output

(a) Global monitoring of discharge from each continent and globally

(b) Early recognition of observed changes to draw the attention of decision-makers on the effects

(c) Establishment of the variability of discharges on regional and global scales

(d) Visualization of changes on a global scale using GIS-based monitoring tools

(e) Regular publication of results

3. Past activities

(a) Selection of suitable stations (re-definition of previous selection)

(b) Verification of the representativity of these stations for continental discharge

(c) Development of the first operational version of a Global Runoff Monitor based on a comparison of runoff values

(d) Publication of a report on Continental freshwater fluxes into the world oceans (GRDC-Report No. 10)

4. Further implementation

(a) Seeking overlapping time-series for the 160 largest rivers of the world for monitoring purposes

(b) Regular monitoring of the discharge situation

(c) Establishment of discharge variability and possible trends

(d) Establishing suitable contacts and means of communication to obtain near real-time discharge information for selected stations

(e) Improving the GIS-based monitoring tools

(f) Establishing of a regular update and reporting facility

(g) Establishing close contacts with information users to develop suitable data products

5. Organization/bodies involved

Based on (a) to (g) above:

GRDC in close cooperation with WMO Secretariat and interested institutions

(a) Cooperation with national hydrological services
(d) National hydrological services, WHYCOS and FRIEND

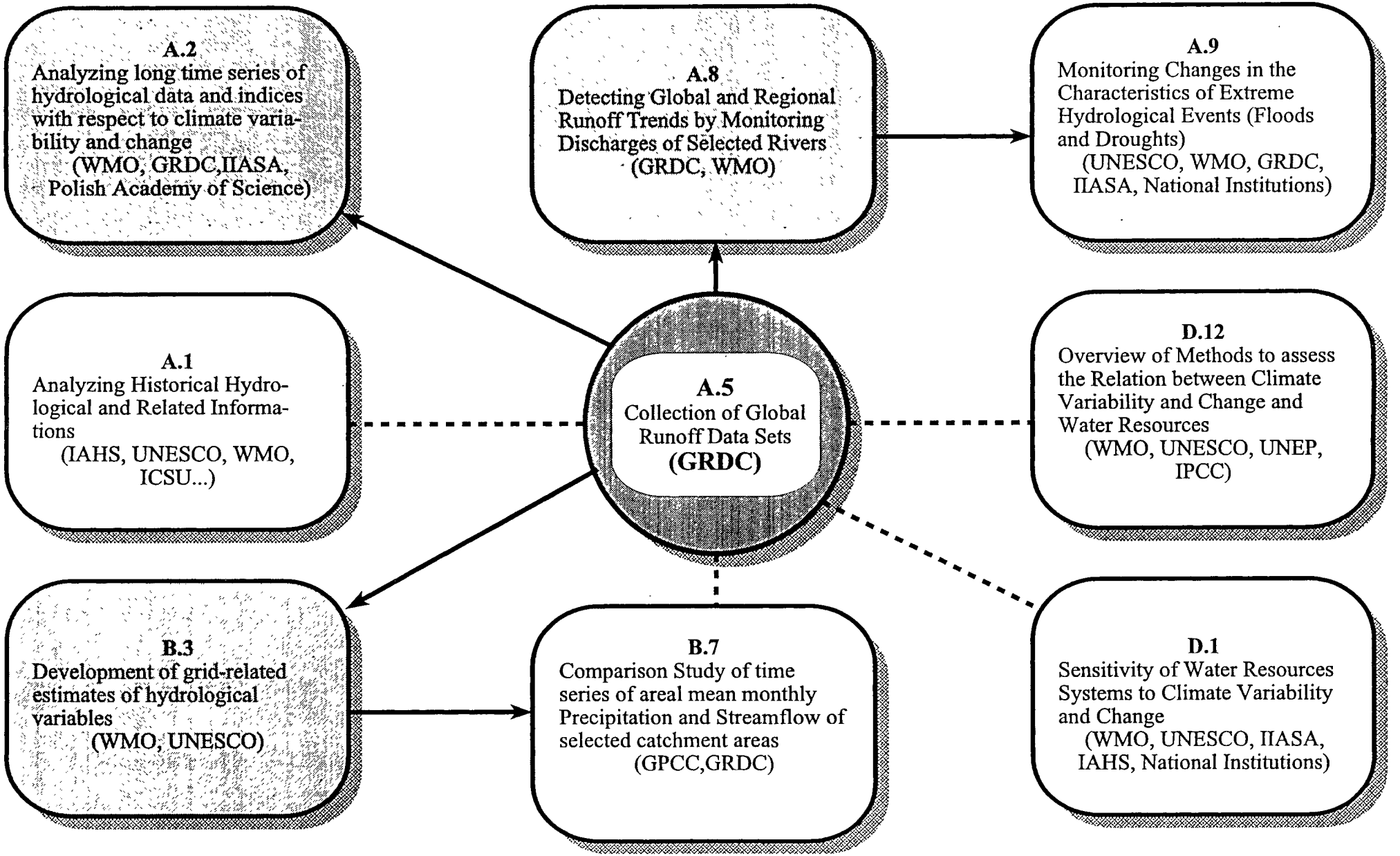
6. Tentative time schedule

(a) to (g): Continuing activities

7. Comments

Liaison with projects A.2 and A.5 and in particular with the emerging WHYCOS which could provide the necessary near real-time links and GTOS, GCOS where this project is an important component.

LIAISON OF THE GRDC WITH OTHER WPC PROJECTS



Annex 9

Selected Information about GTOS

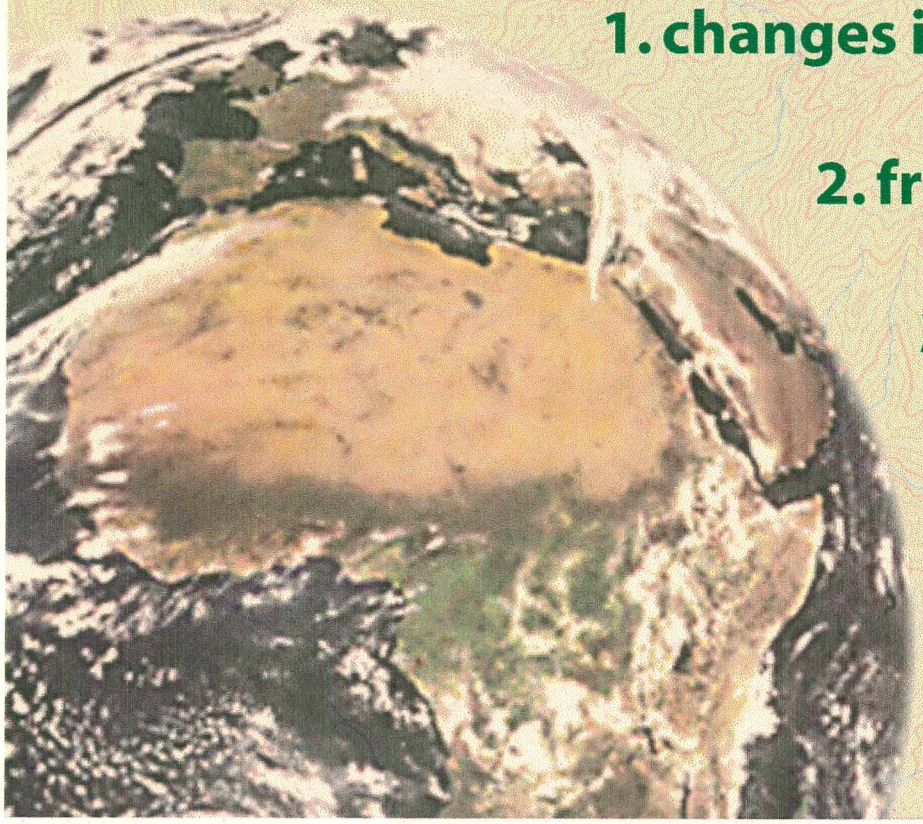
Global Terrestrial Observing System

linking the world's terrestrial monitoring systems to provide a global vision of the Earth we share

GTOS

GTOS

Focuses on five issues of global concern



1. changes in land quality
2. freshwater resources
3. pollution and toxicity
4. loss of biodiversity
5. climate change

GTOS mission statement

- To provide policy makers, resource managers and researchers with access to the data needed to detect, quantify, locate, understand and warn of changes (especially reductions) in the capacity of terrestrial ecosystems to support sustainable development

GTOS

GTOS promotes:

- integrated bio-physical and socio-economic data
- interaction between monitoring networks, research programmes and policy makers
- data exchange and application
- quality assurance and protocols to harmonize measurements

... and provides guidance in data analysis

GTOS

GTOS is *NOT*

- NOT a source of funding
  (but does assist others in seeking funds for scientifically sound work consistent with its objectives)
- NOT a source of primary data
- NOT a research programme

GTOS Co-sponsors

- Food and Agriculture Organization (FAO)
- International Council of Scientific Unions (ICSU)
- United Nations Environment Programme (UNEP)
- United Nations Educational, Scientific and Cultural Organization (UNESCO)
- World Meteorological Organization (WMO)

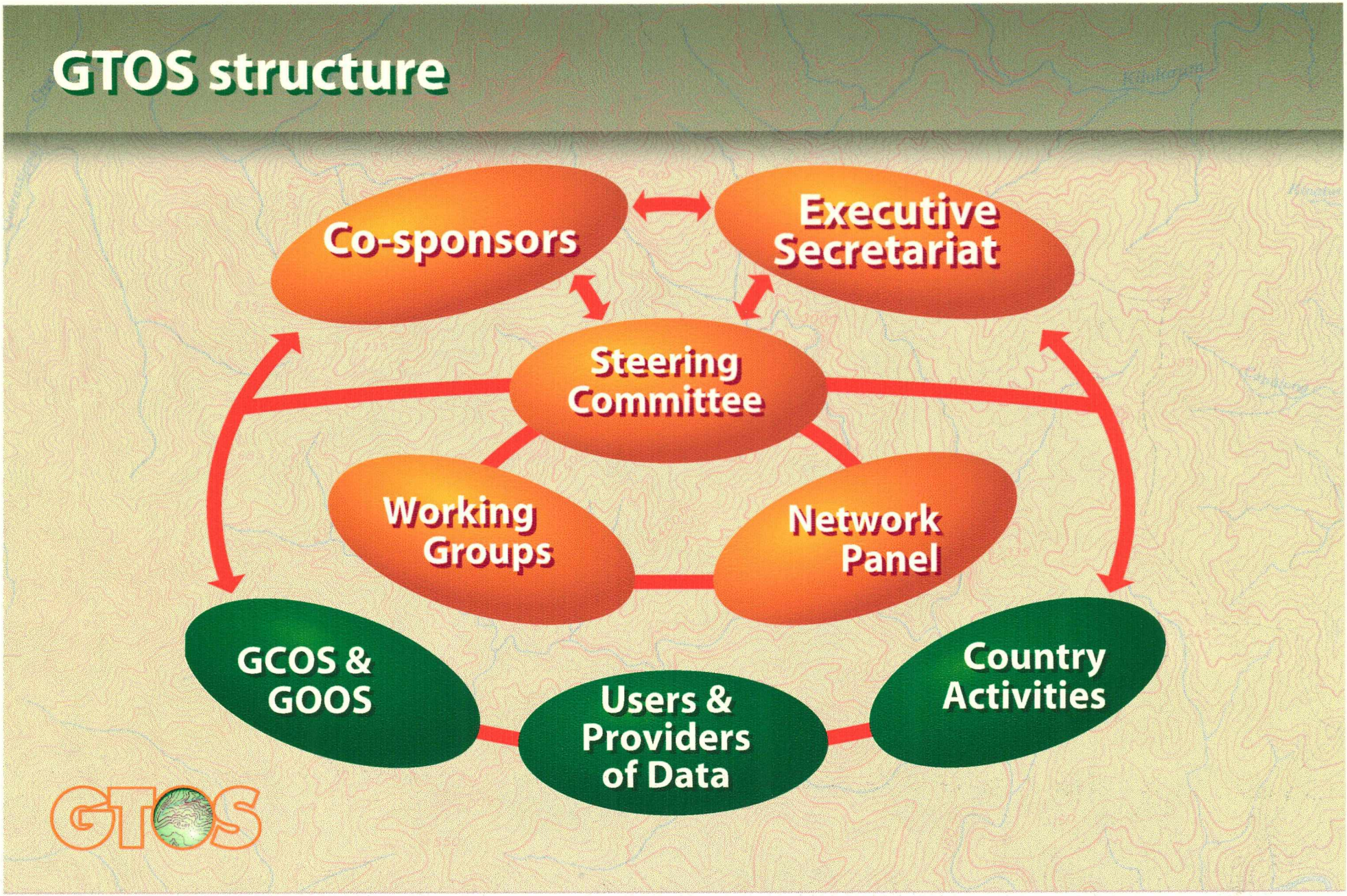
GTOS Steering Committee

- The GTOS Steering Committee **advises** the Co-sponsors and the Executive Secretariat on the **scientific** and **technical content** and **direction of the programme**, identifying opportunities for collaboration with other institutions.

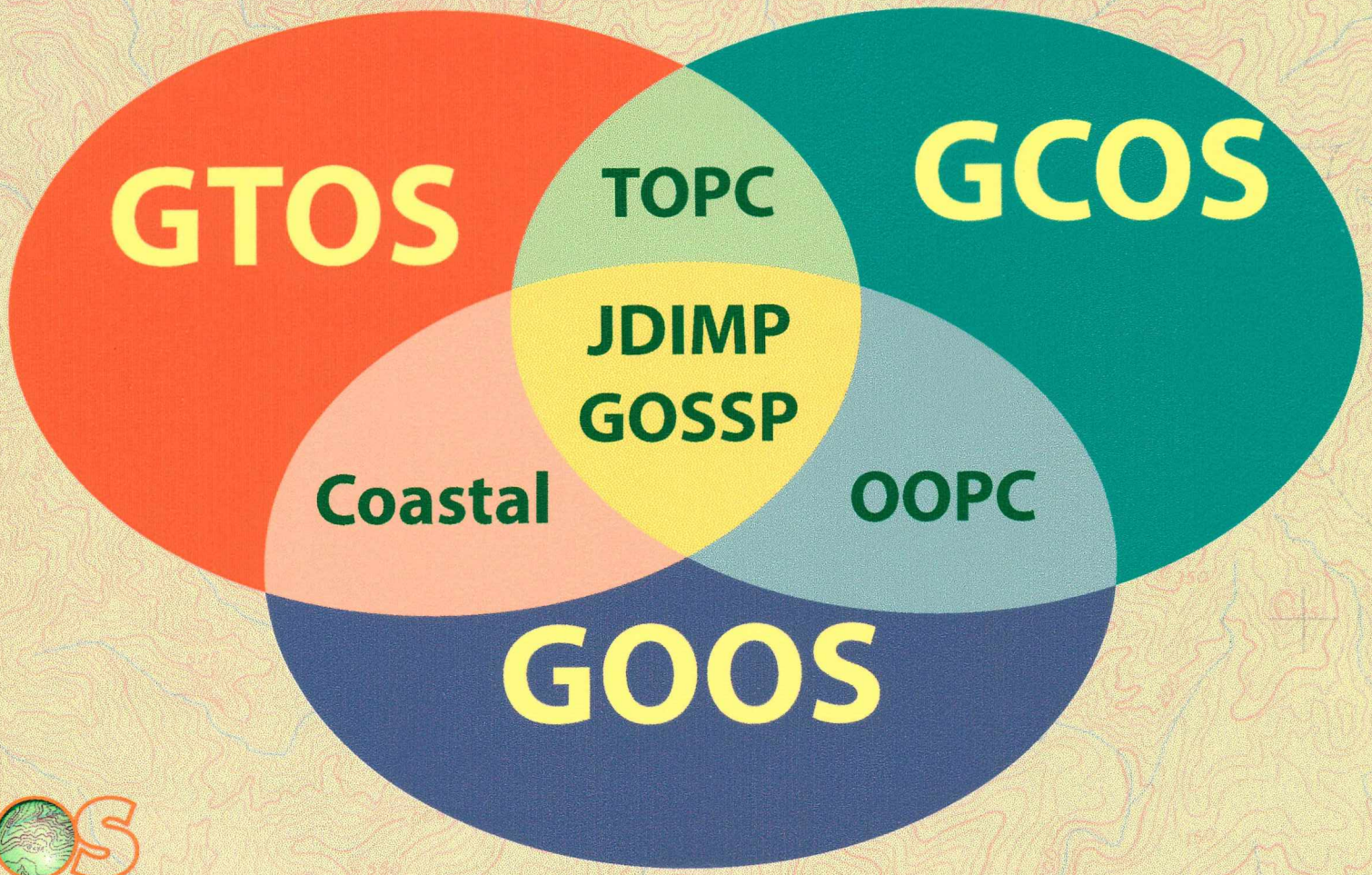
- It is composed of about **15 members**, selected according to their expertise and to geographical location, and one representative of each Co-sponsor.

GTOS

GTOS structure



Joint panels (1997)



Working groups (1997)

- Implementation plan
- Site criteria
- Coastal areas
- Biodiversity
- Social issues
- Earth sciences

GTOS users and providers of data

Governments

Scientific Programmes & Networks

International Organizations

International agreements

GCOS & GOOS

NGOs & Private Sector

Terrestrial ecosystem monitoring sites

TEMS database

- An international directory of **meta-data** on monitoring stations originally developed by UNEP
- Its objective is to register **long-term terrestrial monitoring sites** around the world
- It currently contains information on more than **700 sites** – and is growing
- It is **searchable** by country, latitude/longitude, data variable and eco-region
- The database can be accessed on the **Web**
  – http://www.fao.org/gtos/pages/tems.htm

GTOS

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GTOS

Annex 10

Summary Report of GPCC

Annex

The Global Precipitation Climatology Centre (GPCC)

Summarized status report and on GPCC's relationships to the Global Runoff Data Centre

Bruno Rudolf

General Information

The Global Precipitation Climatology Centre (GPCC) is a German contribution to the international climate research activities. The GPCC is a component of the Global Precipitation Climatology Project (GPCP), which is integrated in the Global Energy and Water Cycle Experiment (GEWEX) of the World Climate Research Programme (WCRP). The centre is operated by Deutscher Wetterdienst (National Meteorological Service of Germany), and it is member of the GEWEX Hydrometeorology Panel. It also contributes to the Arctic Climate System Study (ACSYS) and to the development of the Global Climate Observing System (GCOS).

The functions of the GPCC comprise collection, storage, analysis, and evaluation of monthly precipitation data on global scale and permanently on routine basis. The products are gridded monthly precipitation totals, at first for the land-surface based on raingauge observations, and second, completed by satellite based estimates in cooperation with GPCP participants from NASA and NOAA. Gridded precipitation datasets are available up to date for the period 1986-1996.

The data from raingauge stations, being supplied by the originators (national agencies from more than 130 countries so far), can and will not be provided by GPCC to any other purpose or any third party. The gridded global datasets are freely available as it is defined by the international programmes.

Products

The operational products are gridded area-averaged monthly precipitation depth in millimetres as well as in percentage of normals (reference period 1961-1990) as exemplary shown in the figures, and some statistical information on the grid. The current grid size is 2.5o by 2.5o geographical latitude by longitude:

(1) The "GPCC INTERIMS PRODUCT" of terrestrial monthly precipitation, based on raingauge data from worldwide about 6,700 stations (later decreasing to 6,100) is available for the period 1986 to 1994.

(2) The climate "MONITORING PRODUCT" of terrestrial monthly precipitation, based on observations from worldwide about 6,000 stations. This product is derived since January 1995 month by month routinely with a delay of about two months after observation.

(3) The "VERIFICATION PRODUCT" of terrestrial monthly precipitation will be based on the data from about 40,000 stations, supplied up to now from more than 120 countries.

This product is still in preparation.

(4) The "GPCP COMBINED DATASET" of monthly precipitation over land and ocean, based on the GPCC interims product (1), and infrared and SSM/I satellite observations, is available for the period 1988 to 1995 and July to November 1987 (Huffman et al. 1997).

Access to the gridded products is possible using internet facilities:

Raingauge analyses: ftp://ftp.ncdc.noaa.gov/pub/data/gpcp/gpcc
Combined dataset: ftp://ftp.ncdc.noaa.gov/pub/data/gpcp/version1

The GPCC INTERIMS PRODUCT has been complemented down to 1971 by Xie et al. (1996) using the GPCC analysis system and the precipitation data of Global Historical Climatology Network and the NOAA Climate Prediction Center (about 6,000 stations). However, to do the full quality-control process as it is GPCC standard, was not realised for these analyses.

Activities related to GRDC

The GPCC is currently installing the river catchment area data base provided by Taikan Oki (1997), which includes a flag identifying the river catchment area for each 1o grid globally. This data base will enable the GPCC to derive time series (beginning with 1986) of monthly area-mean precipitation for catchment areas of large rivers. For this purpose, precipitation interpolated on 1o grids (or later 0.5o grids) will be used. The storage of water by snow cover will also be analysed using snow observations available from weather reports.The GRDC is compiling a set of discharge data for corresponding rivers and periods for intercomparison with GPCC's precipitation.

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Annex 11

Project Exposées (University of New Hampshire, University of Austin, Texas)

DEVELOPING A GLOBAL RIVER AND DRAINAGE BASIN ARCHIVE SERIES

DRAFT Proposal to IGBP, UNESCO, IAHS, WMO, ILEC & GEMS-Water/UNEP/WHO

INTRODUCTION AND RATIONALE:

Despite its importance to the habitability of the Earth, rivers and their associated drainage basins have received relatively little attention within the global change debate. Contributing to this condition is the lack of a clear scientific focal point, akin to the Mona Loa CO_2 curve that the atmospheric and ecological modelling communities use as unequivocal evidence of anthropogenic activities at the global scale. We know from site-specific studies that there have been important changes in the state of global rivers, but seldom have there been any synthetic studies upon which to rally the required interest in the scientific and policy-making communities.

Some encouraging developments over the last two years hold promise that this situation can be reversed, most notably several workshops convened to consider the condition of inland waters at continental and global scales and their relation to anthropogenic change. In the United States, these included the Inter-agency Workshop on Earth System Modeling (May 1994) as well as the SCOPE Estuarine Synthesis Meeting (February 1995). Several international fora such as the IGBP-PAGES Fluvial Transport Working Group (February 1994); the Durham, New Hampshire IGBP - BAHC / PAGES modeling workshop on terrestrial and aquatic ecosystem transport (Dec 1994); and, the GEMS-Water/UNEP/WHO Expert Panel on Land-Based Sources of Pollution (June 1995) also have contributed much-needed momentum to this issue. These last three meetings, in particular, established a mandate for the development of basic river-related data banks and a modeling framework to assess the current and future status of global freshwater resources. Central to this goal is development of a global river basin "typology" or characterization to be used in extrapolating knowledge from well-monitored to poorly monitored drainage systems. Collectively, these tools were also recognized to provide critical guidance in the design and maintenance of global river monitoring networks.

EMERGENCE OF GLOBAL REGISTRIES:

A number of key global data bases that describe rivers and their associated drainage basins are rapidly being developed. These include, among several others, the GEMS-GLORI, GLORI-LOICZ "Global Registry of River Inputs", the WMO Global Runoff Data Center Archives, and the FRIENDS network of river discharges. In addition, there is a large body of geographically-referenced thematic data sets describing climate, land cover, soils, topography, lakes, and river networks that can be used to characterize the state of the global population of watersheds. The community is poised to take advantage of these data sets and tools, but integration will be necessary to ensure the most productive (i.e synergistic) use of this information.

The scientific basis for developing this knowledge will ultimately depend on an appropriate data base management system as well as modelling tools. However, no matter how sophisticated such systems become, they will simply remain inadequate without a). basic information on water quantity and quality data, and b). information that is of high quality and relevance to the study of freshwaters at the global scale As the water sciences community struggles to maintain its networks of monitoring stations in regions such as Africa and the former Soviet Union, it becomes increasingly important to inventory, collect, and in some cases "rescue" precious data sources.

Arming the community with such data sets will be an increasingly crucial challenge into the 21st century. With this goal in mind, we propose development of a Global River and Drainage Basin Archive Series that can supply the water sciences and management communities with a coherent suite of information resources upon which to monitor the status of freshwaters, analyze the role of drainage basins in the global change question, and promote the wise use of increasingly scarce water resources. We envision the Archive Series as a multi-year effort involving several international organizations and scientific contributors.

BRIEF DESCRIPTION OF THE ARCHIVES

The Global River and Drainage Basin Archive Series will serve as a repository for basic information on river discharge, river and lake chemistry, and the biophysical attributes of drainage basins. Each volume in the Archive Series would share the following characteristics:

- Developed by Community Consensus
- Geographically Co-Registered to Detailed Maps
- Common Naming Convention with Alternative/Local Names Given
- Systematically Checked for Errors
- Fully-Referenced Data Entries with Point-of-Origin / Point-of-Contact
- Cross-referenced to Other Volumes in the Archive Series
- Standardized Format to Facilitate Synergistic Use by Broad User Community
- Customized Output Describing Any World Basin from One or More Volumes in the Archives Series to Facilitate Interdisciplinary Research & Water Quality Management
- Wide Distribution Based through Printed and Digitized (Diskette, CD-ROM, World Wide Web site) Versions

Table I lists some proposed volumes within the Archive Series. Although each of these data bases could exist in isolation, we see great value in producing a coordinated set of data products. Such coordination would guide the development of each volume from its inception, through data assembly and encoding, checking procedures and final distribution. By establishing some sensible protocols to standardize the contents of each volume, we could ultimately ensure the synergistic uses of these data sets. For example, coordinating GEMS-GLORI data development with the TYGRIS-BAHC drainage basin characterization and GIS effort will help to ensure that the correct

riverine chemistry and drainage basin data sets are jointly assembled so that a usable global typology can indeed be constructed. Another effort that could benefit from such coordination would be GEF programs on river systems.

INSTITUTIONAL ASPECTS:

Given the importance and tremendous scope of this effort, we believe that the Global River and Drainage Basin Archives Series should be supported by an broad spectrum of international agencies, including IGBP, GEMS-Water / UNEP / WHO, UNESCO, and IAHS. Scientific sponsorship would be from IGBP and several of its individual Core Projects (i.e. BAHC, PAGES, LOICZ), UNESCO-IHP technical groups, GEMS-Water / UNEP / WHO, WMO's Global Runoff Data Center, and the International Lakes Environmental Commission (ILEC). The scientific networking capabilities of UNESCO, WMO, and IAHS should facilitate the assembly of interested participants, and when each volume is complete, dissemination to a wide audience of scientists and environmental managers. Funding for the initiative could be from UNEP/GEMS/GEF and individual national agencies. IGBP and UNESCO can facilitate workshops and participant travel.

On a practical level, a Scientific Steering Committee with individuals drawn from IGBP, GEMS-Water/UNEP/WHO, UNESCO, and IAHS should be assembled to oversee development of the Archives and provide the required coordination of the overall effort. This should be facilitated by the collaborative ventures among these groups that are already in place (e.g. IGBP-LOICZ and GEMS-Water GLORI development). Several volume-specific Working Groups would then be assembled to produce the individual contributions to the Series. These Working Groups would a). assemble the first "drafts" of each data volume (including both data entry and source referencing), b). identify a pool of relevant agencies and individual scientists to help check the entries for accuracy and completeness, and, c). release the final data base as an Archive volume.

IMPLEMENTATION:

Development of the Archive Series could begin immediately and build toward the release of a first set of volumes in the 1998-99 time frame. We propose several steps towards it successful implementation:

- Contact Lead/Participating Organizations in 1996, Seeking Advice and Approval to Proceed.
- Present Concept at International Meetings in 1996 (e.g. IAHS Commission Meetings in Vienna, IGBP-Congress in Germany) and solicit inputs from scientific community at large
- Assemble a Scientific Steering Committee to:
  -- Develop a detailed agenda and scope for the Series
  -- Establish a Time Table for Production of the Series
  -- Identity Potential Working Groups and Working Group Chairs
- Solicit Appropriate Institutional Support, including Direct as well as In-Kind Funding
- Begin Work on Selected First Volumes in 1997

TABLE I. PROPOSED CONTENTS OF GLOBAL RIVER AND DRAINAGE BASIN ARCHIVES ("RIVER ARCHIVES")

PARTICIPATING ORGANIZATIONS	TITLE & CONTENTS OF INDIVIDUAL VOLUMES
UNESCO-IHP *IGBP-BAHC* *WMO-GRDC*	• "CONTEMPORARY WATER DISCHARGES" -- Basic monitoring information from existing UNESCO Archives (ca. 950 WMO-GRDC stations); supplemented by WMO-GRDC holdings; FRIENDS Networks.
IGBP-BAHC *GEMS-Water/ UNEP/WHO*	• "BASIC BIOPHYSICAL CHARACTERISTICS OF GLOBAL RIVER SYSTEMS" -- GIS-based attributes and typology of watersheds derived from the TYpology of Global River Systems (TYGRIS-BAHC) global GIS data bank for inland waters. Data to represent biophysical attributes and socio-economic factors including population, energy use, sewerage rates.
GEMS-Water/ UNEP/WHO *CCIW*	• "WATER QUALITY REGIMES IN GLOBAL RIVERS" -- Station-based information and digital data set, summarizing intra-annual variability of water quality parameters. Holdings would describe water chemistry for nutrients, organic matter, dissolved and particulate metals, and major dissolved species. Documentation of both mainstem and upstream tributary conditions.
IGBP-LOICZ/PAGES Comm. on Continental Erosion	• "DISTRIBUTION OF SUSPENDED SEDIMENT FLUXES. *IAHS* SPATIAL AND TEMPORAL TRENDS" -- Literature-based information and digital data set using LOICZ-GLORI and supplements. Use of long-term records to explore mean conditions, trends and variability, contrast contemporary and pre-human conditions.
GEMS-Water/ UNEP/WHO *IAHS Comm. on Water Quality* systems.	• "RIVER WATER QUALITY TRENDS" -- Station monitoring data coupled to literature-based review, spanning at least the period 1960-present, to document systematic changes in water chemistry in selected river
ILEC (Japan) *IGBP-BAHC* *GEMS-Water/ UNEP/WHO*	• "RESERVOIRS AND DAMS" -- Contemporary inventory of engineered lake systems, including basic geographical data, hydraulic information and operating rules, modification of downstream hydrology, related GIS-based biophysical characterization.

TABLE I (continued).

PARTICIPATING ORGANIZATIONS	TITLE & CONTENTS OF INDIVIDUAL VOLUMES
IGBP-PAGES *WMO-GRDC* *ILEC (Japan)*	• "TRENDS IN RIVER DISCHARGE AND LAKE LEVELS" -- Long-term trends in regional runoff and river discharge as a consequence of climatic variability and human-induced changes. For discharge 80-100 stations are likely to have reliable records in excess of 50 years. Lake level data from several well-known sites will be archived: Great Salt Lake, Lake Chad, Aral & Caspian Seas.
ILEC (Japan) *GEMS-Water/ UNEP/WHO*	• "TRENDS IN LAKE AND RESERVOIR WATER QUALITY" -- Long-term trends in lake and reservoir ecosystems, determined from literature-based reports and ILEC data holdings. This archive would also include basic information which, when combined with the river and water quality archives, could be used to determine the impact of impoundment on riverine water quality.
SUITABLE NAT'L and INT'L BODIES	• "SELECTED CASE STUDIES" -- In addition to the global-scale activities listed above, specific raw data sets and reports can be constructed for large and international river systems using as raw material, the various data bases listed above in combination with national survey data and literature-based sources. Candidate rivers with good documentation include the Danube, Nile, Amazon, Mekong, St. Lawrence.

UN/CSD FRESHWATER ASSESSMENT
DRAFT PROJECT PROPOSAL

Freshwater Resources Information System (FRIS)

April 1997

Background

For many years, the definitive source of information about freshwater resources assessment on a country and regional basis has been the water resources study made in the Soviet Union during the International Hydrological Decade which was accompanied by a detailed Atlas of the World Water Balance, comprising some 50 maps of the world and the various continents depicting contours of mean annual precipitation, evapotranspiration, runoff, temperature, and radiation, and bar charts of mean monthly distributions of these quantities at particular locations (Kurzun, 1974).

In the 1970s two other studies were carried out. Baumgartner and Reichel (1975) used a continental water balance approach with the purpose of assessing the water balance of the world. Another country based study was carried out by L'vovich (1974), which led to the publication of a book entitled "World Water Resources and their future". These two studies were respectively done by continent and by country, but the information gathered was not spatially fixed. More recently, the Russian Institute of Hydrology has been updating hydrological information on water resources at continental level based on the geographic information as mapped by Korzun (Shiklomanov, 1990, 1993).

By now, more climatic and hydrologic data have been accumulated, satellite assessment of radiation has added important new data sources, and the time is ripe to synthesise this information on the world water balance into a detailed database in space that can be used for regional assessment and planning. GIS technology has progressed to the point where such maps are now conveniently presented in a digital form so that the user can query gridded maps of mean annual quantities and produce bar charts of the seasonal variation of these quantities.

Justifications

The accurate assessment of the volume and availability of the worldÕs freshwater resources is an important objective for realistic assessment of the prospects for water resources development around the world. Yet, more than ever, information on the assessment of freshwater is becoming of increasing importance with regard to the growing pressure on these scarce resources. The current interest in issues related to global water resources assessment has been recently emphasised after the UN-CSD called for a Freshwater assessment exercise. Other initiatives of international dimension, like the recent creation of the World Water Council and of the Global Water Partnership, show the importance currently given by the international community to the problem of rapidly increasing water scarcity. A decision support system based on geographic information would be of great support to these institutions.

Furthermore, there is an increasing political awareness of the importance of research to commonly recognised international environmental problem like the green-house effect, desertification, land degradation, water mining etc. These environmental problems may have a great impact on plant-water-soil relations in general and more specific on the flow regime of the worlds major rivers. The expected changes in the hydrological cycle due to problems as mentioned, will effect daily life of international community tremendously. Therefore it is of major importance to gain a better insight in the water balance of the world.

The project to build a global Freshwater Resources Information System will take place under participation of four UN agencies directly involved in actions relative to global freshwater assessment: FAO, UNESCO, UNEP, WMO. FAO and UNESCO, in close co-operation with the CRWR of the University of Texas at Austin, carried out a pilot project "Water balance of Africa". In addition, FAO has developed a data base on water resources and water use, through the country surveys carried out in the framework of the Aquastat programme. UNEP is currently building digital elevation models in co-operation with USGS. WMO co-operates with the Global Runoff Data Centre in Koblenz on global information on surface water runoff.

Objective of the project

The objective of the proposed project is to prepare a geographic information system on the world's freshwater resources, with information about water resources for the use of national, regional and international bodies. The geographic information system should provide global assessment of:

- water resources by country and distribution inside the country;
- exchanges of water between countries and regions;
- amount of water already allocated and potential for further development.

The delineation of river basins is of major importance to achieve the objectives mentioned. On the level of river basins, the FRIS would present a picture of the situation of exchanges of water through trans-boundary water bodies. Finally, it would represent a standard set of data which could eventually be used for global and regional prospective studies in freshwater resources assessment, development and management. A typical output of the use of the FRIS would be a quantification of the current state of use of available water resources.

The FRIS should become a very useful tool as a decision support system for policy supporting research in freshwater resources assessment and management. Next to this it could be of use for scientific purposes in better defining the links between climate and the hydrological cycle, in order to come to an improved understanding of the causes of global environmental problems.

Preliminary Data Assembly

Climate Data

A preliminary set of data layers has been compiled for the world using 0.5° cells in latitude and longitude as the spatial framework. The resulting grid for the earth has is 259,200 cells, of

which approximately one third, or 80,000 cells cover the land surface. Data for the oceans are included to facilitate analysis of islands and smaller countries not contained within the major continents. The data layers defined on this 0.5° grid include:

1. Mean annual and mean monthly precipitation and temperature from the Legates-Willmott global climatology.
2. Mean annual and mean monthly net radiation, and incoming solar radiation at the land surface from the NASA Earth Radiation Budget Experiment. These data were originally prepared by NASA on a 2.5° degree grid and were resampled onto the 0.5° grid for the water balance database.
3. Soil water holding capacity based on the FAO/UNESCO Digital Soil Map of the World.

A spatial climate database for Africa and the other principal continents has been spatially selected from this world data set. An additional data source available only for Africa is the mean annual and mean monthly precipitation and temperature database prepared by the Australian National University using a fine mesh grid of 3Õ cells.

Another climate data source is the ISLSCCP (International Satellite Land Surface Cloud Climatology Project) CD-ROM set which uses a 1° grid to present many elements of the climate and land surface in the form of time series of detailed quantities suitable for study of land surface - atmospheric interactions. Daily precipitation and temperature series at about 2000 climate stations are available from a CD-ROM prepared by WMO and the NCDC in the United States. All of the above data have been assembled at CRWR, and other data sources are constantly being sought. FAO itself possesses a considerable climate database in its Agrometeorology section and has experience of accumulating monthly time series of precipitation, especially for the Sahel region of Africa.

Digital Elevation Models, Watersheds and Stream Networks

A most critical data resource for the proposed project is provided by the US Geological SurveyÕs 30Ó digital elevation models of the continents prepared, in association with UNEP, from the contour and stream information in the Digital Chart of the World and by generalizing where available more detailed terrain information sources possessed by the US Defence Mapping Agency. The USGS 30Ó digital elevation models are available on Internet. A great deal of effort has been invested at CRWR and FAO in studying the ways in which these data can be used for watershed and stream network delineation in the Niger basin in West Africa (2.3 million km^2) and for the Souss basin in Morocco (20,000 km^2). The USGS 30Ó DEMs were produced at the EROS Data Centre in Sioux Falls, South Dakota. USGS is presently engaged in a follow-on effort to delineate the major river basins of the world, and preliminary basin delineation have been completed for Africa and North America.

Of major importance for the project will be the development of a standard fully documented watershed coverage which will be derived from the DEMs and available digitized river coverages. It is expected that this standard will be extensively used in future global water resources assessment exercises.

Runoff

Monthly runoff data are available from the Global Runoff Data Centre (GRDC) in Koblenz. At CRWR, mean monthly runoff has been summarised for 160 stations and presented digitally on a point coverage of the station locations. Data from more stations are needed, particularly in the continental interiors and can be provided by GRDC. Such data, presented in a synthesised format, will form a part of the proposed project.

Reservoirs

The project will gather all available information on existing reservoirs and include them in the data base and in the water balance model.

Products

The Freshwater Information System will include digital data, in raster and vector format, that describe the most important hydrologic quantities and related tables and graphics. A preliminary list of the data to be produced comprises (resolutions and data exchange protocols have to be determined):

Maps

1. Precipitation: twelve mean-monthly and one mean-annual precipitation grids;
2. *Temperature*: twelve mean-monthly and one mean-annual temperature grid;
3. *Percentage of precipitation that falls as snow*: twelve mean-monthly and one mean-annual grids;
4. *Net radiation*: twelve mean-monthly and one mean-annual net radiation grids;
5. *Soil water storage capacity*: a grid with maximum soil water storage capacity;
6. *Vegetation*: a grid containing dominating vegetation;
7. *Reference Evapotranspiration*: twelve mean-monthly and one mean-annual evapotranspiration grids;
8. *Potential Evapotranspiration*: twelve mean-monthly and one mean-annual evapotranspiration grids;
9. *Irrigated areas*: a coverage with irrigated areas;
10. *Actual Evapotranspiration*: twelve mean-monthly and one mean-annual evapotranspiration grids;
11. *Watersheds*: a coverage with watersheds;
12. *Rivers*: a coverage with rivers;
13. *Reservoirs*: a coverage with major water reservoirs;
14. *Discharge at points*: one point coverage supported by a database that includes fields for twelve mean-monthly and one mean-annual discharge. Discharge exceeded in 25% or 75% of the years can also be included as additional fields;
15. *Discharge*: one mean-annual discharge grid with a resolution of 1 km × 1 km. this grid will represent the mean-annual flow conditions at every location;
16. *Runoff coefficient*: one mean-annual runoff coefficient grid with a resolution of 1 km × 1 km;

17. *Surplus and deficit of river water resources*: format still to be defined;

Tables

All the documents of the water balance or each country and each river basin:

- Mean annual rainfall by country
- Internal annual water resources by country
- exchanges between countries (mean annual)
- Surplus and deficit by country.

Plan of Activities

The activities to be carried out will likely follow the ones used in the original Atlas of the World Water Balance, namely:

1. Delineate streams and watersheds.
2. Quantify the precipitation over all the continents on a mean annual and mean monthly basis. This has already been done with the Legates-Willmott global climatology and needs only updating.
3. Quantify temperature over all the continents on a mean annual and mean monthly basis. This has also already been done by Legates and Willmott and the same comments apply to temperature as to precipitation.
4. Estimate the percentage of the precipitation that falls as snow on a monthly basis by combining the temperature and precipitation data appropriately.
5. Quantify net radiation over all the continents. This has been done by the NASA Earth Radiation Budget Experiment. Data need to be resampled from an original 2.5° cells to 0.5° cells. It should be possible to co-operate with NASA to recompute the net radiation for the coast line cells using their original algorithm applied to a smaller mesh grid.
6. Map the major freshwater reservoirs of the world.
7. Quantify reference evapotranspiration using Penman-Monteith's formula and compare it to independent estimates of open water evapotranspiration in dams and reservoirs for verification.
8. Quantify soil water storage capacity over all continents.
9. Examine how suitable crop factors can be obtained in combination with global vegetation maps.
10. Quantify potential evapotranspiration using Penman-Monteith's formula.
11. Quantify irrigated areas over all continents.
12. Construct a soil water balance by using precipitation, evapotranspiration and soil water storage capacity data. This results in a map with actual evapotranspiration and maps with soil water surplus.
13. Quantify annual and monthly river discharges for selected return periods at as many places as possible using all data sources, including gaged runoff data where available and also estimates of runoff values made in countries from which getting the gaged data is difficult.
14. Relate precipitation to runoff by simple means such as by using a runoff coefficient derived from watersheds whose data meet particular criteria.
15. Examine how the amount of water available varies with the size of the area being studied or equivalently with the length of distance travelled.

16. Compare evapotranspiration maps derived from steps 12 and 14 with one another. The evapotranspiration map calculated in step 12 show the seasonal variation of soil moisture and give a check on the amount of evapotranspiration to be expected in a spatial sense that can be compared to the map derived in part 5.
17. Derive the information to be published in tables per country and watershed from the maps and compare this information with the information as available in Aquastat.
18. Analyse the differences as discovered in step 15, 16 and 17. Explain the differences and correct mistakes.
19. Create the final versions of the maps and CD-ROM.
20. Publish and disseminate results in digital format.

Tentative schedule

Activity	Month
- Stream-watershed delineation (1)	1-10
- Precipitation maps (2)	1-4
- Temperature maps (3)	1-4
- Maps with precipitation falling as snow (4)	1-4
- Net radiation maps (5)	1-4
- Maps with major water reservoirs	5-8
- Reference evapotranspiration maps (6)	5-8
- Water storage capacity maps (7)	5-8
- Vegetation maps (8)	1-8
- Potential evapotranspiration maps (9)	9-12
- Maps with irrigated areas (10)	10-22
- Actual evapotranspiration maps (11)	9-12
- Maps of rivers with discharge at stations(12)	13-16
- River discharge maps (13)	13-16
- Run-off coefficients maps (14)	13-16
- Surplus and deficit of water resources (17)	17-24
- Comparison and analyses (15, 16, 18)	17-24
- Preparation of the final maps (19, 20)	20-24
Total duration : 2 years	

To: "Klohn, Wulf (AGLW)" <Wulf.Klohn@fao.org>
From: "Arthur J. Askew" <aaskew@www.wmo.ch>
Subject: RE: FRIS
Cc: JeanMarc.Faures@fao.org
Bcc:
X-Attachments:

Dear Wulf,

I like the new version of the Atlas project. I would have many comments on details, but these are probably better dealt with at a meeting of interested parties. Certainly I would encourage you to forward the proposal in this form to UNESCO and to GRDC.

Did you draft the last sentance of Hans Wolter's letter to Dieter Kraemer of 17 March (AGLW: UN 21/42)? In any case, I am assuming this means that I can present the proposal at the forthcoming Seventh Planning Meeting for WCP-Water (Koblenz, 12 - 16 May). This I will do with pleasure, unless I hear from you otherwise.

As regards inventories of river basins: INFOHYDRO has some information on international river basins and the WMO Manuel on Codes, Volume II (WMO Publ. No. 306) includes a fairly exhaustive listing of the major river basins of the World together with a coding system for related hydrological stations. You may recall this as being one of Naginder Sehmi's major projects some years ago. Naturally, we would like this to be taken into account in any global system. I do not recall other WMO sources and I cannot think of a UNESCO source, but they might have one.

Incidentally, who drafted this latest version of the Atlas proposal and gave it the new title? David recently objected to changing the title - so is this the work of Jean Marc Faures and/or yourself?

I trust you are having a good break.

As requested, I am copying this to Jean Marc.

Regards,

00 49 261 1306 280

Wulfgang Grabs,

— as promised.

25/4/97

Return-Path: <Wulf.Klohn@fao.org>
Date: Mon, 21 Apr 1997 17:26:00 +0002
From: "Klohn, Wulf (AGLW)" <Wulf.Klohn@fao.org>
Subject: RE: FRIS
To: "Arthur J. Askew" <aaskew@www.wmo.ch>
Cc: "Faures, JeanMarc (AGLW)" <JeanMarc.Faures@fao.org>
Content-Length: 36377

Dear Arthur,

[[FRIS.DOC : 4365 in FRIS.DOC]]
this is the revised document on the Atlas, which has become the Freshwater Resources Information System (FRIS). If you like it this way, we may then send it to Unesco and GWDC in Koblenz, etc.
After all, may be it's not a bad idea to have a meeting on this. Otherwise, time goals tend to slip.
FRIS is included in our 98-99 budget, but the money value behind it is only symbolic.
One thing that would be needed first is a global inventory of river basins. Could you refresh my mind on the work done on this subject by WMO/Unesco?
I will be away for 10 days (Berlin and a few days of rest). Please copy correspondence on this matter to Jean Marc Faures.

Best regards, Wulf

Attachment Converted: "C:\TMP\FRIS.DOC"

Annex 12

Summary of Continental Scale Experiments

WORLD METEOROLOGICAL ORGANIZATION

TENTH SESSION OF THE COMMISSION FOR HYDROLOGY

THE GEWEX CONTINENTAL-SCALE PROJECT, LARGE-SCALE HYDROLOGICAL STUDIES AND THEIR RELEVANCE TO WATER RESOURCES AGENCIES

Submitted by A.J. Hall (Australia), CHy Rapporteur on GCIP and
Large-scale Hydrological Studies and J.S. Schaake (USA),
CHy Rapporteur on GEWEX and Water and Energy Inter-actions at the Land Surface

(Final Draft)

SEPTEMBER 1996

No. 17

APPENDICES

Appendix A GCIP

Science Goal of GCIP

The science goal of GCIP is to fully understand and characterize the water and energy cycles over large continental areas, in order to enhance the representation of these cycles in climate models. The source of this understanding is observations at small scales over large space and time scales, especially precipitation, runoff, surface evaporation, atmospheric water vapor and clouds, and radiation. However, uniform observation of key fields such as surface evaporation and soil moisture (and others) over large continental areas is not possible. Therefore, the GCIP Science Plan (WMO, 1992) calls for operational numerical weather prediction four dimensional data assimilation systems (4DDA) to fill the gaps in observations by providing the physically consistent coupling between available observations and the modelled dynamics/energetics of atmospheric and land/surface evolution. For GCIP, such assimilations can be provided easily only by operational centers, such as national weather prediction centers. 4DDA is a particular aspect of cycling model runs and observed data. ADD MORE

GCIP Objectives

The scientific objectives for GCIP, formulated in early 1990 and presented in the GCIP Scientific Plan (WMO, 1992), are to:

a. Determine the time/space variability of the hydrological and energy budgets over a continental scale.

b. Develop and validate macroscale hydrological models, related high-resolution atmospheric models and coupled hydrological/atmospheric models.

c. Develop and validate information retrieval schemes incorporating existing and future satellite observations combined with enhanced ground-based observations.

d. Provide a capability to translate the effects of a future climate into impacts on water resources on a regional basis.

These objectives translate into a set of four parallel science questions:

a. How do water and energy budgets vary in space and time at high resolution on a continental scale?

b. How can surface and groundwater processes at the catchment scale be aggregated

interactively with the subgrid-scale atmospheric processes in general circulation models?

c. How can these diverse elements fundamental to the determination of hydrological and energy cycles be best incorporated (retrieved and assimilated) into analyses and coupled hydrological/atmospheric models in a consistent fashion?

d. What are the best approaches for assessing the effects of climate variability and change on water resources?

To address these questions adequately, GCIP must assemble the necessary data sets to support water and energy budgets analyses as well as to develop coupled hydrological/atmospheric models. Assimilating new data (such as surface Doppler radar and satellite information) into cloud and precipitation models and meshing these into continental and global models are main GCIP challenges. Also, scaling issues are involved in parameterizing the relevant continental hydrological and atmospheric phenomenon for the coupled models. Therefore, scale aggregation/disaggregation issues will demand detailed attention. Further discussion on the science issues is given in the GCIP Implementation Plan, Vol. II, Research (IGPO, 1994).

GCIP - Mississippi

The first GCIP experiment commenced on the 1st June 1994 in the Mississippi River basin with a three-month GCIP Integrated Systems Test over the Arkansas-Red River basin in the southwest portion of the Mississippi River basin. Data from this GCIP Initial Data Set (GIDS-3) are available on CD-ROM and online from the GCIP Data Management and Service System (DMSS), which can be accessed through the World Wide Web via the GCIP "Home Page" at NOAA/NCDC (address: http:/www.ncdc.noaa.gov/gcip/gcip-home.html). Also available on CD-ROM and the DMSS is an earlier GIDS-1 data set which covers the three-month period, 1 February through 30 April 1992, and provides researchers with routine operational data and high-resolution augmented research network data from the west-central Mississippi River basin collected during the STORM-FEST field experiment. Data are now becoming available on the DMSS for the Enhanced Summer Observing Period, 1 April through 30 September 1995 over the Arkansas-Red River basin. The Enhanced Observing Period is scheduled to run for five years over the entire Mississippi River basin and commenced on 1 October 1995.

The area of the Mississippi River basin (3.224×10^6 km^2) is the third largest of the sixteen rivers in the world with individual flow rates of more than 10^4 m^3/sec, and the largest of any Northern Hemisphere river flowing to the oceans (Baumgartner and Reichel, 1975). The basin is a continental-scale domain covering roughly the central half of the continental US (Figure 3). Flanked by the Great Lakes and Canada in the north, the Appalachian Mountains in the east and the Rocky Mountains in the west, this is a region of varying land use, vegetation, soil conditions, groundwater characteristics and topography. The varying landscapes provide a diverse region in

which to study clouds, precipitation, evaporation, runoff and the land-vegetation-atmosphere interactions that determine these. The flows along the Mississippi River and its tributaries reflect complex climate forcings by atmospheric and hydrological processes. These flow characteristics can be significantly modified by human activities while extremes at either end of the spectrum can have major impacts on human endeavors. In drought years, such as 1988, there were wide spread crop losses and disruptions to river traffic. The record-breaking floods in 1993 wrought havoc on industry, commerce and the lives of those living and working along vast stretches of the flood plain of the Mississippi River and several of its major tributaries.

GCIP-Mississippi is a major scientific undertaking with broad international interest, since it addresses many issues in the forefront of climate research and water resources management. GCIP will depend upon the modernized, ground-based US meteorological observing networks. Among these are the advanced Doppler weather radars and a network of profilers capable of making continuous measurements of wind through the atmosphere. The radar data, when validated by strategic networks of conventional raingauges, will provide accurate hourly precipitation measurements at a high spatial resolution of 4 km. These measurements can be correlated with data from space borne instruments to improve techniques of precipitation estimates from satellites over the whole globe. The wind profilers, coupled with data on atmospheric humidity from ground-based and airborne instruments, will enable moisture flowing into and out of the GCIP domain to be quantified and incorporated into computer models. Here too, the enhanced capabilities will improve satellite-based estimates of water vapour on a global scale.

The ambitious scientific program of GCIP-Mississippi is dependent on the latest developments in atmospheric and hydrological modelling and on advances in computer technology. Climate processes involving solar driven energy and hydrology cannot be modelled separately and the research plan for GCIP-Mississippi includes improved techniques for coupling land surface and atmospheric processes in global climate models. One important task for GCIP scientists is to incorporate into a single consistent numerical representation, both the large-scale features of the atmospheric circulation and, at a necessary level of detail, processes related to variations in land surface attributes, such as vegetation, soil type and topography. This development effort and its extension to other parts of the globe will require the cooperation of the international community of hydrologists, meteorologists and other geoscientists.

Linking hydrological processes at different scales has been hindered by poor data sets and the difficulty in representing the complexity involved. New, high-resolution measurement techniques for precipitation, wind and humidity, new methods for assimilating data into climate models, and the scientific community's recognition of the need for advanced schemes that represent the hydrological cycle in coupled models now provide the necessary capabilities and the incentive to support the continental-scale efforts.

Revised Scientific Objectives

During 1995 and 1996 the US National Research Council's GEWEX Panel reviewed GCIP. Recognizing the overall goal of GCIP as demonstrating skill in predicting changes in water resources on seasonal and annual time scales as an integral part of the climate system the scientific objectives were revised to be:

1.. Determine and explain the annual, interannual and spatial variability of the water and energy cycles within the Mississippi River basin.

2. Develop and evaluate coupled hydrologic-atmospheric models at resolutions appropriate to large-scale continental basins.

3. Develop and evaluate atmospheric, land and coupled data assimilation schemes that incorporate both remote and *in situ* observations.

4. Improve the utility of hydrologic predictions for water resource management up to seasonal and interannual time scales.

5. Provide access to comprehensive *in situ*, remote sensing and model output data for use in GCIP and other seasonal-to-interannual climate studies and as a benchmark for future hydrology and climate studies.

Appendix B MAGS

Complementing the GCIP mid-latitude project is a high-latitude continental-scale project on the North American Continent, the Canadian GEWEX Program Mackenzie River basin study. Phase I (1992-98) of this work is called the Mackenzie GEWEX Study (MAGS). The objectives of the Canadian GEWEX Program are (1) to contribute to the international GEWEX program in areas of special Canadian interest and expertise, and (2) to contribute toward the better understanding and prediction of changes to Canada's water resources arising from climatic change. A central goal of the Canadian GEWEX Program is to develop the ability to model the energy and water resources of the Canadian Artic basin on spatial scales of 100 km and a temporal scale of one month. This will include an improved ability to model the fresh water flux into the Artic Ocean. The objectives of MAGS are to understand the water and energy fluxes and reservoirs associated with the Mackenzie River basin and to develop the capability of developing appropriate models to account for these processes.

A strategy to accomplish these objectives has been developed. In summary, it is to develop a comprehensive dataset that characterizes the critical aspects of the Mackenzie River basin's water and energy cycles; to understand the various processes and interactions; and to assess model performance and to, as appropriate, improve model capability so that they can adequately account for the critical processes.

During the GCIP effort in the Mississippi River basin a series of large scale hydrological and related atmospheric and land-atmosphere studies will be conducted during MAGS. Within the Mackenzie River basin are many important cold region phenomena such as snow and ice processes, permafrost, Arctic clouds, and radiation interactions that will be essential components of any global climate system model. The results of MAGS will be an improved understanding of cold region, high latitude hydrological and meteorological processes and the role that they play in the global climate system. Furthermore, the Mackenzie River and Mississippi River basins taken together provide a true continental area in which to test and validate GCIP models. The NCEP mesoscale Eta model has been extended to cover the Mackenzie River basin , as has the Canadian RFE model to cover the Mississippi River basin. The Beaufort and Arctic Storms Experiment (BASE) is another Canadian GEWEX project that will provide knowledge on precipitation over the Mackenzie River basin. The first major intensive field project of BASE was undertaken for the Inuvik region (about 68° N) in late 1994. MAGS shares common interests with BOREAS as approximately 80% of the Mackenzie River basin is covered by forest of one type or another; and with the land portion of the Canadian Cryosphere System Study (CRYSYS) because of the importance of snowfall, snow cover, ice cover, and glaciers in the hydrological cycle in Canada. The Mackenzie River is also a major inflow to the Arctic Ocean and thus MAGS is an important contribution to the WCRP Arctic Climate System study (ACSYS).

Work under MAGS has been proceeding along several lines:

- Field "point" studies to understand the important physical processes.
- Studies to relate these physical processes to variables which will be used in hydrological and atmospheric models at the basin scale.
- Using these basin scale studies, develop physically based parameterization schemes suitable for meso- to macro-scale modelling. Individual parameterization schemes will

be tested and validated at meso- and macro-scales.
Incorporation of parameterization schemes into hydrological-atmospheric models. Integrated models will be tested and validated at a range of scales from basin to meso- to macro-scales.

A draft version of the MAGS Implementation Plan was produced in mid 1995. This is available on the World Wide Web (URL address http://www.dow.on.doe.ca/GEWEX/gewex_homepage.html) and calls for enhanced observing periods and special water budget studies in 1997-98. The start of the CAGES effort is scheduled for late August 1997 and will run for about one year to properly capture a complete water year in greater detail than currently achievable.

The Canadian GEWEX Program is planned as an integration of scientific activities in atmospheric science and hydrology by university and government researchers. The linkages between GCIP and MAGS researchers will be mutually beneficial, including individual collaboration and arrangements among university scientists and the provision of operational analyses from the RFE model of the Canadian Meteorological Centre and the NCEP Eta model.

The results from the Canadian GEWEX Program are leading to improved understanding of cold region, high latitude hydrological and meteorological processes, and in the role that they play in the global climate system. Because conducting research in the Arctic is complex and expensive in both human and financial terms, it has been difficult to properly characterize in Arctic river basin modelling studies such processes as snowcover formation in areas of blowing snow, refreezing of meltwater within cold snowpacks, frozen soil infiltration and evaporation from snow free areas. MAGS has already made significant progress in improving the understanding and ability to model several of these important cold region hydrological processes which in the past had been neglected in basin scale modelling in permafrost areas.

Appendix C BALTEX

The Baltic Sea Experiment (BALTEX) is a continental-scale project also aiming for improved knowledge on energy and water cycle processes important for climate (International BALTEX Secretariat, 1994). The entire Baltic Sea catchment area covers 2.1 x 10^6 km^2. It is partly a densely populated, heavily industrialized area, and intensive land use is common. It covers heterogeneous terrain including variable land surfaces, with mountains, numerous rivers and many lakes, and a semi-enclosed epicontinental sea. The BALTEX area ranges from a mild and humid mid-latitude climate to a subartic winter climate. Wintertime advection of Artic air masses may lead to excessive surface fluxes and deep convection with heavy snowfall over much of the area. Snow accumulation and melting, and sometimes highly variable rainfall patterns, determine the river runoff conditions. The Baltic Sea is a unique brackish sea with complex hydrography and variable sea-ice conditions. Its annual net water discharge to the world ocean through the Danish Straits is comparable to the Mississippi River.

BALTEX will explore, model and quantify the various processes determining the spatial and temporal variability of the energy and water cycle of the Baltic Sea and its catchment area. The project will make specific assessments of the total flux divergence of heat, water and momentum for this region and determine its coupling to the large-scale atmospheric circulation and to the water exchange through the Danish Straits, the outlet of the Baltic Sea to the North Atlantic Ocean. The scientific objectives will be addressed by a combined observational and modelling approach in which the Baltic Sea, the land surfaces of its catchment area and the atmosphere will be considered as one system. The principle scientific objectives are : (1) to explore and model the various mechanisms determining the space and time variability of energy and water budgets of the BALTEX region and this region's interactions with surrounding regions; (2) to relate these mechanisms to the large-scale circulation systems in the atmosphere and oceans over the globe; and (3) to develop transportable methodologies in order to contribute to the basic needs of climate, climate impact and environmental research (Raschke, 1994).

The basic program elements will be consist of: collection of *in situ* and remote sensing data, re-analysis of existing data sets, data assimilation, numerical experiments and coupled modelling and process studies, including field experiments. Existing observing networks will provide the bulk of the meteorological, hydrological and oceanographic data needed for the initialization and validation of models and for diagnostic studies. The BALTEX region has a dense network of meteorological and hydrological stations and is potentially a very useful region for studies of the water and energy cycles. Special efforts will be made to improving the use of satellite and weather radar information and to establishing a comprehensive network of weather radar stations for the BALTEX region. This will require the systematic exchange of data such as high resolution observations of precipitation.

The BALTEX group represents all 10 countries with water discharge into the Baltic Sea. The implementation plan has a preparatory phase (1994-1996), during which particular consideration will be given to model updating and to an intensive inventory of all ground-based observational systems in the BALTEX area and neighboring countries. The enhanced research phase of BALTEX is scheduled for 1997 to 2000, and will include the main field experiments and model studies. A second research phase is planned to continue numerical and field studies. The field experiments will involve both field campaigns studying small- and mesoscale processes, and

Intensive Observation Periods (IOP), studying extreme events and modification of synoptic-scale systems. An example of an IOP is PIDCAP, the BALTEX Pilot Study for Intensive Data Collection and Analysis of Precipitation undertaken during September 1995 to February 1996 include the collection of data from some 3500 precipitation stations which will be processed on a 50x50 km grid and a 15x15 km grid for regional model comparisons. Its objectives are to collect, analyze and intercompare measured and estimated precipitation from different data sources in order to identify and establish reliable standards for model validation and to validate the output of different regional models against such precipitation data sets. Five further field experiments are planned which include both field campaigns and IOPs: 1. Cloud/Precipitation/Air-Sea Interaction Experiment, 2. Cloud/Precipitation/Air-Land Surface Interaction Experiment, 3. Atmosphere-Ice-Ocean Experiment, 4. Baltic Sea Vertical Advection and Mixing Experiment, and 5. Front Modification Experiment. BALTEX will exchange experience with other ongoing projects in the region such as the Northern Hemisphere Land Surface Climate Processes Experiment (NOPEX) and the Artic Climate Systems Study (ACSYS). The major BALTEX field experiment is scheduled for October 1999 to March 2001.

The plan is for several models to be operated by various government services and larger research institutions. Different versions of regional-scale models, which have been originally developed for operational weather forecast purposes (such as the Nordic HIRLAM and the Deutschland model of the German Weather Service) will be coupled to hydrological and oceanographic models to develop a very high resolution (10-20 km) comprehensive, fully coupled model as a central analysis and forecast tool. Since the Baltic Sea is about 20 percent of the BALTEX domain, an oceanographic component has been added to the meteorological and hydrological components found in the previously discussed continental-scale projects. GCIP and BALTEX scientists are expected to share experiences, data, modeling advances, and achievements in validating satellite retrieval techniques.

Appendix D LBA

The continental-scale program being planned for Amazon River and adjacent biomes in Brazil is known as LAMBADA-BATERISTA-AMBIANCE (LBA) (LBA Science Planning Group, 1996). This involves three independently justifiable research initiatives associated with land use change which have respective emphasis on documenting and understanding: (1) the continental-scale energy and water budgets - the Large-Scale Atmospheric Moisture Balance of Amazonia Using Data Assimilation (LAMBADA), and (2) focussed plot and mesoscale studies of the ecohydrological processes - Biosphere-Atmosphere Transfer and Ecological Research In situ Studies in Amazonia (BATERISTA), and (3) biogeochemical processes - Amazon Ecology and Atmospheric Chemistry Experiment (AMBIANCE). These three initiatives are being jointly coordinated between the countries involved (Brazil, Venezuela, Bolivia and Columbia), and the disciplines and national interests involved, to gain maximum cost effective research benefit. They are timed to occur over a two year observational period beginning in 1997/98.

The release of latent heat associated with heavy precipitation over Amazonia is a major energy source for the atmosphere. The impact of natural variations in land surface characteristics along with the potential impact of human induced changes, most notably the continued deforestation of the Amazon basin, are questions of major importance in predicting climate change. Hence, the broad objectives of LBA are: (1) to improve our understanding of the physical and biological processes controlling the energy, water, carbon, trace gases and nutrient cycles found within Amazonia and to determine their link to the atmosphere; (2) to improve our understanding of how these energy, water, carbon and nutrient cycles might respond when biological systems are changed (deforestation, selective logging, agricultural management, reforestation or shifts in species compositions) and global climate systems are changed (increasing atmospheric CO_2 concentration and associated changes in the physical climate system); and (3) to improve our understanding of the effects of biogeochemical changes on the composition of the atmosphere, including key greenhouse gases (N_2O, CH_4, CO_2) and species regulating the oxidizing potential of the atmosphere (NOx, CO, hydrocarbons, O_3) and on surface water chemistry.

The basin-wide perspective of the study and the need to quantify the effects of land and vegetation disturbance and recovery bring will necessitate heavy reliance on satellite data as well as integrative models for the Amazonia region that can be validated by the proposed process studies and landscape-scale measurements.

One LAMBADA science activity addresses energy and water cycle interaction with cloud processes; another is concerned with the transport of water vapor in determining precipitation over Amazonia. This element of LBA will concentrate on understanding the regional-scale energy, heat and moisture over the entire Amazon basin. The data will provide invaluable diagnostic information on the atmospheric energy and water balance of the region and will improve our understanding of some of the governing processes in tropical meteorology. The field observation phase of LAMBADA will provide data that would permit quantification of the energy and moisture budgets of the regions and their dependence on large-scale atmospheric circulation.

For these and related activities an expanded radiosonde network is planned for a large area within the Amazon River basin, along with enhanced hydrological and surface meteorological networks,

radars, and a comprehensive satellite remote sensing capability. The latter will include data from the Tropical Rainfall Measuring Mission (TRMM) and NASA's EOS-AM platform. These data will permit a detailed description of the energy, heat and moisture budget of the entire region and a few embedded subregions. Under some conditions, measurements of the atmospheric carbon budget and possibly other trace gases for the same areas may be possible.

The BATERISTA element will focus on mesoscale/local-scale process to provide detailed information to support the formulation and validation of hydroclimatological, biogeochemical and ecological models. A number of sites selected for BATERISTA will focus on surface-atmosphere exchange measurements, and ecological and soil process studies that will serve as calibration sites for satellite remote sensing and airborne flux measurement work. These are to have flux measurement (radiation, heat, moisture, momentum, CO_2 and some trace gases) equipment and will also serve as the foci for the ecological, biogeochemical, hydrometeorological and remote sensing studies. The measurements in these areas are intended to provide an understanding of the physical, chemical and biological processes governing the surface radiation and energy balance, the carbon budget and the budget of critical trace constituents (trace gases and soil nutrients). The areas are to be distributed around the region to obtain adequate sampling of the ecoclimatological gradients. As far as possible, the intention is to build upon the existing network. One central area, the primary research area, is to be the focus of some detailed studies comparing processes within and above undisturbed forest, cleared pasture, abandoned pasture, regrowth forest, etc. These local-scale studies will be used to validate remote sensing techniques and airborne flux measurements which will then permit extrapolation of the process models to larger areas and ultimately allow direct comparison with the large-scale network results. Most of the proposed sites will form part of two axes for ecological transects running through the rainforest out to the Cerrado (savanna) to the south and from the rainforest to the dry shrubland to the east.

As in GCIP, the field observations and meteorological fields provided by a mesoscale 4DDA scheme will enable estimates to be made of energy and water budgets and their dependence on large scale atmospheric circulation. The planning for LAMBADA is being coordinated with GCIP activities, including the use of the NCEP Eta model over the Brazilian study region. NCEP has extended the domain of the Eta model to cover Amazonia. Within the Brazilian Institute for Space Studies (INPE) the Center for Weather and Climate Prediction will also run the Eta model and data assimilation system as well as its own GCMs, mesoscale, hydrometeorological and landscape scale models.

The hydrological component of LBA will attempt to address the full spectrum of the hydrological issues, from the continental scale or the Amazon River basin scale (10^6 - 10^7 km^2) to the regional scale or mesoscale river basins (10^2 - 10^5 km^2), and eventually down to the scale of hillslopes and small basins (1-10 km^2) and individual leaves. The linkages of the hydrological processes and the biogeochemistry of surface waters at the same scales are also addressed. A Multi-scale Nested Drainage Basin Approach (HYNEST) will be used to relate the results across the various scales. The approach of HYNEST is to apply in a "nested", well coordinated manner, atmospheric and distributed land-surface hydrological models with different spatial resolutions at different spatial scales. The early ideas on the nested drainage approach were discussed by Bonell and Balek (1993), Becker et al (1993) and Becker (1994).

The HYNEST models should be coupled, on or off-line, with the corresponding atmospheric model, so that the fluxes at the land-atmosphere interface are identical to both. Fluxes computed with different models could then be compared for validation purposes at a variety of scales, for elementary grid units or for gauged river basins used in modelling, or for any other sub-areas of interest, eg forest sites, deforested sites, etc. The hydrological models need to be run on a continuous basis for at least two years to realistically simulate the longer term depletion and refilling of water storages within the basin. The large storage capacities of land hydrological systems for surface, soil and groundwater, and their much longer residence times than the atmosphere, are the main reason for the above requirement. Longer term simulations can also provide the basis for the identification of periods where the initial and final total water storage are equal. Only for those periods the simple difference between precipitation and river basin discharge can be used to calculate basin evapotranspiration.

Some of the ongoing and near term activities which have become part of the initial implementation phase of LBA include NASA's Smoke, Cloud, Atmosphere, Radiation Programme that took place in Brazil (SCAR-B) from 15 August - 15 September 1995. A water, energy and CO_2 fluxes experiment is also underway near Manus, Brazil. This effort will last at least a year and will include night boundary layer experiments. Design studies underway include a mesoscale field experiment, a remote sensing of of biophysical parameters study and a water budget closure analysis. The plans call for the performance of simultaneous measurements to characterize most of the physical and chemical components of the Earth surface reflectance, the atmosphere and the radiation field in the biomass burning environment. The Concise Experimental Plan has been published by the LBA Science Planning Group (1996) and the Integrated Science Plan is scheduled to be finalized during 1996.

Appendix E GAME

The GEWEX Asian Monsoon Experiment (GAME) was proposed by the Japan National Committee to the WCRP in March 1993 (Japan National Committee for WCRP, 1994). Monsoon Asia, or more widely, the Eurasian Continent, plays a dominant role in driving the seasonal cycle of planetary-scale surface energy exchange and transport in the climate system. The entire area is extremely heterogeneous and diverse with land surfaces extending from equatorial to polar regions, from the humid tropics of Southeast Asia to the arid and semi-arid regions in the interior of the continent. The scientific objectives of GAME consist of the following major parts: (1) to understand the role of the Asian monsoon in the global energy and water cycle, (2) to improve the simulation and seasonal prediction of the Asian monsoon by global climate models and numerical forecasting models, (3) to understand multi-scale interactions in the energy and hydrological cycles of the Asian monsoon region, and (4) to assess the impact of monsoon variability on the regional hydrological cycle.

It has been shown that the anomalies of land surface conditions (ie snow cover, soil moisture, etc) are likely to cause anomalous monsoon circulation and precipitation through continental-scale atmosphere-land surface interactions (eg Yasunari et al, 1991), though the physical processes of the monsoon/land surface are not yet fully understood. Most of the problems in the GCMs in the prediction of monsoon precipitation come from the uncertainties and poor physical bases in the land surface processes, as well as the cloud/precipitation processes in the models. GAME will focus on understanding these physical processes, based on observations and monitoring, intensive process studies and modelling. The science strategy of GAME consists of three components: (1) monitoring by satellites and in-situ surface observations, (2) process studies based on four regional experiments (Tropics, Sub-tropics, Tibetan Plateau and Siberia), and (3) modelling of the hydrological-atmospheric processes in the climate system. GAME will focus on the energy and water cycle processes and land/atmosphere interactions in the diurnal to seasonal cycles of the Asian monsoon system.

To understand the physical processes and validate the models relating to multi-scale cloud processes and atmosphere-hydrosphere interactions, and to obtain ground truth data for the satellite measurements, several GCIP-like regional scale field experiments are planned as part of GAME. These planned experiments are to be conducted at the regional or large-basin scale over various land surfaces and under various climate conditions. The main scientific objectives for each region are:

(1) Tropics: Chao Praya River basin, Thailand and tropical rainforests in Malaysia and Sri Lanka
   a. Energy and water cycle of the Chao Praya river basin
   b. Precipitation/soil moisture feedback
   c. Role of vegetation in the energy and water cycle

(2) Subtropic: the humid subtropics and temperate region of the Huai-He River Basin Experiment (HUBEX) in central China
   a. Energy and water cycle of the Meiyu (Baiu) frontal system
   b. Role of land surface/atmospheric interaction on formation of mesoscale cloud systems and precipitation in the Meiyu (Baiu) frontal system

(3) Tibetan Plateau: headwaters of the Yangtze River

a. Energy and water cycling processes of the Plateau monsoon

b. Role of the land surface/atmosphere interaction on seasonal evolution of the monsoon over the Plateau and surrounding regions

(4) Siberian Tundra: a permafrost area in the Taiga region in western Siberia.

a. Energy and water cycling processes of the Lena River basin

b. Role of the Cryosphere/atmosphere interaction on the energy processes of the atmosphere and the hydrological cycle.

In each region, three types of field campaigns are planned: (1) One dimensional or small area (< 10 km^2) energy and water flux sites representing various surface conditions, for improving the land-surface parameterization of climate models; (2) Mesoscale energy and water cycle process studies at a scale of 10 - 1000 km^2 for modelling GCM sub-grid scale hydrological processes; and (3) Regional and large river basin-scale (> 10 000 km^2) energy and water vapour budget studies based on the radiosonde observation network combined with enhanced surface hydrometeorological observation network. These will also contribute to the 4DDA data assimilation and enhanced modelling activities at the global and nested regional scale. The global 4DDA with the new T213L30 NWP model with a simple SIB land surface model commenced its operational runs at the Japanese Meteorological Agency in March 1996 with a horizontal grid size of 55 km. The GAME Regional Models (Kimura model, JSM model and the RAMS model) will provide regionally nested modelling of the energy and water cycle processes with a grid size of 10-30 km over each of the four study regions and are being initially tested as part of HUBEX and GAME-Tibet.

These process studies will run for at least one year to obtain the full seasonal cycle of the energy and water cycle processes of the four areas. The studies are planned for 1997 through 1999, with the main observing year, coinciding with the Intensive Observing Period (IOP) in 1998, for the first three areas (humid tropics and two areas in China), and 1999 for Siberia. The IOP will measure the energy processes and water cycles of the Asian monsoon system. The full use of the new Tropical Rainfall Measuring Mission (TRMM) and other earth observing and meteorological satellites is required for the IOP, combined with enhanced upper air soundings and surface-based observations. The main scientific aims of the IOP are: (1) to resolve the processes of the seasonal progress from the pre-monsoon onset, the onset of the mature phase and the intra-seasonal variability of the summer monsoon; (2) to resolve the full diurnal cycle of convective cloud systems, precipitation and land-surface hydrological processes; and (3) to study the multi-scale interactions between sub-grid scale hydrological processes and mesoscale atmospheric processes.

The implementation of the IOP will require full international cooperation, particularly for the enhanced radiosonde observations and the special data archive of the routine meteorological and hydrological observations of the countries concerned. The surface observations will be supported by the Asian AWS Network (AAN) linked to the GMS satellite. About 20 Automated Weather Stations (AWS) will be deployed from the Artic Tundra to the tropical rainforest region, and from the humid temperate region to the dry climate region of the interior of the continent. These enhanced AWSs will have direct measurements of sensible and latent heat fluxes, soil moisture gradients and surface skin temperature. To assist in these matters the first meeting of

the GAME International Science panel (GISP) was held in Tokyo in March 1996. The Panel will coordinate with other GAME related international and national projects, such as the South China Sea Monsoon Experiment (SCSMEX) and the Chinese Tibetan Plateau Experiment (TIPEX), which also has its IOP planned for the summer monsoon of 1998. The draft have been revised and are due to be finalized in 1996.

Annex 13

GRDC-relevant Research Projects at the FIH (Abstracts)

Transformation of Measured Runoff Data to Grid Points

Karlheinz Daamen

Within the framework of a national research project funded by the Federal Ministry of Education and Research (BMBF), methods for the calculation of grid-based runoff on a 0.5° x 0.5° grid were extended and verified for the Weser and Elbe catchments. Simultaneously, the project contributed also to the WMO WCP- Project B.3: Development of Grid-related Estimates of Hydrological Variables. Only the area-weighted runoff balancing (method 1) enables to calculate the grid-based runoff exclusively from gauge-based runoff data, although it is only applicable to areas with a high gauging station density. Data acquisition and assimilation, as well as the digitization of gauge-bases catchment limits are highly time-consuming. This method, therefore, may only be used for selected regions for which it may serve as a reference data set for the evaluation of the quality of the other methods, too.

The disaggregation of runoff by the use of statistical relationships between runoff and catchment characteristics (method 2) needs, at least at topographically more intensively structured relief, the inclusion of long-term mean areal distribution of precipitation depth. By this procedure, empirical relationships between runoff and precipitation as well as further catchment characteristics can be established. The relationships are regionally differentiated. The influence of evapotranspiration on runoff is not explicitly taken into consideration within the computational scheme. Therefore, this method was not further investigated within the project.

With respect to a possible continent-wide applicability, the water balance model of Thornthwaite-Mather was extended. The model WABIMON enables the calculation of long-term mean grid based runoff using the existing global hydrometeorological and physiographic data sets. Combined with the monthly means of runoff at selected reference gauges, the time-dependent grid-based runoff can be calculated.

Improvements in future projects have to be done in the model components of the water balance model, especially the parameterization of runoff coefficient, and in the selection criteria of the reference gauges. For this task, the runoff data of the Global Runoff Data Centre (GRDC) and the precipitation data (Rudolf et al., 1992) of the Global Precipitation and Climatology Centre (GPCC) of Europe are foreseen for evaluation. Method 3 forms the basis for the calculation of timely monthly overviews of grid-based runoff planned by the GRDC.

The project has finished at the end of 1995. The results have been documented in a report (BfG, 1997).

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The Development of a GIS-supported Water Balance Model as a Tool for the Validation of Climate Models and Hydrometeorological Datasets

P.Krahe

A monthly water balance model is currently in development at the BfG which shall be used for continental hydrologic modelling with respect to climate models (GCM's) and the development of global water ressources.

The following applications of the Water Balance Model are carried out or planned in the future:

* Estimation of monthly gridded runoff on continental scale in combination with discharge data stored in the GRDC
* Test of consistency and homogeneity of discharge data stored in the GRDC
* Verification of model parameter of hydrological models used in global and regional climate models and development of parameter estimation techniques using measured discharge data and GIS-datasets
* Reliability of gridded global precipitation and meteorological data sets derived from measured data
* Verification of water balance components of global and regional climate models
* Study of availibility of water resources and their possible change in regard of global greenhouse warming

The water balance model applied is a variation of a scheme which was first proposed by Thornthwaite and Mather (1957) and subsequently has been transposed in todays notation with slight modification by Vörosmarty et al.(1989). Improvements with regard to the production of direct and delayed runoff are introduced in the previous schemes. To run the model gridded rainfall and temperature data are needed. Soil and landuse data stored in a Geographical Information System are used for the calculation of model parameters.

The model was applied for Central Europe using a rainfall dataset of GPCC within the project "Transformation of Measured Runoff Data to Grid Points" (BfG, 1997) and verified for the german catchment areas of the rivers Danube, Rhine, Weser, and Elbe. The results indicate that the model can be used for the estimation of monthly gridded runoff if measured discharge data are used for correction of errors related to the model and the rainfall- resp. temperature data.

The model is very sensitive against the quality of the rainfall data. Therefore it can be used to test the reliability of gridded global meteorological especially rainfall datasets derived from measured data as well the output of climate models. An example is given by Krahe and Grabs (1996) for Central Europe using a rainfall dataset of GPCC.

Beside the simple structure of the model, it can also be used to test the reliability of presently available global datasets of soil and landuse parameters to simulate the hydrological cycle in climate models. The studies have shown that an improvment of estimation techniques for parameters of runoff production in continental hydrological models is necessary. The activitities of the BfG are concentrated on the development of parameter estimation techniques for recession coefficients of baseflow based on geological and hydrogeological maps (Krahe et al.,1997).

The applications of the model have already shown that some further developments of the water balance model are needed. The parameterization of the runoff coefficient to model the effect of infiltration excess runoff will be improved using an extended precipitation

climatology and a probability-distributed soil moisture storage.

In further studies a validation and verification of the Water Balance Model is planned for the whole territory of Europe using the discharge data stored in the GRDC and precipitation datasets of GPCC.

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Annex 14

Status of Membership of the GRDC Steering Committee

GRDC - Steering Committee: Membership (6/1997)

Institutional Members

WMO
UNESCO
UNEP/WHO
World Bank
ICSU
GPCC

Governmental Members

Government of Japan

Individual Members

H.-J. Liebscher (Chairman of GRDC)
K. Wilke
Z. Kaczmarek

Ex-officio Members

WMO-CHy
GHP
FRIEND

Observers

President, Federal Institute of Hydrology
Ad-hoc observers

Secretary, GRDC

W. Grabs

Report No. 1 (May 1993)	Second Workshop on the Global Runoff Data Centre, Koblenz, Germany, 15 - 17 June, 1992.
Report No. 2 (May 1993)	Dokumentation bestehender Algorithmen zur Übertragung von Abflußwerten auf Gitternetze. (Incl. abtract in English by the GRDC: Documentation of existing algorithms for transformation of runoff data to grid cells) by G.C. Wollenweber.
Report No. 3 (June 1993)	GRDC - Status Report 1992.
Report No. 4 (June 1994)	GRDC - Status Report 1993.
Report No. 5 (November 1994)	Hydrological Regimes of the Largest Rivers in the World - A Compilation of the GRDC Database.
Report No. 6 (December 1994)	Report of the First Meeting of the GRDC Steering Committee, Koblenz, Germany, June 20 - 21, 1994.
Report No. 7 (June 1995)	GRDC - Status Report 1994.
Report No. 8 (July 1995)	First Interim Report on the Arctic River Database for the Arctic Climate System Study (ACSYS).
Report No. 9 (August 1995)	Report of the Second Meeting of the GRDC Steering Committee, Koblenz, Germany, June 27 - 28.
Report No. 10 (March 1996)	Freshwater Fluxes from Continents into the World Oceans based on Data of the Global Runoff Data Base.
Report No. 11 (April 1996)	GRDC - Status Report 1995.
Report No. 12 (June 1996)	Second Interim Report on the Arctic River Database for the Arctic Climate System Study (ACSYS).
Report No. 13 (Februray 1997)	GRDC Status Report 1996

Report No. 14 (February 1997)	The use of GRDC - information Review of data use 1993/1994. Status: January 1997
Report No. 15 (June 1997)	Third Interim Report on the Arctic River Data Base (ARDB) for the Arctic Climate System Study (ACSYS): Plausibility Control and Data Corrections (Technical Report)
Report No. 16 (August 1996)	The GRDC Database. Concept and Implementation.
Report No. 17	Report on the Third Meeting of the GRDC Steering Committee, Koblenz, Germany June 25-27, 1997