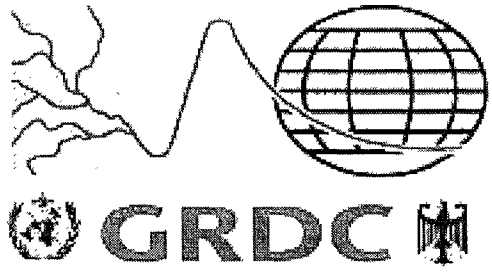
Weltdatenbank Abfluß
Bundesanstalt für Gewässerkunde
Koblenz, Deutschland

Global Runoff Data Centre
Federal Institute of Hydrology
Koblenz, Germany

Report No. 23

Report on the Fourth Meeting of the GRDC Steering Committee, Koblenz, Germany, 23 - 25 June 1999



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Annexes to the Report

1. General

1.1 The principal objective of the fourth meeting of the GRDC Steering Committee (SC) was to develop a common understanding of the strategic development of GRDC Activities and Research in the four year period 1999 – 2002. In choosing this subject it was intended to prepare an outreach of GRDC's activities which reflects the identity of GRDC and its role in water-related activities of WMO and other UN agencies and collaborating institutions. Members of the Steering Committee had contributed "Vision Statements" prior to the meeting which served as guideline for the discussion.

1.2 A further development which needed a response from GRDC-SC was the adoption of Resolution 25 (adopted at thirteenth WMO Congress) in May 1999 which regulates the exchange of hydrological data.

1.3 The participants welcomed the hospitality of the Federal Institute of Hydrology (BfG), Koblenz, where the meeting was conducted.

2. Opening of the meeting

2.1 The fourth meeting of GRDC-SC was formally opened by the chairman of the GRDC Steering Committee, Prof. H.-J. Liebscher. In his opening remarks, Prof. Liebscher reviewed activities of the GRDC in its 11 years of existence. He emphasised the continued stream of data deliveries to the GRDC databank and progress made in research through visiting scientists and institutional collaboration.

2.2 In his welcome address, the President of the Federal Institute of Hydrology (BfG), Mr. V. Wetzel noted the increased financial and institutional support made by BfG in response to the growing demand for data and related products as well as the advisory capacity of GRDC. Affiliating GRDC with BfG ensures the technical and scientific in-house support which is necessary for GRDC to meet its targets. Mr. Wetzel invited participants to search on their behalf for collateral means to foster the activities of GRDC for the benefit of water-related programmes and projects.

2.3 On behalf of WMO, the Director of the Organization's Hydrology and Water Resources Department, Mr. Arthur Askew, noted that GRDC is a valuable contribution by the Federal Republic of Germany to all water-related programmes within the United Nations family of agencies and to WMO in particular. He thanked Mr. Wetzel for his continued support of GRDC.

3. Organisation of work and adoption of the Agenda

3.1 Messrs R. Helmer (WHO) and G. Matthews (World Bank) were unable to attend, but had given valuable advise to the GRDC Secretariat prior to the meeting.

3.2 The provisional agenda was discussed and adopted by the participants without change.

4. GRDC at the Federal Institute of Hydrology: Review and perspectives for development

4.1 Mr. Wetzel presented a review of the inputs provided by BfG to GRDC, for which it provides the core funding. Funding includes staff salaries, provision of office space and office infrastructure, as well as data processing facilities and support to travel of GRDC staff. The presentation highlighted the support structure and facilities provided by BfG, which showed a budget increase of 72 % from 1994 to 1998. The financial development in the years 2000 through 2002 foresees (without staff costs) an increase of 18%, especially in terms of data processing capacity, research, publications and external support contracts. In the three-year perspective to staff development until 2002, an additional resource person for GIS-systems is planned as well as an increase of administrative assistance.

4.2 Mr. Wetzel called on members of the Committee to lobby for additional funding of GRDC from other countries and governmental and non-governmental donors. He highlighted the demands of services which cannot be borne from core funding of a single agency or country but should reflect the international character of the research community which is served by GRDC.

4.3 The scientific support of BfG will focus on three aspects: development of water balance models, aspects of regionalization and support in the development of GIS-systems.

4.4 The figures and tables of the presentation are reprinted in Annex 3 of this report.

4.5 The SC welcomed BfG's plans to increase the resources it provides to GRDC. The Committee warmly thanked BfG for the excellent support it provides to GRDC, the strong commitment of Germany to GRDC and, through BfG, recorded its appreciation to the relevant German authorities.

4.6 The Committee also agreed to search for collateral funds to enable GRDC to fulfil its tasks.

4.7 Mr. Diop, the representative of UNEP, confirmed that agencies intend to explore for additional resources in collaboration with GIWA/GEMS/Water/GPA in activities such as mapping of river basins with regard to quantity and quality.

4.8 The Committee further recommended to use EURAQUA contacts to support secondment of staff to GRDC and prepare joint proposals to EU for work in data sparse regions.

4.9 Participants expressed the hope that other sources of support could be found through international organisations, contracts and support from other national agencies.

5. Report of GRDC activities

5.1 An executive summary of key GRDC activities in the interim period between the third and the fourth meeting of the GRDC-SC was presented by Mr. W. Grabs (Annex 4).

5.2 From the report, the following trends and highlights were apparent:

- The co-operation with visiting scientists and institutions has increased considerably the research capacity of GRDC;
- GRDC is now capable of delivering global data products;
- The inflow of data into the GRDC database continues at a satisfactory level; additional efforts are necessary to obtain data from data sparse regions, i.e. Africa, parts of Asia;
- Requests for data have stabilised at about 100 per year;
- Additional advisory services and the involvement in new projects and activities have increased.

6. Vision statements of participants for the strategic development of GRDC

6.1 Participants had been requested to prepare vision-statements of the role and function of the GRDC as a basis for a discussion of the strategic development of GRDC. The vision statements are reproduced in Annex 5.

6.2 The Committee discussed elements of a vision for the future development of GRDC. Conceptionally, in the past, hydrological data had been viewed as an entirely domestic matter. With the growing need to harmonise water resources development in shared river basins, the transnational character of data has been realised. Within a country, decision makers were supplied with data from the national hydrological service (NHS) or other institutions holding water- and related data.

6.3 In the future, data needs will be more regional and globally oriented as a response to requirements in research and applications with regard to a better understanding of the climate system, for early warning purposes and detection of trends and other changes in the climate system and water availability. Researchers working on regional and global scales need to obtain data from GRDC to support decision-making on these scales. The results of research projects and studies are fed back to decision-makers with implications on global, regional and local scales. The positive involvement of national hydrological services is crucial in this process chain. In fact, by supplying data for regional and global research, national hydrological services get access to knowledge, methods, models and process studies outside the scope of their own activities in return for the data supplied. However, this concept is as yet not well understood by the public and the services concerned.

6.4 The Committee noted that a vision for the GRDC should include the following elements:

- Maintenance and expansion of the database,
- Strengthening of the distribution system,
- Increasing co-operative activities with research institutions and hydrological services, as well as value-added contributions to water-related programmes and projects.

6.5 In this way the Committee sought to combine two elements of future GRDC work: The conservative aspect to maintain and further improve GRDC's core activities; and a framework for an expansion and outreach of GRDC activities.

6.6 The Committee finally agreed on the following Vision Statement:

The GRDC

- **Is recognised as the definitive archive of and distribution centre for high-quality discharge data and related meta-data;**
- **Receives a steady stream of data ;**
- **Produces and distributes value-added data-related products;**
- **Promotes and is actively involved in studies addressing regional and global issues.**

7. Strategic development of GRDC

7.1 GRDC is now in its eleventh year of existence and has developed from a depository of global hydrological data to a service provider for the global research community in the areas of:

- Global climate models
- Hydrological modelling
- Water balance models and coupled models
- Regional and global assessment of surface water availability
- Operational hydrology

7.2 Increasingly, clients request research quality data products and generic research products from GRDC. Likewise, GRDC is actively participating in many global and regional programmes and projects.

7.3 On the one side, GRDC has rapidly adapted its capacity to the changing and increasing demand for data, products and research as well as advisory services. On the other side, GRDC should be in a position to formulate and pursue new directions in global and regional hydrological issues in a more pro-active manner. Examples of strategic developments are:

- The establishment of a Global Hydrological Monitoring System, in concurrence with WMO's World Weather Watch Programme and WHYCOS, is a strategic initiative which GRDC has been promoting since 1996.
- GRDC is undertaking the development of a modelling system to assess the balance between water availability, demand and consumption in large basins in an effort to find a methodology for the rapid assessment and regular monitoring of the water resources situation and development in selected large basins which are indicative of continental changes in the availability of water resources.
- The development of a global water balance model, currently tested for Europe, and the development of global gridded high resolution runoff fields in collaboration with the University of New Hampshire, as well as research to assess the impact of climatological anomalies such as El Nino on changes in hydrological regimes are further examples of innovative approaches by GRDC.

7.4 On the basis of the Vision Statement, participants discussed a strategic outreach for the development of GRDC within a time horizon of the next five to ten years. The development perspectives of GRDC in different time frames (see table on the following page) was discussed and adopted by the Committee's members. Elements of the strategic development were identified and are documented below.

7.5 To keep its unique identity, GRDC should focus its work on programme and activities related to regional and primarily global issues and try to close data gaps in data sparse regions. In this respect, GRDC and FRIEND are complementary activities where FRIEND's focus is regional and GRDC's focus global with some overlaps where close co-operation is required. The Committee noted, that this co-operation had already come to fruition (see item 14 in this report).

7.6 GRDC should maintain and continuously update the database – in close co-operation with the suppliers of the data.

7.7 GRDC should identify topic-related "targeted networks" with the ability to provide specific information and data. Examples for GRDC target data bases are the database on the 200 reference hydrological stations and the Arctic Runoff Data Base (ARDB) for the Arctic Climate System Study (ACSYS).

7.8 Global programmes such as GCOS, GTOS, GEMS/Water GIWA/GPA need to be consulted to define what these programmes need and how GRDC can respond to these needs – so as to define and produce specific data sets and products for their purposes. Another strategic element in this context is the definition of a global hydrological network.

7.9 The issue of regional GRDC representation was discussed extensively. A major positive aspect of regional representation of GRDC is the closer proximity to data providers and users in the region, a model on which FRIEND is based. Negative aspects are that all regional databases would need to be mirrored to the central GRDC database so as to maintain consistency of the system. The administrative effort for such an implementation is beyond the capacity of GRDC. Alternative approaches were suggested:

- GRDC should liase with regional HYCOS centres;
- GRDC should develop closer links with regional FRIEND groups.
- Further, other regional or national bodies could be identified which would co-operate with GRDC in data collection, development of data products and other GRDC-related services.

7.10 The Committee felt that a specially important strategic approach will be the development of close collaborations with major River Basins Authorities (RBAs), in particular in developing countries. Examples are the RBAs in the Niger, Zambezi, Senegal, Mekong Rivers and others, depending on opportunity.

7.11 Already now, on regional and global levels, there is a pressing need for near real-time hydrological data, especially for coupled land surface-ocean-atmosphere models, which cannot be satisfied as of now. GRDC was encouraged to obtain institutionalised access to near real-time discharge data from NHSs, regional WHYCOS Data Centres and other sources where feasible.

7.12 The feed-back loop between GRDC and data providers needs to be enhanced, inter alia by providing incentives for data providers to further submit data to GRDC. The benefit to data providers needs to be further developed so as to enhance data flow.

7.13 With respect to the role of GRDC, the SC felt that the WMO Commission for Hydrology should be of assistance in clarifying the role of the Centre with regard to the role of WMO World Data Centres. The question was then asked whether GRDC could itself become a WMO World Data Centre. SC recommended to put this question forward to CHy.

Global Runoff Data Centre (GRDC)
Perspectives of Development

Short-term	Medium-term	Long-term
▫ Development of methods for water resources management on a global scale. Pilot region: Danube river ▫ Development of water balance models ▫ Re-engineering of GRDC-database-system ▫ Production of global-scale data products on CD-ROM ▫ Development of a monitoring system for global river discharge ▫ Global Water Partnership (GWP) Pilot region: Southern Africa	▫ Water resources management in selected basins of the world ▫ Aspects of regionalization ▫ Cooperation in international projects such as: - ACSYS - BALTEX/BRIDGE - FRIEND - GEMS/Water - GEWEX - GCOS - GTOS - GWP ▫ Research cooperation with institutions and researchers	▫ Support in development of GIS-systems ▫ Establishment of a global GIS-supported Water Information System ▫ Operation of a global monitoring system ▫ Cooperation in projects such as: - FRIEND - GEMS/Water - GCOS - GTOS - WHYCOS

Support by Section M2/BfG	
Continuous tasks:	▫ Acquisition and dissemination of hydrological data ▫ Support to water related programs of specialized agencies of the United Nations

8. Implementation of the strategic outreach

8.1 Following the strategic outreach discussion, the Committee recommended a number of action items for GRDC and its partners to implement. It was clear, however, that a complete outreach and implementation plan would need further refinement and the Committee requested the CHy Advisory Working Group Hydrology to assist GRDC-SC in this important matter.

8.2 A pre-requisite element of such a plan would be the preparation of an overview of GRDC's contribution to major global projects. Action items identified are recorded below.

8.3 GRDC and GEMS/Water should jointly "market" both programmes vice-versa, especially in regions where both data bases are weak. The Committee noted that this had been done in the past; however, due to financial constraints on GEMS/Water, these joint actions have diminished in the last two years.

8.4 The formation of strategic alliances as mentioned above (i.e. with WHYCOS, GEMS, GIWA, FRIEND) and emerging programmes/projects such as HELP, Global Hydrological Database for Climate, etc. need pro-active participation from GRDC.

8.5 For collaborating centres/institutions in Africa, there is a need for GRDC to contact regional/subregional bodies dealing with hydrology, such as Agrhymet-OMVS-OMVG, SADC, National Hydrological Services and River Basin Authorities as mentioned above.

8.6 Product development is seen as a key element to convey the potential and actual use of the global database for users. GRDC is therefore encouraged to continue its efforts in forming partnerships to undertake projects which are mutually beneficial.

8.7 GRDC was further advised to organise a "products workshop" with the aim of reaching broad consensus on a set of data products which then would be compiled in a catalogue of revised data products.

8.8 Guidance to users with regard to the selection of data is essential in providing efficient services. Great strides have been made towards the development of a user-friendly data catalogue. The critical point, however, is the lack of the meta-data which are needed to put discharge data into perspective.

8.9 Meta-data templates associated with GRDC data should be produced which contain information about land-use, abstraction/diversion/water use, quality of data, regulation/in-stream structures/diversions, in addition to meta-data already stored in the GRDC database.

8.10 The Committee noted GRDC's efforts to incorporate information from the ICOLD CD-ROM "Large Dams and Reservoirs" This activitiy needs further and expanded efforts to obtain additional information.

8.11 Mr. A. Gustard was requested to follow up on the feasibility of linking the FRIEND meta-data catalogue with the GRDC catalogue.

8.12 Participants noted the paramount importance of quality assurance of hydrological data for research purposes. The guiding principle of GRDC has been that the responsibility for the quality of hydrological data rests with the data providers. It is impractical for the Centre to seek to compile all relevant information for a total quality control of GRDC data.

8.13 The SC urged GRDC to define and implement a quality assurance programme within the limitations defined by the availability of additional information.

8.14 Further along these lines, the SC discussed the need for an automated process for the real-time estimation of water level and discharge data. It was felt that such an automated process would be of great value to those collecting and processing hydrometric data, would greatly assist in improving the quality control (QC) and quality assurance (QA) activities, and would benefit the intended users of the data. Such a process was seen as being critical with the trend to real-time and near-real time systems such as advanced through WHYCOS (see sections 10.7 and 13.2). The SC recommended that an expert meeting be organised on the "Automation of QA/QC Procedures for Real-time Estimation of Water Level and Discharge Data". Such a meeting fell under the joint auspices of the WMO and UNESCO. Both organisations were asked to consider their support for such an initiative. The SC also noted the considerable efforts made by GRDC in the past years to perform a plausibility control of dubious data. The co-operation of data providers in both efforts was seen as indispensable.

8.15 To promote the interaction between GRDC and the data providers, the Committee suggested that GRDC compile a searchable, comprehensive database of data providers, users and collaborators with GRDC to close loopholes in the distribution of reports to data providers and to keep providers and users more up-to-date on developments.

8.16 As another recommendation, GRDC was requested to develop and prepare country reports using the available database for a number of countries per year. The country reports should contain information about the database and a number of statistical analyses and presentations which are of interest on the national and regional level, including key graphics etc. This should also enhance collaboration between NHSs and the GRDC in the preparation of meaningful data products at a national/regional level with the aim of stimulating data transfer from these countries to GRDC.

8.17 Key reports with a monitoring character, such as GRDC-Report No. 10 (river discharge into the Oceans) should updated from time to time, every five years or as appropriate.

9. GRDC publications and public relation activities of GRDC

9.1 GRDC had continued to publish its series of reports. These are documented in Annex 6. In May 1999 GRDC-Report No. 22 „Global, Composite Runoff Fields Based on Observed River Discharge and Simulated Water Balances" had been printed and GRDC-Report No. 24 „Summary Report of the Use of GRDC Data 1992 – 1998" was prepared for printing. Other publications include the first CD-ROM "World of Water", which contains a global data set of GRDC data and a data set with statistical and graphical presentation of 200 river basins representing the surface water flow from continents into oceans, marginal and inland seas.

9.2 Public relations activities focused on the complete restructuring of the GRDC presentation on the Internet with the aim to give more up-to-date information and news about the Centre and its activities, provision of improved services and the placement of prominent data products. The new Internet presentation had been delayed and an interim version would be on the Web around end of October 1999.

9.3 The Committee discussed the level of awareness of data providers and potential users and concluded that the international awareness of GRDC is excellent whereas the awareness at national level is much less.

9.4 The Committee advised GRDC to enhance its public relations activities on

- Web sites,
- Nationally,
- Internationally.

These activities should concentrate on potential data providers such as NHSs and, to a lesser degree, the scientific community.

9.5 Web pages of programmes/projects/institutes where GRDC should be visible should be checked for formulation/wording and updated information. Likewise, more hyperlinks in homepages of associated programmes and projects (i.e. WCRP) should be established on the GRDC homepage.

9.6 As general advice, GRDC should co-ordinate its public relations activities with those of GPCC and GEMS/Water.

9.7 Improved Web presentation of GRDC, together with enhanced catalogue functionalities, were seen as essential to boost the use of GRDC data. This should also include the publication of reports on the Web, including re-publication of selected previous GRDC reports which would improve the access to publications beyond the printed versions.

9.8 Likewise, the Committee felt that a data base of addresses should be established as a matter of priority, and better links should be established with the Hydrological Advisors of WMO Members and NHSs (see also 8.15 above).

9.9 The public relation effort should include the updating and revision of the GRDC leaflet, including its translation in other languages such as French and Spanish. The SC is aware of the financial constraints to implement this recommendation and its members will seek to attract third party co-funding.

9.10 In this respect, the SC requested the WMO Secretariat to be more active to promote public relation activities including improved contacts to NHSs. WMO was further requested to assist in updating and publishing the GRDC-brochure and publicising GRDC through its Regional Associations.

9.11 The Committee recommended that working groups and/or scientific lectures could be prepared for the eleventh session of CHy in December 2000 on activities/needs/future directions of GRDC.

10. Acquisition of data and information for GRDC

10.1 Data flow to the GRDC continued in 1997 – 1998 with the acquisition of updates and new stations. Shortage of funds with regard to other commitments of GRDC led to a decline in country missions for the acquisition of data. Due to the restructuring of UNEP, the previously well functioning joint activities with GEMS/Water for data acquisition suffered. The Committee discussed practical recommendations for collaborative efforts with other

water-related programs and through joint data acquisition initiatives to widen and intensify data acquisition for GRDC using all possible sources and channels of communication.

10.2 The SC advocated the collection of further information pertaining to data, termed "meta-data". Current efforts have proven to be difficult as most data providers have problems to communicate information such as validity of rating curves, instruments used for observations, data quality assurance techniques, influence on the station discharge by water abstraction and storage schemes, land-use characteristics, and other factors that are required to render the data useful to users. In this regard, GRDC has co-registered its stations with information on dams and reservoirs released by the International Commission on Large Dams (ICOLD) to provide users with information on such structures upstream/downstream of GRDC Stations. The SC recommended actions to improve this situation, with particular emphasis to be placed on a reasonable amount of sites such as those identified through WCP-Water activities (see item 12.6 of this report).

10.3 The figures below summerize the data availability in the GRDC database:
Since July 1998, data for 117 Stations were received out of which 9 stations were newly added to the GRDC database and 97 stations were updated. Australia and Ivory Coast dominated the data deliveries. Annex 7 provides an overview of data flow until July 1999.

10.4 Based on the GRDC criteria for data collection, the Committee discussed priority areas for data collection and came up with the following suggestions:

Highest priorities with regard to data-collection should be:
- Rivers discharging into the Oceans,
- Data and meta-data in support of the refocused activities of WCP-Water (see section 12.6),
- Discharge data which match the collections of other data centres such as that of GEMS/Water.

10.5 In addition, project-oriented data acquisition efforts similar to that for the ACSYS – ARDB may be undertaken once special criteria of such projects are clearly defined. In this respect, GRDC should follow closely activities with regard to the creation of a Global Hydrology Database for Climate.

10.6 A footnote should be added to the criteria for data acquisition by GRDC:
"These criteria may be specified or extended, as necessary, to meet specific data requirements of international environmental programmes."

10.7 Near-real-time acquisition of data is potentially possible through GRDC's link to WHYCOS and data supplied through Internet. This mode of data acquisition is expected to grow in the future, once more near-real-time data become accessible.

10.8 In some parts of the world there are major gaps in run-off observations, even on major rivers, which is largely a result of the decline of observations during the last few decades. This deterioration is to be addressed by the GRDC and data rescued wherever possible.

10.9 The Committee advised that efforts should be undertaken to make known the role of global data bases at national level (recommendations or comments of international conferences) and links with ongoing national research programmes, etc.

11. Use of GRDC data for local, regional and global research and assessments

11.1 The use of GRDC data is summarised in GRDC Report No. 24, a draft of which was made available to participants during the meeting. The report will be published by October 1999. The report will also be sent to data providers and –through WMO channels – to Hydrological Advisors.

11.2 The figure below shows the development of data requests with respect to different interests. The number of data requests has reached a plateau of around 100 requests per year. Climate and ocean-related research, where hydrological data are needed for model validation, provide a comparatively high number of requests. Regional interests can also be linked to research and interests in the management of transboundary rivers. There is a marked increase in demands for advisory services, value-added products and hydrometeorological modelling. The user structure needs an adequate response by GRDC, especially with regard to data products, research and more recent data which coincide with time frames when recent satellite technologies became more widely available for climate research, say, in the time frame 1985 to present.

12. Interactions of GRDC and the World Climate Research Programme (WCRP)

12.1 The SC noted that the requirements of WCRP projects were the original basis for the establishment of the Centre with the focus on support to WCRP projects with high quality discharge data, such as for the validation of Global Circulation Models (GCMs). Within GEWEX, GRDC is recognised as a project in support of its activities. Major support of GRDC is requested in activities of the GEWEX Hydrometeorological Panel (GHP), in particular for the Co-ordinated Enhanced Observing Period (CEOP-I) of GHP and the continental scale experiments under the guidance of the GEWEX - GHP. Further support is necessary for the Arctic Climate System Study (ACSYS).

12.2 The WCRP representative, Mr. Savtchenko, outlined the main future priorities and challenges of WCRP which are:

Understanding the hydrological cycle:

(i) Reducing uncertainties associated with the hydrological cycle, its main components and its interaction with changes in radiative forcing;
(ii) Improved understanding of land-surface processes and linkages with the atmosphere;
(iii) Refining techniques for the prediction of regional precipitation and runoff anomalies on time scales from seasons to decades.

12.3 He recommended, that GRDC should closely co-operate with GHP research groups to develop a specific GRDC support component for GHP and in particular its Co-ordinated Enhanced Observing Period Study (CEOPS-I) which was in the process of being launched.

12.4 The Committee noted with satisfaction GRDC's support for ISLSCP-I and its preparedness to fully support ISLSCP-II. The SC was further informed that GRDC has published a CD containing data and extreme values for more than 1,200 gauging stations world-wide and a set of 200 stations which would potentially serve as a basic station network for the proposed Global Hydrological Observation Network in support of climate. In addition, GRDC has published global gridded runoff fields from observed discharge in combination with a water balance model on a 0.5 degree grid. This represents at present the best available

combined high resolution runoff field. The publication had been executed as a joint project with the University of New Hampshire, USA.

12.5 With respect to the newly developed Climate and Cryosphere Programme (CLIC), WCRP would like to see a response from GRDC as to whether the Centre would be prepared to assemble the data on glacial and ice-sheet runoff. The Committee discussed the problems involved in accessing such kind of data and requested by CLIC and asked GRDC to consult on the possibilities of obtaining and archiving such data for use in CLIC.

12.6 World Climate Programme Water (WCP-Water)

12.6.1 Under the new formulation of WCP-Water, GRDC would work with the programme, but it will no longer be listed as a WCP-Water project as GRDC has grown to be a permanent body. Mr. Pilon reported on new developments in WCP-Water. For many years, it had focussed its major research efforts on a number of aspects linked to climate change issues. The programme can play an important and even stronger role in the future, as it has recently gone through a refocusing process. This process has resulted in an even sharper concentration of efforts on these pertinent issues. It has been decided that WCP-Water should concentrate on two main activity areas where especially the first one is envisaged to be addressed in the immediate future. The two proposed areas are:

A. Hydrological studies in the context of climate variability and change; and
B. Application of climate and enhanced hydrological information in planning, design and operation of water resources systems.

12.6.2 It is obvious that there is a clear link between the two proposed activity areas in that the first area will provide important, and necessary, input to the second area. Area B is in reality an application of whatever results emerge from A. It was thus natural that the decision was made to initially concentrate on the first activity area mentioned above. The proposal is that efforts should be directed to an assessment of historical data for various geographical regions. It is important to note that the data for the analyses must meet a stringent list of requirements. These requirements would or could be considered as meta-data. In this framework, it is hoped that GRDC will continue to support WCP-Water by maintaining the historical data and the meta-data associated with the refocused WCP-Water initiatives.

13. Status of WHYCOS (WMO) and links with GRDC

13.1 The SC was briefed about the current status of WHYCOS projects and the state of development of already funded WHYCOS projects such as MED-HYCOS in the Mediterranean region and SADC-HYCOS in countries of southern AFRICA. Further development of HYCOS sub-projects and the envisaged mechanism to link these regional HYCOS-projects into WHYCOS were presented. At present, the level of interest for HYCOS-projects in different regions is far beyond the capacity of project preparation and funding opportunities.

13.2 Twelfth WMO Congress (1995) noted the link between WHYCOS and GRDC. The link with MED-HYCOS is rather weak and there is at present no direct link with SADC-HYCOS. In a situation where there is an urgent demand for near real-time data, this situation is not satisfactory. The Committee discussed the data needs and the state of development of WHYCOS and concluded that the WMO Secretariat should be more pro-active in facilitating links between different HYCOS projects and GRDC so as to guarantee a flow of basic

information i.e. with regard to site selection, data collection and quality control, data policy and dissemination plans, as well as the state of the project in terms of the status of operational stations.

13.3 The SC was of the opinion that WHYCOS is the only source for global near real-time hydrological data where GRDC is in the position to permanently archive and further disseminate these data together with the historical datasets.

13.4 The Committee was concerned that data policies of different WHYCOS projects may not be compatible with each other, thus hindering the compilation of global near-real-time datasets which has been seen as a primary objective of WHYCOS.

13.5 The SC therefore requested the WHYCOS International Advisory Committee that participating countries in regional HYCOS projects should be made aware of the global perspective of WHYCOS in the conception phase which should then be reflected in the data policy of HYCOS partners. In HYCOS projects in the implementation phase, partners should be likewise made aware of the inherent global character of WHYCOS

14. Status of FRIEND and co-operative activities between FRIEND and GRDC

14.1 A general overview of FRIEND and its state of development was presented to participants by Dr Gustard (Annex 8). Specific developments on each FRIEND project were presented as well as region-specific research activities and results. The report will also highlighted on the foreseen future development of FRIEND in IHP-V and IHP-VI.

14.2 Since 1993, co-operative activities have been envisaged and carried out. These activities include participation of FRIEND representatives in GRDC-SC meetings and vice-versa, the joint collaboration in regional projects, specifically the Hindu-Kush Himalaya FRIEND. In this project, GRDC is represented in the Steering Committee and has been tasked to head the data acquisition activities. GRDC is also represented in two working groups of Hindu Kush Himalaya FRIEND, namely the Database Group and the Snow Hydrology Group. GRDC also participates in an INTAS project co-ordinated by the Institute of Hydrology, Wallingford in Russia, Belorussia and Ukraine to establish a regional data centre for the European Water Archive.

14.3 GRDC is acting as Regional Data Centre for Northern European FRIEND. The Steering Committee of the Alpine and Mediterranean FRIEND (AMHY-FRIEND) has recommend that GRDC act as technical co-ordinator and repository of the FRIEND – AMHY database. The Committee was invited to discuss the implications of these developments also in terms of possible support to GRDC to fulfil these additional tasks. Co-operative efforts could also be planned for regional data collection efforts, joint research activities at the boundary lines between national and regional (FRIEND domain) and regional to global research (GRDC domain). A step in this direction has been the presentation of FRIEND during the 1998 meeting of the GEWEX Hydrometeorological Panel, which welcomed the co-operation with FRIEND, especially in the GEWEX Continental Scale Experiments.

14.4 Mr. Gustard pointed out that major assets of the FRIEND projects are partnerships in science projects in the different FRIEND regions and the access to hardware and software (i.e. HYDATA and its components) by collaborating scientists. These are strong incentives for research partners in the regions to cooperate and produce joint research results which are directly beneficial to institutions in the regions.

14.5 Further positive experiences of FRIEND collaborative projects are its close links with Data providers and users in the regions, topic-oriented databases and extensive meta-data collected in research projects. In this way, unique and comprehensive databases have been created with high regional relevance.

14.6 The Committee discussed the commonalties and differences between FRIEND and GRDC and recorded its views.

14.7 Data requirements for FRIEND and GRDC may be different with regard to the topics for which the data are needed. In data sparse regions, where mainly network data can be collected, the separation of data requirements of FRIEND and GRDC is not always feasible and efforts have been made to explain to data providers the need for the same data for different purposes on different scales (i.e. local, regional, global).

14.8 The only major difference between data needs can be observed in the case of small basins, which are not the focus of GRDC. However, GRDC seeks data from small basins in countries which have no large basins or for river basins which represent pristine conditions to match quantity data with quality data requirements for the GEMS/Water programme. Increasingly, therefore, joint efforts should be made by GRDC and FRIEND groups to collect data while on the other hand highlight the different perspectives and use of the data collected.

14.9 The establishment of the Hindu Kush Himalaya FRIEND project in 1997 has demonstrated opportunities and avenues for successful joint project participation of FRIEND and GRDC.

14.10 Further joint co-operative efforts between FRIEND and GRDC are planned in the GEWEX project; specifically in the Continental Scale Experiments under the stewardship of the GEWEX Hydrometeorological Panel (GHP).

14.11 In order to define data needs and to identify overlaps between the GRDC and FRIEND databases, GRDC should take the initiative to prepare a joint catalogue of FRIEND and GRDC databases as a basis for seeking updates to the data and defining data needs.

14.12 In order to establish closer co-operation, the SC recommended that GRDC establish links with regional FRIEND groups through visits and collaborative work, including the exchange of data.

14.13 As a strategic alliance, the feasibility of local/regional representation of GRDC in FRIEND database groups should be examined as a matter of priority. The Committee felt that in due course this could be achieved in the person of the regional FRIEND database co-ordinators.

14.14 Mr. Hofius pointed out that the German National IHP/OHP Committee supports database activities of GRDC in FRIEND projects as a contribution to co-operation with FRIEND projects.

15. Status of GEMS/Water and future perspectives

15.1 Mr. Diop informed the Committee that the Freshwater Sector or Unit DOES NOT exist anymore in UNEP. The Committee further noted that within the UNEP new strategy for

water, it is planned that GIWA (which is part of DEIA&EW) will handle all UNEP Water ASSESSMENT activities, while GPA will handle the Water MANAGEMENT activities.

15.2 The background documentation for the Intergovernmental Council (IC) session of UNEP in December 1998 foresaw a strengthened role of GEMS/Water as a key programme of UNEP. It is expected that Freshwater activities of UNEP will be strengthened in future. Mr. Diop pointed out that UNEP may feel it appropriate to change the name of the GEMS/Water programme while largely retaining its successful activities.

15.3 The Committee agreed with the view of Mr. Diop that the issues of water quality and quantity need to be viewed in an integrative way. In this respect, the successful co-operation between GEMS/Water and GRDC in the past was noted and the SC expressed its hope that this co-operation would be intensified once UNEP disburses the necessary funds to its envisaged programmes and co-operative partners.

15.4 Information was provided on the UNEP initiative to develop an atlas and maps for freshwaters and river basins to analyse issues such as quality and quantity of water as well as the types of early warning networks to be put in place.

15.5 In order to improve collaborative programmes, Mr. Diop suggested that WMO and UNESCO should liase with UNEP to make use of its funding sources in joint projects, such as through the Global Environment Facility (GEF).

16. Joint programmes of GEMS/Water and GRDC

16.1 The Government of Canada has agreed to further sponsor the GEMS/Water Collaborative Centre in Burlington over the next three years to maintain and improve the global GEMS/Water database on water quality and to continue collaborative activities with participating countries. This has been the basis for the strengthened co-operation between GRDC and GEMS/Water from 1998 onwards.

16.2 The revitalisation of GEMS/Water after a dormant stage in the past two years is of strategic importance for GRDC as the GEMS collaboration is a cornerstone for combining water quantity and quality issues in a global collaborative effort. Recently, GEMS/Water is in the process of increasing the number of stations and participating countries to improve the quality and spatial coverage of its assessments.

16.3 Likewise, GEMS/Water activities are geared to improve "after sales service" to participating countries in a business approach to running an effective UN programme on water quality monitoring. This includes the development of new products of high impact and relevance to satisfy client needs.

16.4 The centreline for joint programmes and activities between GRDC and GEMS/Water is the benefit through enhanced recognition and services provided to users.

16.5 The SC identified the following strategic elements of collaboration between GRDC and GEMS/Water:

- Make efforts to advertise the importance of addressing water quality and quantity in an integrated programme context and highlight the co-operation of WMO-GRDC and UNEP-WHO-GEMS/Water;

- GRDC and GEMS/Water should further expand their co-operations to support GIWA and GPA;
- GRDC activities with regard to the assessment of freshwater availability versus demand and consumption in large river basins could be co-ordinated with GIWA activities on the basis of selected basins;
- Strategic joint partnerships (GRDC, GEMS/Water) should be further developed with FRIEND and Global Water Partnership (GWP), and also with the HELP programme which is now under development;
- Co-operation between GRDC and GEMS/Water needs to maintain:
  - effective publications,
  - training programmes,
  - a quality assessment and quality control programme.

16.6 On the working level, joint programmes have been envisaged and undertaken following a working agreement between GEMS/Water collaborating centre in Burlington and the GRDC. Collaborative activities relate to the production of a joint meta-data catalogue for users, describing measuring stations at rivers which are common to the databases of GEMS and GRDC. Using GEMS and GRDC data, one of the next steps envisaged is the calculation of suspended sediment load of selected rivers to the world oceans. Further collaboration between GEMS and GRDC in areas such as basin assessments of water quantity and quality, data acquisition and research depends on the availability of resources for GEMS and GRDC.

17. Status and co-operative activities between GPCC and GRDC

17.1 GPCC and GRDC are considered key global databases for GEWEX. Both centres are members of the GEWEX Hydrometeorological Panel (GHP) and provide inputs to GHP Global Scale Experiments and modelling efforts. The availability of precipitation information on a 30 minute grid and gridded runoff fields on the basis of a simulated river network with 30 minute resolution obtained from the collaborative effort of GRDC with the University of New Hampshire, opens a new window of opportunity for co-operation. Likewise, GPCC data are used for the Water Balance Model (Europe) developed by BfG in collaboration with GRDC which is nearing its completion and is planned to be tested for other regions of the world.

17.2 In GRDC's efforts to assess the water budget of large basins, a wider scope is seen for co-operation with GPCC. Mr. Rudolf expressed his interest to co-operate in the development of a joint common product "Water Budget in Large River Basins".

17.3 In the development process, quality control of data and results need to be developed as a matter of urgency:

1. Quality control (QC) of data: automated review of flow data should be combined with an automated QC of GPCC data;
2. The development of basin water balances requires the QC of flow and precipitation data taking into account possible scale problems;
3. Precipitation fields need to be tested against observed runoff in mountainous areas.

As a strategic element for co-operation, a high level joint product for GEWEX needs to be developed as a matter of urgency, in particular to support the Co-ordinated Enhanced Observing Period (CEOP-I) of GHP.

18. New Project: Hydrology for the Environment, Life and Policy (HELP)

18.1 The representative of UNESCO, Mr. Bonell, provided the following input with regard to the development of the HELP project, where a close co-operation between GRDC and FRIEND would be essentially.

18.2 A UNESCO-sponsored informal expert group meeting in December 1998 hosted by the Institute of Hydrology, UK, considered the feasibility of a field-oriented global programme on experimental hydrology (hydrological processes) linked with policy and development and put forward a conceptual framework to the Fifth Joint WMO/UNESCO International Conference on Hydrology, Geneva, February 1999.

18.3 The Conference unanimously endorsed the concept and requested UNESCO (in collaboration with WMO) to establish a Task Force to develop an implementation strategy for the Programme. The Conference also suggested that the title of the Programme, the World Hydrology Initiative for Policy and Development (WHIPD) should be changed. The title is now HELP (Hydrology for the Environment, Life and Policy). The Task Force will consist of policy makers, facilitators (water-land resource managers) and scientists, and is scheduled to meet in November 1999 at the University of Arizona. Clearly, close links with FRIEND and GRDC activities will have to be developed at the implementation stage.

19. Review of decisions of Thirteenth WMO Congress relevant to the operations and planned activities of the GRDC

19.1 WMO held its Thirteenth Congress in Geneva in May 1999. The Committee was informed of the Congress discussions which have relevance to GRDC and its activities, such as those concerning:

- Exchange of hydrological data
- World Hydrological Cycle Observing System (WHYCOS)
- World Climate Programme Water (WCP-Water)
- Global Climate Observing System (GCOS)
- World Climate Research Programme (WCRP) and the GEWEX project as part of WCRP

19.2 Participants recognised the progress made with regard to global data availability which is documented in Resolution 25 of WMO (Cg-XIII) (see Annex 9 of this report). The Committee noted that this resolution represents a milestone for negotiations with NHSs for the supply of data to the GRDC.

19.3 Congress had recommended that increased research attention be given to regional climate processes and phenomena. It had also suggested that WCRP should consider a research initiative on regional climate in co-operation with the climate impact community.

19.4 The SC considered this recommendation and requested GRDC and FRIEND to collaborate to provide the data needed for the validation of regional and global scale (nested) models.

20. Review of GRDC policy for the acquisition and dissemination of data

20.1 Based on the decisions of Twelfth WMO Congress, the GRDC guidelines for the acquisition and dissemination of data had been amended in 1997. As a result of the adoption of Resolution 25 (Cg-XIII) "Exchange of Hydrological Data and Products" (Annex 9). The Committee analysed and discussed the implication of this resolution on the GRDC's policy for the acquisition and dissemination of data.

After an in-depth discussion, the SC made the following decisions:

(a) It requested CHy to review the status, policies and activities of GRDC and advise the Centre accordingly;

(b) The Declaration of the Data User should be reviewed in the light of Resolution 25 (Cg-XIII) on the advice of CHy;

(c) On the basis of recommendations of the SC, the present policy is amended and draft revised Policy Guidelines are annexed to this report for the consideration of the CHy Advisory Working Group;

(d) Until further advice, GRDC will operate under the revised Policy Guidelines attached to this report as Annex 10.

In addition, the SC commented on aspects of Resolution 25 and the dissemination of data.

20.2. As a principle, the SC strongly supports the GRDC policy of not paying for data. Contributions towards the processing of data (i.e. collation, digitization, formatting) may however be necessary to enable Hydrological Services to send the data in a form usable for the GRDC. This needs to be decided by GRDC on a case-by-case basis. The participants agreed that the financial assistance to selected Hydrological Services, especially in developing countries, is an important incentive to process data for entry into the GRDC database.

20.3 With regard to the ownership of data, the Centre reiterated its view that the data providers, such as national hydrological services, are the owners of the data stored in the GRDC, with the understanding that these data may be disseminated to users on the basis of Policy Guidelines which balances the interests of both the data providers and data users. Minimum conditions as to the use of the data support the principle of free and unrestricted access to hydrological data. This view means that the data owners are also the custodians of datasets that they provided to the Centre and so have responsibility to make changes, announcing errors and deleting and updating their datasets. In this interpretation, it is clear that the GRDC is a repository of global discharge data and a hub for the dissemination of these data, but claims no ownership itself.

20.4 As the GRDC operates under the principle of free and unrestricted access to data and information, restrictions on datasets by the providers are discouraged. In fact, such restrictions apply to only three gauging stations. In these extremely rare cases, the original data are not released but only data products using restricted data. Again, this case is rather hypothetical. The SC recommended that GRDC should inform WMO of all such restrictions on data.

20.5 The SC noted that there had been some concerns as to how to interpret the "Draft Principles Governing Access to Data Held in WMO World Data Centres (WDCs)" set out in Annex V of the report of EC-XLIX. These referred to "common ownership" of data held in

WDCs and the non-acceptance of restricted data. The adoption of the latter would restrict contributions and it seems doubtful whether other centres would follow this principle.

20.6 In view of these earlier concerns, the SC was pleased to note that the subsequent session of the Executive Council had adopted a revised set of "Principles Governing Access to Data Held in WMO World Data Centres (WDCs)", which are included as Annex VIII in the report of EC-L. The references to "common ownership" and "non-acceptance of restricted data" do not appear in the revised Principles as a result of concerns expressed by WMO's Commissions for Atmorsheric Science and Climatology.

20.7 Addressing the current policy of GRDC for the dissemination of data, the meaning of item 2.6 of the Policy Guidelines would possibly allow the transferance of the entire database which also would have potential consequences for GEMS/Water and could lead to the withdrawal of some contributing countries from the programme. The Committee recommended to reword item 2.6 to read: "... Requests for the entire database or substantial parts of it will be referred to the WMO Secretariat so that advice may be sought from CHy".

21. Status of GRDC-projects

21.1 In addition to day-to-day operations such as data acquisition, processing and dissemination to users, and outsourced research, GRDC has always maintained some projects or collaboration in projects aimed at promoting the research and operational capacity of the Centre for the benefit of users seeking specialised services.

Development of Global Gridded Runoff Fields

21.2 Mr. Grabs informed the Committee that, in collaboration with the University of New Hampshire (UNH Messrs. B. Fekete and C. Vörösmarty), GRDC produced a GRDC report on Global, Composite Runoff Fields Based on Observed River Discharge and Simulated Water Balances providing fields at a 30 minute spatial resolution on a monthly basis. The demand for this report had exceeded expectation and the report would be reprinted by GRDC. In parallel, a CD would be produced and published under the auspices of UNH.

Modelling the Balance of Water Supply and Water Demand in Large Basins : A case study for the Danube River

21.3 The resource person for this GRDC project, Mrs. Dornblut, advised the meeting of its objectives and status.

The plan is to establish the balance between available water resources and water demand and consumption and thus compute probabilities of water availability and water supply for different water user sectors on a monthly time step for different planning horizons. For that purpose, a program is used which simulates the hydrological and the water management systems in a river basin on the one side and water demand on the other. Model inputs are long time series of hydrological data, which were stochastically generated on the basis of observed discharge. Rules for reservoir management and water requirements for different water users, such as potable water supply, irrigation, navigation, power generation and ecology, are then deterministically defined. Up to now this program is used for water management balances in small and medium size river basins. At GRDC this system will be used for modelling the balance of water availability demand consumption in large river basins for rapid assessments of the critical state of river basins with respect to water scarcity. The data requirements and

the algorithms of the program will be tested in a pilot study in the Danube Basin and adapted and refined for their practicability in other large river basins. This research and development of methodological development is seen as GRDC's potential contributions to UNEP's Global International Waters Assessment (GIWA).

21.4 The Committee expressed its interest in the progress of this project as a timely response to the global freshwater resource assessment activities and its potential links with GIWA. The project was expected to be very useful use for the strategic development of GRDC's assessment capacity.

Database technologies at the GRDC: Status and development

21.5 The database manager, Mr. Pauler, briefed the Committee on progress made in the development of the GRDC database system. Progress in database technologies had required a complete re-engineering of the GRDC database system. This included also a complete overhaul of user services with respect to the GRDC catalogue tool.

The SC was informed about the re-engineering of the database and the benefits from this exercise:

- Upgrade to a database management system providing higher security, and allowing more users to access the system;
- Stable Operation System and better connectivity facilities for the client computers;
- Better integration of the database server into the BfG's LAN.

Even though it would have been possible to migrate the database directly from the former Informix 5 to the new Informix 7 system, GRDC took the chance to fix the database and table design for a better accommodation of the GRDC's needs. Additionally new tables have been integrated to manage new information (i.e. dams and reservoirs) and simplify the plausibility check of GRDC discharge data (i.e. long-term mean monthly extreme data). These new features are available for customers, too.

The changes for the client computers were more difficult to implement because the GRDC's special software packages like the Base Tool, the Plausibility Tool and the Monitoring Tool needed to be newly developed. Here the GRDC took the opportunity to review the concept of these tools to make them more user friendly and more efficiently. It was stated that the GRDC Base Tool for user access to the information stored in the GRDC database is already implemented, and the concept phase for the GRDC Plausibility Tool will be finished by the end of 1999. The GRDC Monitoring Tool will be realised by using ARCInfo/ARCView facilities for a better adoption to the forthcoming tasks.

During this year (October) the new GRDC Web site will be published on the BfG's webserver. This site will provide more information and download features. Depending on the policy guidelines and the acceptance of the site more Internet activities are planned for the future.
A summary of the presentation is added as Annexes 11 to 13 to the report.

GIS-related activities at GRDC

21.6 In past years GIS activities of the GRDC were confined to visualize the stored gauging stations of the database in context to their location in continents or in their catchment areas, using the geographical analysis tool RAISON FOR WINDOWS. By increasing collaboration

with other international institutes, GRDC decided to work in future with ARCView and ARCInfo which allows also compatibility by exchanging digitized maps. The task manager, Mr. Decouet, informed the SC about current developments.

At present, GIS activities of GRDC are confined to compute and visualize watersheds related to the gauging stations of the database, using available elevation models.
First experiences are made with the ETOPO5 (5 minutes resolution) model from the NGDC Colorado and the STN-30p network from the UNH, New Hampshire.

The Centre is currently testing elevation models with 1 km resolution to obtain more accurately computation results for drainage basin boundaries.

In future, selected watersheds could be used to visualize the results of water management models and could be used as input of water balance models.

21.7 The SC recommended that GRDC improve its GIS capacity so as to enhance its capacity for spatial hydrological analysis and, possibly, as an archive for meta-data with regard to dams, reservoirs, land-use etc. needed for in-depth spatial analysis of hydrological processes on regional and global scales. The extension of GIS capacity at GRDC had also be seen in the context of the Danube project described above and the global water balance model under construction at the Federal Institute of Hydrology in collaboration with GRDC.

22. Global Water Partnership (GWP)

22.1 Messrs. Grabs and Portmann reported on this item. On behalf of the German Ministry for Economic Co-operation and Development, the German Technical Agency (GTZ) in co-operation with the Federal Institute of Hydrology / Global Runoff Data Centre (BfG/GRDC) is implementing the Integrated Water Resources Management (IWRM) component as the German contribution to the GWP. In a 12-month pilot phase, the component will be conceptualised and applied in Southern Africa as a pilot region with the active support of the Southern African Technical Advisory Committee (SATAC) of GWP and the Water Unit of the South African Development Community (SADC). Based on lessons learnt, the IWRM network will be gradually expanded in collaboration with partners of the network.

22.2 GRDC is developing a document management system with the objective of providing quality controlled, specific information in IWRM to planners and decision makers. The system is in its early implementation phase.

22.3 In addition to the activities in GWP, GRDC will use the system to manage river basin information in context-oriented document archives in the future. This activity is part of the meta-data information requested by users.

22.4 The SC welcomed the activities of GRDC in the context of GWP and suggested closer informal links with the WMO Hydrological Operational Multipurpose Sub-System (HOMS).

22.5 The documentation of the German contribution to GWP is attached as Annexe 14 to this report.

23. Database projects

23.1 In the family of global data centres, GRDC maintains twinning activities with Centres such as GPCP, GEMS/Water and ICOLD. It has become apparent, however, that three specific databases are missing in the family of data centres which are vital to obtain global information about the hydrological cycle and major influencing factors:

- Database on evaporation;
- Database on groundwater;
- Database on lakes and reservoirs in expansion of the database compiled by ICOLD.

23.2 In addition, there is a requirement for a meta-database to guide users in the identification, evaluation, selection and access to hydrological data and information.

23.3 A Global Hydrological Network for Climate has been proposed complementary to activities at GRDC, WHYCOS and FRIEND.

23.4 In all these database activities, the SC felt that the Centre should keep upreast with current and future developments and, where this falls within the core interests of GRDC, get involved in selected activities. The database issues are discussed in more detail below.

Establishment of a global database on evaporation (WMO)

23.5 Mr. Askew provided information on this topic. At present, data on evaporation are not collected in a global database. On the basis of decisions of the Third GRDC-SC meeting, WMO made an inquiry about the availability of evaporation data among Members of WMO with a positive response: 51 countries returning the questionnaires and 49 countries being able to supply data. When the inquiry phase has been completed, WMO/GRDC will contact the sources of data directly to collect evaporation data for inclusion in a separate global database.

23.6 Mainly Class-A pan evaporation data would be collected. The evaporation database serves also the purpose of a data repository for Class-A pan data in an effort to rescue them.

23.7 Mr. Gustard cautioned that the collection, processing and archiving of such heterogeneous data, with various degrees of quality and probably mostly in print form, could easily exceed the capacity of GRDC to digest without deviating from its priority activities. The Committee consented to this view and requested GRDC to follow up contacts and decide on the technical and organisational feasibility of establishing such a database under its present resource constraints.

23.8 It was recommended that, as a preparatory step, a small expert meeting should convened to establish the needs of such a database, its potential use and aspects of implementing it. The Committee noted that, as an alternative, countries could be requested to archive these data in a way and format which would allow easy access to the data.

Database on Groundwater

23.9 The Committee noted that there was currently no global database on groundwater, despite the growing need for such data for the calculation of national and regional water budgets, establishment of regional aquifer recharge volumes, determination of the storage coefficients for hydrological models, global freshwater assessments and other uses. Participants were informed that the Netherlands might well make a proposal to host a

database on groundwater. The SC advised that GRDC should liase with the relevant Dutch organisations to keep a close link between GRDC and the new centre if it was established.

Lakes and reservoirs

23.10 Users need to know about the storage volume, size and location of the world's major reservoirs and lakes in addition to the streamflow data provided by GRDC. This knowledge is of prime importance to establish flow lag-times, ageing of water in river basins, lakes and reservoirs and to establish the retention of water in a way which is out of phase with the natural hydrological regime of rivers. Knowledge about these parameters is required for the validation of global circulation models, transport rates of matter and pollutants and to quantify effective sinks (in the carbon and phosphorus cycles). GCOS, GTOS and UNEP have a strong need for such a network.

23.11 On the basis of a proposal made by State Hydrological Institute St. Petersburg (Annex 15) SC discussed this item at some length and recommended that a global database on lakes and reservoirs was required, linking the GRDC database and the GEMS/Water database. It was therefore very interesting to learn of the proposal, made by the Russian Federation during WMO's Thirteenth Congress, to establish such a centre. A detailed proposal for the establishment of such a database should be discussed inter alia with ICOLD, ILEC, GRDC and GEMS/Water. The SC proposed that GRDC and GEMS/Water should lead the discussion initially.

Establishment of a meta-database for G3OS

23.12 To obtain knowledge about information which is often scattered and fragmented in different institutions is a pressing requirement for all Global Observing Systems. Mr. Liebscher briefed the SC about the possibilities of the establishment of a meta-database on hydrology. The necessity of such a meta-database had been discussed during the consultative WMO/UNESCO meeting in Paris in February 1999 and a first informal meeting on this subject was held in March 1999 in Koblenz with the concerned agencies and representatives of databases and Water programs. Minutes of the meeting are added as annex 16 to the report.

23.13 Mr. Askew informed the group that WMO Executive Council had earlier agreed that WMO World Data Centres (WDCs) could serve as meta-data centres. The SC recommended that GRDC should participate in the establishment of the meta-database to respond to the need of a global meta-database for the global observing systems. The Committee noted that clear definitions of the needs are necessary to avoid the creation of a meta-database which in future would be impractical to maintain. G3OS are requested to identify basic needs for such a system.

23.14 On the level of the GRDC, the Committee recommended that a template for meta-data should be developed and implemented in the GRDC catalogue system. This would allow users to query meta-data so as to establish which stations within the GRDC database are of interest to them.

23.15 For the conceptual design and implementation of the system, participants recommended that the ACSYS experience and the resources for similar meta-database efforts should be used, including the experience of the NASA Distributed Active Archive Centre and the Global Change Master Directory. Also, liaison should be sought with the GHP-Data Management Group set up in parallel with CEOP-I, which will also use a meta-database for its activities.

23.16 For surface water resources assessments, climate modelling and the calculation of the discharge of matter from continents into the world oceans, a global hydrological network is required with short reporting times so as to provide adequate input information for regional and global observing and forecast systems. Equally important needs for a Global Hydrology Network are assessments such as climate trends, freshwater flux to the oceans and flow from snow and glacier fields in receiving water bodies.

23.17 The need for such a system has been amply demonstrated in the GRDC report on the impact of El Nino on hydrological regimes in Asia and the Pacific (GRDC-Report No. 21, 1998). GRDC had previously advocated the establishment of such a system based on about 200 existing gauging stations which represent the surface discharge of continents into the world oceans (GRDC-Report No. 10, 1997). The GCOS/GTOS Plan for Terrestrial Climate-Related Observations (GCOS-32, June1997) supports this view. GRDC has already offered a data set of 199 stations as a first step for the designation and subsequent establishment of a Global Hydrology Network and has embarked on a special data collection effort for station data from these reference stations with some feed-back from hydrological services. The GCOS Steering Committee at its meeting in February 1999, considered "the establishment of a global hydrology network an important step to meeting the climate observation needs for hydrological information".

23.18 Under the guidance of WMO, GRDC is prepared to play an active part in the establishment of such a system on the basis of already existing stations, which is seen as a complementary effort to the establishment of WHYCOS.

General discussion on global databases

23.19 Real-time river discharge data have been under-utilised by the atmosphere - ocean - landsurface - cryosphere modelling community due to the three-to-five year delays in reporting hydrological data to GRDC. This is contrasted with the real-time availability of meteorological and oceanographic data for weather and climate forecasting. The accessibility to near real-time hydrological data on regional and global scales is an absolute necessity to support coupled modelling and forecasting. Some hopes in this respect are the increase of Internet sites which provide online hydrological data, including the development of WHYCOS.

23.20 The SC discussed the need for near-real-time data and requested GRDC to develop the capacity to access, store and provide online access to archived global online/WHYCOS data. The Committee further requested GRDC to report to CHy within one year about its intended activities to cater with near real-time data.

23.21 There are major gaps in observations, even for major rivers, which is largely a result of the decline of observations during the last two decades. Therefore, data stored in the GRDC database is also deficient in timeliness and completeness. In other cases, hydrological services have ceased to supply data for political reasons and, more often, because of lack of capacity to adequately acquire, process, control, store and disseminate their own data. If global coverage of recent data is declining, the value of GRDC datasets for many comprehensive assessments and modelling purposes is limited.

23.22 Finding 24 of the meeting on the adequacy of the Global Climate Observing Systems (G3OS), (Buenos Aires, November 1998) stated that "It is urgent to address the inadequacy of

the hydrological network and in particular the timely exchange of data for the discharge of major rivers and other hydrological variables."

23.23 The SC discussed these issues and suggested that GRDC should be involved in activities which address this situation. The Committee was informed by Mr. Rudolf that the German Weather Service (DWD) would host a meeting to discuss the issue in the spring of 2000 (See also Annex 17).

23.24 In the discussion that followed, the Committee advised GRDC to prepare well for the GCOS-meeting. Participants were of the opinion that the planned meeting should thoroughly discuss the needs, purposes and data requirements of the various projects and databases. The meeting would need a broader view and consultations and invitation of experts from other entities such as WCP-Water, FRIEND and WHYCOS. In this regard, the meeting should also clarify whether the requirements by GCOS and GTOS for the Global Hydrological Network for Climate are also accommodating the appropriate requirements of WCP-Water and other climate–related groups.

23.25 The discussion of the scope of the meeting should also include, whether the proposed network should be limited to river discharge alone or be expanded to include a wider range of observations. The SC remarked that the implementation of such a network would require additional resources for the following activities:

- Upgrade of existing stations (site instrumentation);
- Telecommunications;
- Data processing;
- Quality control;
- Reporting;
- Training.

23.26 A very preliminary figure of USD 2 million was aired for the establishment of such a network of 200 stations based on already existing stations, many of which would need to be upgraded. Follow-up costs in the order of less than USD 300,000 would be incurred annually to maintain basic functions of the system on the basis of shared costs with hydrological services.

23.27 When concerning arresting the global decline in long-term monitoring, there is dichotomy in the position of national governments and agencies. On the one hand, there have been several recent, high profile meetings - all of which highlight "water" as the critical environmental issue of the 21st Century. None of these meetings, however, mention what to do as regard to operational hydrology and scientific research needs, including the need for high quality, long-term data sets. The same comment applies to the severe impacts on water resources from climate variability (e.g. ENSO) and possible climate change (in association with the UN Framework Convention on Climate Change). There seems to be an assumption that such data and scientific knowledge are already comprehensively available. More pertinent, at a national level, there is a reluctance to finance indefinitely long-term monitoring, because there is a conflict with the short-term cycles of funding, routinely adopted by Governments. It was noted that the philosophy of HELP is to address this issue by complete involvement of both "policy" and "user" groups so that the scientific outputs are directly available to "users". To also encourage long- term monitoring, it will be necessary to allocate intermediate mile-stones/deliverables to satisfy donor/national agency requirements.

24. Review of membership of the Steering Committee

24.1 Membership of the GRDC-SC has been unchanged since its first meeting in 1994. The SC was invited to review the present membership including ex-officio members and observers. In addition to a representative from the WMO Commission of Hydrology (CHy), membership should include representation of relevant UN water-related programmes and initiatives, and relevant other programmes with affiliations to GRDC such as GPCC and the GEMS/Water Collaborating Centre in Burlington. The membership of the Government of Japan had a special history based on the need to liase with a country which is acknowledged to have a special role in research and water resources development activities and a long-lasting co-operation with GRDC. In addition to institutional members, membership of the SC could also be granted on the basis in a personal capacity. GRDC should be enabled to invite observers or other representatives, for example from one or more WMO regional associations or countries relevant to specific items of the agenda.

24.2 The SC noted that the CHy Advisory Working Group had nominated, as representative of the Commission, Paul Pilon (Canada) who is Chairman of the CHy Working Group on Applications.

24.3 The Committee further noted that Professor Kaczmarek had recently resigned from being a member of SC and thanked him for the valuable services he had rendered to the advancement of the GRDC.

24.4 Although the World Bank is a member of the SC, no representative attended the SC meetings since 1994. The Bank had a written advising that the situation would change in the future so as to enable participation at GRDC-SC meetings.

24.5 After discussions, the Committee proposed the following membership of the GRDC-SC for approval by the Advisory Working Group of CHy:

Chairman: Prof. H.J. Liebscher
Secretary to the SC: Head of GRDC
Institutional members:
- WMO
- UNESCO
- UNEP
- WHO
- ICSU
- World Bank
- Federal Institute of Hydrology (BfG)

Non-institutional members:
- GPCC
- GEMS/Water (or successor, once identified by UNEP)
- FRIEND
- WCRP
- CHy

Observers, invited experts and governmental/non-governmental institutions:
- Government of Japan
- Developing country from another WMO region: from Africa for the fifth meeting
- President of BfG

25. Date and venue of next meeting

It was agreed that the fifth meeting of the Steering Committee should be held in June or July 2001 in Koblenz, specifically after WMO EC-LIII.

26. Closure of meeting

The Steering Committee acknowledged and thanked Mr. Grabs and his staff for the excellent work and leadership provided in the advancement of the GRDC.

Acronym List for GRDC Report No. 23

ACSYS	Arctic Climate System Study
Agrhydmet-OMVS-OMVG	French Centre for Agriculture, Hydrology and Meteorology in West Africa
AMHY-FRIEND	Alpine and Mediterranean FRIEND (UNESCO)
ARDB	Arctic Runoff Database
BfG	Bundesanstalt für Gewässerkunde (Federal Institute of Hydrology, FIH)
CEOP	Co-ordinated Enhanced Observing Period
CEOPS	Co-ordinated Enhanced Observing Period Study
Cg	WMO Congress
CHy	Commission for Hydrology
CLIC	Climate and Cryosphere Programme (WMO)
DEIA&EW	Division of Environmental Information, Assessment and Early Warning (UNEP, Nairobi)
DWD	Deutscher Wetter-Dienst (German Meteorological Service)
EC	WMO Executive Council
ENSO	El Niño Southern Oscillations
ETOPO5	Elevation and Topological Model (5 minutes resolution)
EU	European Union
EURAQUA	Forum of European Freshwater Research Organisations
FRIEND	Flow Regimes from International Experimental and Network Data
G3OS	The three Global Observing Systems (GCOS, GOOS and GTOS)
GCM	Global Climate Model / Global Circulation Model
GCOS	Global Climate Observing System
GEF	Global Environment Facility
GEMS/Water	Global Environmental Monitoring System / Freshwater Quality Programme
GEWEX	Global Energy and Water Cycle Experiment
GHP	GEWEX Hydrometeorological Panel
GIS	Geographical Information System
GIWA	Global International Waters Assessment (UNEP)
GPA	Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (UNEP)
GOOS	Global Ocean Observing System
GPCC	Global Precipitation and Climatology Center
GRDC	Global Runoff Data Center
GTOS	Global Terrestrial Observing System
GTZ	German Technical Co-operation Agency (Deutsche Gesellschaft für Technische Zusammenarbeit)
GWP	Global Water Partnership
HELP	Hydrology for the Environment, Life and Policy
HOMS	Hydrological Operational Multipurpose Sub-System (WMO)
HYCOS	Hydrological Cycle Observing System
HYDATA	Hydrological Data Archive (Institute of Hydrology, Wallingford, UK), Software
IC	Intergovernmental Council (UNESCO)
ICOLD	International Commission on Large Dams
IHP	International Hydrological Programme (UNESCO)
ILEC	International Lake Environment Foundation Committee, Japan
INTAS	International Association for the Promotion of Co-operation with Scientist of the New Independent States of the former Soviet Union, EU, Brussels
ISLSCP	International Satellite Land Surface Comparison Project
IWRM	Integrated Water Resources Management
LAN	Local Area Network
MED-HYCOS	Mediterranean HYCOS (WMO)
NASA	National Aeronautics and Space Administration
NGDC	National Geophysical Data Center
NHS	National Hydrological Service
OHP	Operational Hydrological Programme (WMO)
QA	Quality Assurance

QC	Quality Control
RBA	River Basin Authority
SADC	South African Development Community
SATAC	Southern African Technical Advisory Committee
SC	Steering Committee
STN-30p	Simulated topological network at 30-minute spatial resolution (from UNH)
UN	United Nations
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNH	University of New Hampshire, USA
WCP-Water	World Climate Programme - Water
WCRP	World Climate Research Programme
WHIPD	World Hydrology Initiative for Policy and Development – substituted by HELP
WHYCOS	World Hydrological Cycle Observing System (WMO)

Annex 1

List of Participants

4th Meeting of the GRDC Steering Committee
(Koblenz, Germany, 23. June – 25. June 1999)

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Annex 2

Agenda of the meeting

4th Meeting of the GRDC Steering Committee
Koblenz, 23 – 25 June 1999

Annotated Provisional Agenda

Status: 14 June 1999

As announced in the 1st letter of invitation dated 10th February 1999, GRDC proposes to focus the meeting on

The Strategic Development of GRDC Activities and Research in the four year period 1999 - 2002

In choosing this subject it is intended to prepare an outreach of GRDC's activities which reflects the identity of GRDC and its role in water related activities of WMO and other UN agencies and collaborating institutions. The Steering Committee is requested to take note of all items during the discussion and recommendations in view of the strategic development of GRDC. The strategic development of GRDC will be discussed under agenda item 30 on Friday on the basis of items and recommendation previously discussed and the „Vision Statements" made available to GRDC prior to the start of the meeting.

GRDC requests participants to kindly send us pre-prepared statements prior to the start of the meeting by mail, fax or e-mail to: grdc@bafg.de or Fax No. 0049 261 1306 5280. The „Vision Statement" should not exceed 2 sentences which reflect the personal view of the participants towards the strategic development of GRDC.

Wednesday, 23rd June

1. 09:00 Opening of the meeting (Chairman, H.-J. Liebscher)

Following brief greeting and introductory comments, the 4th meeting of GRDC-SC will be formally opened by the chairman of the GRDC Steering Committee, Prof. H.-J. Liebscher

2. 09:10 Discussion and adoption of the Agenda

The provisional agenda will be discussed, necessary changes made and the final agenda adopted by participants

3. 09:30 GRDC at the Federal Institute of Hydrology: Review and perspectives for development (V. Wetzel)

Federal Institute of Hydrology (BFG) provides the core funding of GRDC on behalf of Germanys commitment to host the GRDC. Funding includes staff salaries, provision of office space and office infrastructure as well as data processing facilities and support of travel of GRDC staff. The presentation will highlight on the support structure and facilities of BFG and future perspectives of further development from the view of BFG.
The SC may wish to comment on the presentation made and provide feed-back to BFG on the past, present and future support of GRDC activities.

4. 09:45 Report of GRDC activities (W. Grabs)

The 3rd meeting of GRDC-SC recommended to discontinue the yearly status reports and to produce and publish instead a bi-annual report combining the status report and the report of the SC meeting. The group is invited to discuss the presentation in view of the strategic development of GRDC which will be discussed under agenda item 30 on Friday

5. 10:15 „Vision Statements" of participants for the strategic development of GRDC

Participants are requested to prepare a „Vision-Statement" of the role and function of the GRDC in future as perceived by each individual. The statement should not exceed two sentences. All statements will be produced in such a way that they can be placed on pin walls. The progress of the meeting and recommendation by SC will be registered against the vision statements and these statements will be amalgamated to GRDC's outreach for its strategic development which will be discussed under agenda item 30 on Friday.

6. 10:30 GRDC publications and public relation activities of GRDC

GRDC continued to publish its series of reports which is documented in the list of reports to be supplied to participants. In addition to the list, two more reports are in print: GRDC-Report No. 23 „Global, Composite Runoff Fields Based on Observed River Discharge and Simulated Water Balances" and GRDC-Report No. 24 „Summary Report of the Use of GRDC Data 1992 – 1998". Publication also includes the first CD-ROM „World of Water", which contains a global data set of GRDC data and a data set with statistic and graphical presentation of 200 river basins representing the surface water flow from continents into oceans, marginal and inland seas.

Public relation activities focused on the complete restructuring of its presention in the Internet with the aim to give more up-to-date information and News about GRDC and its activities, provision of improved services and the placement of prominent data products. The new Internet presentation will be on the Web around end of May 1999. During the meeting, the new Internet presentation will be demonstrated.

7. 11:00 Acquisition of data and information for GRDC

Data flow to the GRDC continued in 1997 – 1998 with the acquisition of updates and new stations. Shortage of funds with regard to other commitments of GRDC led to a decline of country missions for the acquisition of data. Due to the restructuring of UNEP, the previously well functioning joint activities with GEMS/Water for data acquisition suffered. The group is invited to make practical recommendations for collaborative efforts with other water-related programs and through joint data acquisition initiatives to widen and intensify data acquisition for GRDC using all possible sources and channels of communication.

The collection of further information („meta-data") has proven to be difficult as most data providers have problems to communicate information such as validity of rating curves, instruments used for observations, data quality assurance techniques, influence of the station discharge by water abstraction and storage schemes. GRDC has co-registered its stations with information on dams and reservoirs released by the International Commission on Large Dams (ICOLD) to provide users with information on such structures upstream/downstream of

GRDC stations. SC may recommend on strategies to include meta-data to the GRDC database.

8. 11:15 Use of GRDC data for local, regional and global research and assessments

The use of GRDC data is summarized in GRDC Report No. 23 which will be made available to participants during the meeting. Based on the presentation, SC is expected to discuss the user structure and possible adaptation of data acquisition activities to reflect the use of GRDC data for different research purposes. Likewise, SC is invited to recommend further suitable data products which could be offered by GRDC to support research priorities.

9. 11:30 Status of WHYCOS (WMO)

SC will be briefed about the current status of WHYCOS projects and the state of development of already funded WHYCOS projects such as Med-HYCOS in the Mediterranean region and SADC-HYCOS in countries of southern AFRICA. Further development of HYCOS sub-projects and the envisaged mechanism to link these regional HYCOS-projects into WHYCOS will be presented.

10. 11:50 Links between WHYCOS and GRDC

XIIth Congress of WMO with regard to WHYCOS outlined the linkage of WHYCOS to GRDC. Any new developments as a result of the XIIIth meeting of Congress in May 1999 will be communicated to SC during the meeting. SC is requested to discuss its view of the links between WHYCOS and GRDC, to intensify communication and consultation between these two major data collection initiatives of the OHP of WMO. The discussion of collaborative activities of GRDC with regional HYCOS projects should include issues of station selection and the exchange of data between HYCOS and GRDC.

11. 13:30 Status of FRIEND (A. Gustard)

A general overview of FRIEND and its state of development will be supplied to participants during the meeting. Specific developments on each FRIEND project will be presented under this item. The report will also highlight on specific regional FRIEND research activities and results and the foreseen future development of FRIEND in IHP-V and IHP-VI.

12. 14:00 Cooperative activities between FRIEND and GRDC (A. Gustard, W. Grabs)

Since 1993, cooperative activities have been envisaged and carried out. These activities include participation of FRIEND representatives in GRDC-SC meetings and vice-versa, the joint collaboration in regional projects, specifically the Hindu-Kush Himalaya FRIEND. In this project, GRDC is represented in the Steering Committee and has been tasked to head the data acquisition activities. GRDC is also represented in two working groups of Hindu Kush Himalaya FRIEND, namely the Database group and the Snow Hydrology group. GRDC participation in an INTAS project coordinated by Institute of Hydrology, Wallingford in Russia, Belorussia and Ukraine to establish a regional data center for the European Water Archive has succeeded. Further information on both projects will be made available to SC under this agenda item.

For Northern European FRIEND, GRDC is acting as Regional Data Center. The SC of the Alpine and Mediterranean FRIEND (AMHY-FRIEND) has recommend that GRDC should act as technical coordinator and repository of the FRIEND – AMHY database. The group is invited to discuss the implications of these development also in terms of possible support to GRDC to fulfill these additional tasks. Cooperative efforts could also be perceived for regional data collection efforts, joint research activities at the boundary lines between national to regional (FRIEND domain) and regional to global research (GRDC domain). A step in this direction has been the presentation of FRIEND during the 1998 meeting of the GEWEX Hydrometeorological Panel, which welcomed the cooperation with FRIEND especially in the GEWEX Continental Scale Experiments.

13. 15:20 Status of GEMS/Water and future perspectives (E.S. Diop)

The background documentation for the Intergovernmental Council (IC) session of UNEP in December 1998 foresaw a strengthened role of GEMS/Water as a key program of UNEP in the freshwater sector. It is expected that the Freshwater Unit of UNEP will be strengthened in future. SC will be briefed about decisions of UNEP-IC and earmarked resources and planned activities. The revitalization of GEMS/Water after a dormant stage in the past two years is of strategic importance for GRDC as the GEMS collaboration is a cornerstone to combine water quantity and quality issues in a global collaborative effort. SC is requested to make recommendations towards the cooperation between GRDC an GEMS/Water.

14. 15:45 Joint programs of GEMS/Water and GRDC (R. Robartz, W. Grabs)

The government of Canada has agreed to further sponsor the GEMS/Water collaborative Center in Burlington over the next three years to maintain and improve the global GEMS/Water database on water quality and to continue collaborative activities with participating countries. This has been the basis for the strengthened cooperation between GRDC and GEMS/Water from 1998 onwards.
On the working level, joint programs have been envisaged and undertaken following a working agreement between GEMS/Water collaborating center in Burlington and the GRDC. Collaborative activities relate to the production of a joint metadata catalog for users, describing measuring stations at rivers which are common to the databases of GEMS and GRDC. Using GEMS and GRDC data, one of the next steps envisaged is the calculation of suspended sediment load of selected rivers to the world oceans. Further collaboration between GEMS and GRDC in areas such as basin assessments of water quantity and quality, data acquisition, research depends on the availability of resources of GEMS and GRDC. Participants may wish to discuss the collaborative efforts and comment on a strategy to follow from which both – GEMS and GRDC - will benefit through enhanced recognition and services provided to users.

15. 16:15 Status and cooperative activities between GPCC and GRDC (B. Rudolf)

GPCC and GRDC are considered key global databases for GEWEX. Both centers are members of the GEWEX Hydrometeorological Panel and provide inputs to GEWEX Global Scale Experiments and modeling efforts. The availability of precipitation information on a 30 minute grid and a simulated river network with 30 minute resolution obtained from the collaborative effort of GRDC with the University of New Hampshire open a new window of opportunity for cooperation. Likewise, GPCC data are used for the Water Balance Model (Europe) which is nearing its completion and is planned to be tested for other regions of the world. SC will be briefed about new developments at GPCC and is invited to comment on future joint activities as part of the development strategy of both, GRDC and GPCC.

Thursday, 24th June

16. 09:00 Review of decisions of XIII th Congress of WMO relevant to the operations and planned activities of the GRDC (WMO)

WMO will hold its XIIIth Congress in Geneva in May 1999. It is expected that XIIIth Congress will discuss the following subjects, which have relevance to operation and activities of the GRDC:

- Exchange of Hydrological Data
- World Hydrological Cycle Observing System (WHYCOS)
- World Climate Program/Water (WCP/Water)
- Global Climate Observing system (GCOS)
- World Climate research Program (WCRP) and the GEWEX project as part of WCRP

A representative of WMO will brief SC of relevant discussions and resolutions of XIIIth Congress. Members of SC are requested to discuss and recommend GRDC actions to respond to Congress discussions/resolutions.

17. 10:00 Review of GRDC guidelines for the acquisition and dissemination of data

Based on the decisions of XIIth Congress of WMO, the GRDC guidelines for the acquisition and dissemination of data had been amended. Depending on Congress XIII resolutions regarding the exchange of hydrological data, it might be necessary to revise the policy.

18. 10:50 Status of GRDC-projects

In addition to day-to-day operations such as data acquisition, processing and dissemination to users, and outsourced research, GRDC has always maintained some projects or collaboration in projects aiming to promote research and operational capacity of GRDC for the benefit of users seeking specialized services. The status of current projects is reported and discussed. The group will be informed on ACSYS and GEWEX-related projects and activities.

19. 11:15 Development of Global Gridded Runoff Fields (W. Grabs)

In collaboration with the University of New Hampshire, UNH (Balazs Fekete, Charles Vörösmarty), GRDC and UNH have produced a GRDC report on Global, Composite Runoff Fields Based on Observed River Discharge and Simulated Water Balances at a 30 minute spatial resolution on a monthly basis. This report is currently printed. Concurrently, a CD will be produced and published. Participants will receive copies of the report and are invited to discuss further activities in this area.

20. 11:30 GRDC project briefing: Modeling the Balance of Water Supply and Water Demand in Large Basins : A case study for the Danube River (I. Dornblut)

On the basis of the balance of available water resources, water demand and consumption, probabilities of water availability and water supply for different water user sectors will be computed on a monthly time step for different planning horizons. For that purpose a program system is used, which simulates the hydrological system and the water management system on one side and water demand on the other side in a river basin. Model input are long time series of hydrological data, which were stochastically generated on the basis of observed discharge. Rules for reservoirs management and water requirements of different water users such as potable water supply, irrigation, navigation, power generation and ecology are deterministically defined. This program system up to now is used for water management balances in small and medium size river basins. At GRDC this system will be used for modeling the balance of Water availability demand consumption in large river basins for rapid assessments of the criticality of river basins with respect to water scarcity. In a pilot study the data requirements and the algorithms of this program system will be tested in the Danube basin and adapted and refined for their practicability in large river basins.
This research and development of methodological development is seen as GRDC's potential contributions for UNEP's Global International Waters Assessment (GIWA). Participants are invited to comment on the presentation and its use for the strategic development of GRDC's assessment capacity.

21. 11:50 Database technologies at the GRDC: Status and development (J. Pauler)

Progress in database technologies required a complete re-engineering of the GRDC-database system. This includes also a complete overhaul of user services with respect to the GRDC catalog tool. The briefing reviews latest database systems development and user functions. The participants may wish to comment on desirable future options and facilities for users.

22. 12:10 GIS-related activities at GRDC (T. Decouet)

In the past, the software package RAISON has been extensively used by GRDC in the context of the GEMS/Water collaboration. Lately, ArcInfo/ArCView is used for the spatial representation of hydrological data. As a result of the UNH/GRDC collaboration, a simulated river network with a 30 minute resolution is also used. Based on a brief overview of current activities, SC is requested to outline strategies to arrive at the development of a GIS-based water information system on the basis of observed discharge data and collateral information from existing global databases. This is seen in close context of the Danube project described

above and the global water balance model under construction at the Federal Institute of Hydrology in collaboration with GRDC.

23. 13:45 Global Water Partnership (GWP) (W. Grabs, F. Portmann)

On behalf of the German Ministry for Economic Cooperation and Development, the German Technical Agency (GTZ) in cooperation with the Federal Institute of Hydrology / Global Runoff Data Center (BfG/GRDC) is implementing the Integrated Water Resources Management (IWRM) component as the German contribution to the GWP. In a 12-month pilot phase, the component will be conceptualized and applied in Southern Africa as a pilot region with the active support of the Southern African Technical Advisory Committee (SATAC) of GWP and the Water Unit of the South African Development Community (SADC). GRDC is developing a document management system with the objective to provide quality controlled, specific information in IWRM to planners and decision makers. The system at its present development stage will be demonstrated to participants and SC is requested to comment on the suitability and development options of such a system for GRDC and especially its potential for the Hydrological Operational Multipurpose Sub-System (HOMS) of WMO.

24. 14:15 Database projects

Excluding the establishment of FRIEND-related databases at the GRDC, where GRDC will serve as custodian of the data only, three new database projects which have been initiated earlier will be discussed under the following agenda items. In addition, SC is invited to reflect the current state of opinion of the creation of a global database on groundwater resources, possibly in collaboration with other UN agencies (such as FAO).

25. 14:20 Global Hydrology Network for water availability assessments and climate modeling needs

For surface water resources assessments, climate modeling and the calculation of matter from continents into the world oceans a global hydrological network is required with short reporting times to provide adequate input information for regional and global observing and forecast systems. The need of such a system has been amply demonstrated in the GRDC report on the impact of El Nino on hydrological regimes in Asia and the Pacific (GRDC-Report No. 21, 1998). GRDC has previously advocated the establishment of such a system based on about 200 existing gauging stations which represent the surface discharge of continents into the world oceans (GRDC-Report No. 10, 1997). The GCOS/GTOS Plan for Terrestrial Climate-Related Observations (GCOS-32, June1997) supports this view. GRDC has offered already a data set of 199 stations as a first step for the designation and subsequent establishment of a Global Hydrology Network and has engaged in a special data collection effort for station data from these identified reference stations with some feed-back from hydrological services. GCOS-SC on its meeting in February 1999 „considers the establishment of a global hydrology network an important step to meeting the climate observation needs for hydrological information".

Under the guidance of WMO, GRDC would be prepared to play an active part in the establishment of such a system on the basis of already existing stations, which is seen as complementary effort to the establishment of WHYCOS. SC is requested to discuss this idea, feed-back ideas on the conceptual framework, a strategy to achieve this objective and possible approach for funding of this global network including a first cost estimate.

26. 14:40 Establishment of a metadatabase for G3OS (H.-J. Liebscher)

To obtain knowledge about information which is often scattered and fragmented in different institutions is a pressing requirement for all Global Observing Systems. SC will be briefed about the possibilities of the establishment of a metadatabase on hydrology. The necessity of such a metdatabase has been discussed during the consultative WMO/UNESCO meeting in Paris in February 1999 and a first informal meeting on this subject was held in March 1999 in Koblenz with the concerned agencies and representatives of databases and water programs. SC may wish to recommend appropriate actions on the side of the GRDC to respond to the need of a global metadatabase for the Global Observing systems

27. 15:15 Establishment of a global database on evaporation (WMO)

At present, data on evaporation is not collected in a global database. On the basis of decisions of the 3rd GRDC-SC meeting, WMO has made an inquiry about the availability of evaporation data amongst Members of WMO with a positive response. When the inquiry phase has been completed, WMO/GRDC will contact the sources of data directly to collect evaporation data for inclusion in a separate global database.

28. 15:40 Infrastructure and resources of GRDC

Present staff of GRDC consists of 4 full-time permanent staff and three part-time permanent staff. Core funding is provided by the government of the Federal Republic of Germany through the Federal Institute of Hydrology. Increasing number and extent of tasks requires an adaptation of staff and funding for GRDC. SC is invited to discuss implications of the growing number of tasks and expectations on the physical development of GRDC.

29. 16:10 Review of membership of the Steering Committee

Membership of the GRDC-SC has been virtually unchanged since its first meeting in 1994. SC is invited to review the present membership of SC, standing ex-officio members and observers. Membership in the GRDC-SC in addition to a representative from the WMO Commission of Hydrology (CHy) should include representation of relevant UN water related programs and initiatives, and relevant other programs with affiliations to GRDC. This includes also representation of other global data centers such as GPCC and the GEMS/Water collaborating Center in Burlington. In addition to institutional members, membership of SC can also be on the basis of a personal capacity. Membership on a personal basis should also allow for rotation. GRDC Secretariat should be enabled to invite observers or other representatives, i.e. of WMO regional associations, countries on specific items of the agenda.

In the current meeting, Paul Pilon (Canada) will represent CHy as chairman of the working group on applications; Professor Kaczmarek has recently resigned from being member of SC. Although the World Bank is a member of SC, there has been no representative attending the SC-meetings since 1994. SC needs to consider this situation when reviewing the composition of GRDC-SC and respond to the Advisory Working Group of CHy.

Friday, 25th June

30. 09:00 Strategic Development of GRDC

GRDC is now in its 11th year of existence and has developed from a depository of global hydrological data to a service provider for the global research community in the areas of

- Global Climate Models
- Hydrological modeling
- Water Balance Models and coupled models
- Regional and global assessment of surface water availability
- Operational hydrology

Increasingly, clients request research quality data products and own research products from GRDC. Likewise, GRDC is now participating as member or in an advisory function in many global and regional programs and projects.

On one side GRDC has rapidly adapted its capacity to the changing and increasing demand for data, products and research as well as advisory services. On the other side, GRDC should be in a position to formulate and pursue new directions in global and regional hydrological issues in a more pro-active way. Moreso, as its Steering Committee consists of representatives of major UN water-related programs and respected experts. Examples of strategic developments are:

- The establishment of i.e. a Global Hydrological Monitoring System in concurrence with the World Weather Watch Program and WHYCOS is a strategic initiative which GRDC has been promoting since 1996.

- Lately, GRDC undertakes the development of a modeling system to assess the balance between water availability, demand and consumption in large basins in an effort to find a methodology for the rapid assessment and regular monitoring of the water resources situation and development in selected Large Basins which are indicative of continental changes of the availability of water resources.

- The development of a global water balance model, currently tested for Europe and the development of global gridded high resolution runoff fields in collaboration with the University of New Hampshire as well as research to assess the impact of climatological anomalies such as El Nino on changes in hydrological regimes are further examples for innovative approaches by GRDC.

On the basis of past and present developments and the vision statements of the invitees, SC is requested to discuss and formulate a strategic outreach for the development of GRDC within a time horizon of the next 5 to 10 years. Background information will be supplied during the meeting. SC is further requested to formulate guidelines for future development. It is likely that the meeting time is not sufficient to finalize this task. In this case, the expected output would be the general approach and major strategic development issues which then are further refined and detailed by a subgroup of GRDC-SC over a period of a few months.

31. 11:30 Implementation of the strategic outreach

Based on the general discussion and strategic outreach, even when only the main directions can be discussed and documented, SC is invited to discuss avenues of the implementation of a GRDC strategy. Main issues are here:

- Strengthening of cooperative links with experts and water programs
- Avenues of resource mobilization
- Increased direct participation in relevant programs and projects including those in other UN agencies such a UNEP

32. 12:00 Any other business

This item serves as wrap-up and housekeeping for a complete summary of results

33. 13:15 Summary of meeting results

Main results of discussions and SC-recommendations will be summarized to be included in the meeting report. With the assistance of SC members, the strategic outreach of GRDC should be expanded to a paper to be published in appropriate ways. The first draft report should be circulated to participants by end of August 1999.

34. 13:45 Date and venue of next meeting

SC may consider the date of the next meeting in June 2001. Having had the SC meeting for the fourth time in Koblenz, SC is invited to think of feasible alternatives for the 5th meeting of GRDC-SC.

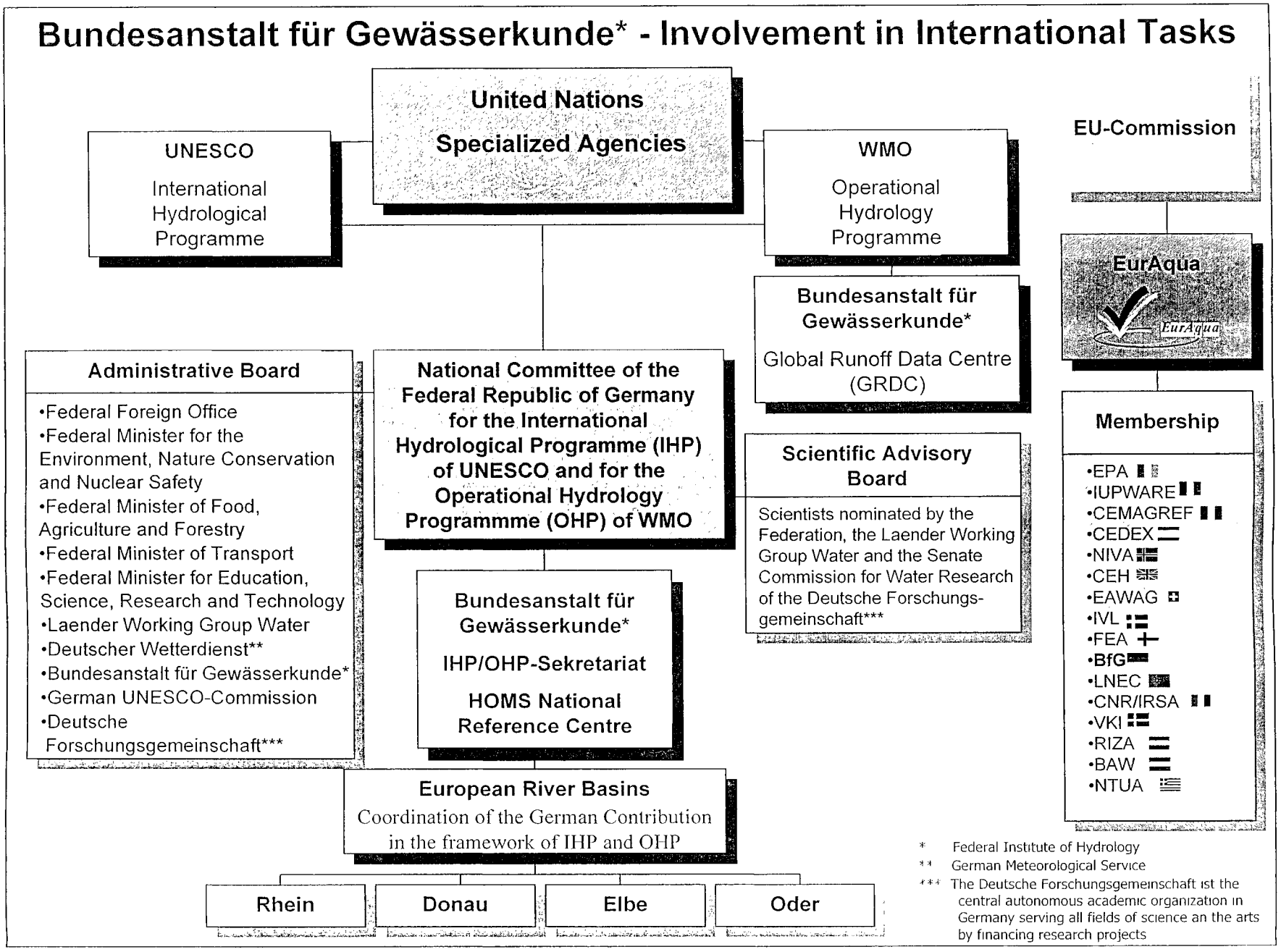
35. 14:00 Closure of meeting

[1] C:\wp51\sc\sc99\annotate

Annex 3

Presentation of Mr. Wetzel, Director of BfG, Germany

Bundesanstalt für Gewässerkunde* - Involvement in International Tasks



* Federal Institute of Hydrology

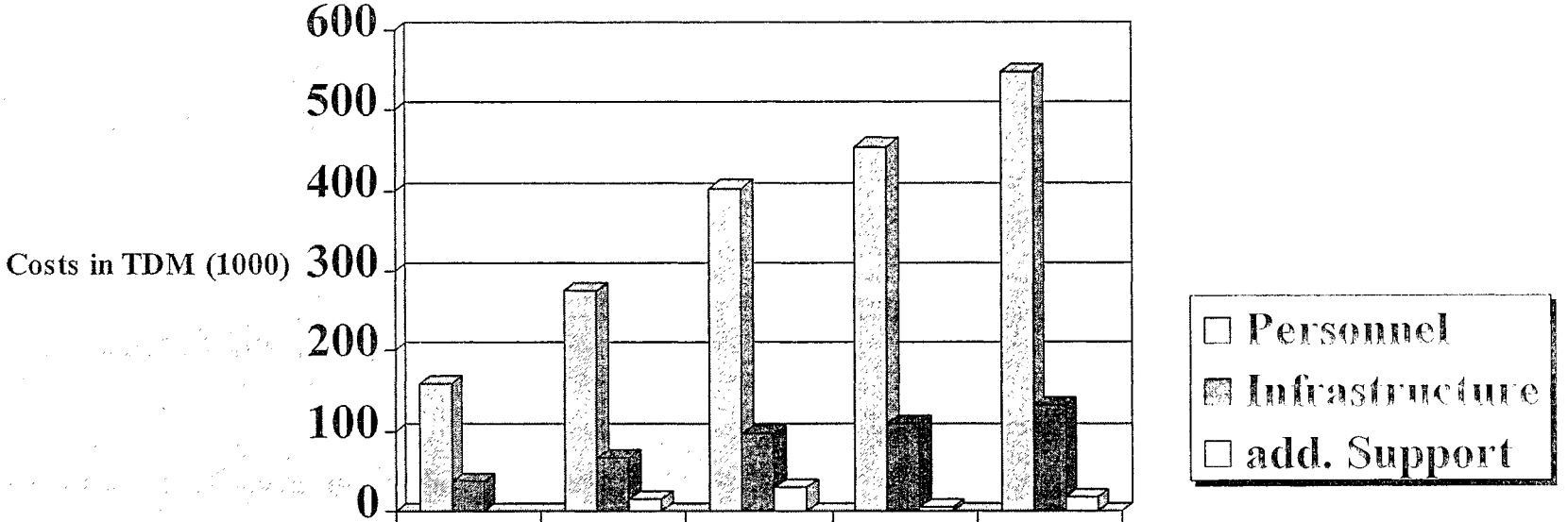
** German Meteorological Service

*** The Deutsche Forschungsgemeinschaft ist the central autonomous academic organization in Germany serving all fields of science an the arts by financing research projects

3 years perspective in staff development

	Present	Future
	available %	available %
1 Head of GRDC	100	100
1 Deputy Head	**50**	100
1 Database Manager	100	100
1 Task Manager	100	100
1 Researcher	100	100
1 GIS-specialist	---	100
1 Administrative assistant	**50**	100

Personnel, infrastructure and additional support by BfG for GRDC



	1994	1995	1996	1997	1998
Personnel	159	276	403	455	548
Infrastructure	38	66	97	109	132
add. Support	-	15	30	5	18

31.08.99

Source: Programmbudget BfG

Global Runoff Data Centre (GRDC)
Perspectives of Development

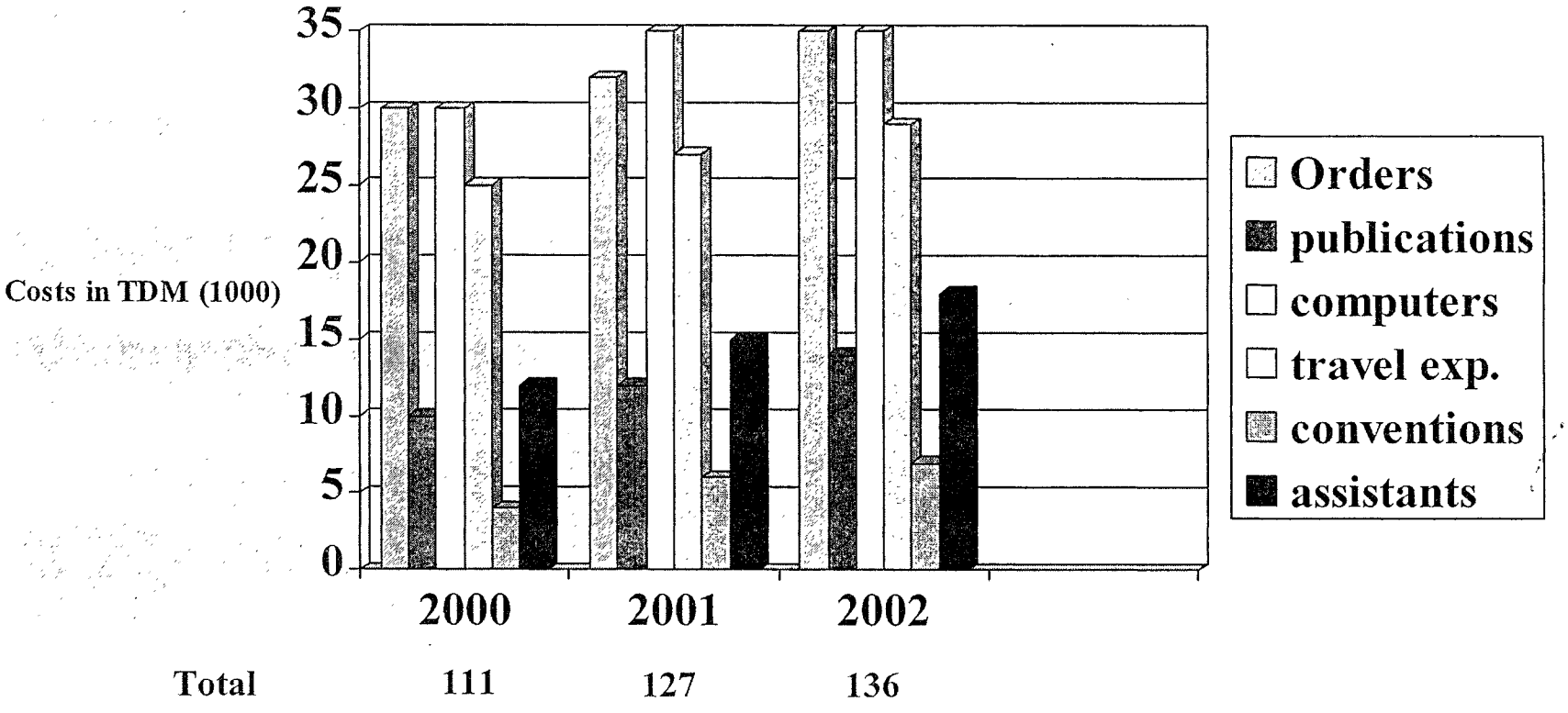
Short-term	Medium-term	Long-term
▫ Development of methods for water resources management on a global scale. Pilot region: Danube river ▫ Development of water balance models ▫ Re-engineering of GRDC-database-system ▫ Production of global-scale data products on CD-ROM ▫ Development of a monitoring system for global river discharge ▫ Global Water Partnership (GWP) Pilot region: Southern Africa	▫ Water resources management in selected basins of the world ▫ Aspects of regionalization ▫ Cooperation in international projects such as: - ACSYS - BALTEX/BRIDGE - FRIEND - GEMS/Water - GEWEX - GCOS - GTOS - GWP ▫ Research cooperation with institutions and researchers	▫ Support in development of GIS-systems ▫ Establishment of a global GIS-supported Water Information System ▫ Operation of a global monitoring system ▫ Cooperation in projects such as: - FRIEND - GEMS/Water - GCOS - GTOS - WHYCOS

Support by Section M2/BfG	
Continuous tasks:	▫ Acquisition and dissemination of hydrological data ▫ Support to water related programs of specialized agencies of the United Nations

Financial development perspective years 2000/2002

Budget Head	2000	2001	2002
	DM x 1000	DM x 1000	DM x 1000
Subcontracts(Digitization of data,applied research)	30	32	35
Publications,reports,brochures	10	12	14
Data processing (Hardware,Software)	30	35	35
Travels	25	27	29
Conferences,cooperation with foreign scientists	4	6	7
External support	12	15	18
Total	111	127	136

Financial Plan GRDC
2000/2002



	2000	2001	2002
Total	111	127	136

31.08.99

Source: Allocation of resources by GRDC, January 14, 1998

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(general E-mail: grdc@bafg.de)

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Annex 4

Executive summary (activities since third meeting)

4th Meeting of the GRDC Steering Committee, Koblenz, 23-25 June 1999

GRDC – Activities June 1997 – June 1999

Executive Summary

Database Management System development

Progress in database technology required the re-Engineering of the GRDC Database Management System which runs now under WINDOWS NT with largely enhanced user functions including accessibility of the GRDC catalog from the Internet. Additional functions relate to visualization features under ArCView and improved data management facilities to incorporate additional meta-data information and improved database queries.

Data Acquisition

From 1997 to June 1999, discharge time series were received for 136 new gauging stations and time series were updated for 303 gauging stations. Asia and South America were dominant in the database development. Further data were received from European countries and Newly Independent States. Within the next weeks, about 400 stations will be updated from Canada and before the end of 1999, several hundred stations will be updated and newly added from U.S.A. Likewise, the import of about 200 stations from Russia, Belorussia and Ukraine is envisaged within the next few months from the INTAS project (see below). The situation of hydrological data from Africa has not been encouraging and for the future it is hoped that in the framework of WHYCOS and FRIEND the situation may somewhat improve.

Data Use

Use of GRDC services has reached a level of about 100 requests per year. While requests for data for climate applications have declined, the request for advisory services form GRDC, higher-level data products etc. have increased. For other uses of GRDC data such as regional hydrology, operational hydrology, ocean-related research, no clear trend can be established. Increasingly, large scale industries seek strategic advice from GRDC which almost always is linked to water quality issues. This indicates a growing field of interest in global considerations of strategic private investment considerations.

Data Products

Standard data products such as basic statistics, variability hydrographs, percentile visualization, extreme values, flow duration curves etc. were improved. Major new developments, all on shelf since May 1999 are:

- CD-ROM „World of Water" with a comprehensive dataset of nearly 1.300 gauging stations with long-term mean monthly flows and full data information including graphics of 200 rivers discharging into the world Oceans, marginal and inland seas;

- Global gridded runoff fields with a resolution of 0.5° in combination with a water balance model.

- GRDC catalog tool with largely improved functions for users to search the database for suitable data. This tool will be supplemented with functions for online visualization of hydrographs etc, once the database system itself is accessible via Internet.

Public Relations

User friendly services and the distribution of 22 GRDC Reports since 1993, out of which 8 have been published between June 1997 and June 1999 were the backbone of public relation appearance of GRDC.
The Centre has its own homepage which is linked to several other homepages of collaborating institutions. The number of cross references from other homepages to GRDC has largely increased. The home page is currently under complete reconstruction in the context of major changes of the Web representation of BfG (Federal Institute of Hydrology). GRDC's representation at major conferences has likewise increased its visibility.
A major event has been the presentation of GRDC at the 6th Session of the Commission for Sustainable Development at the UN Headquarters, New York in April 1998. Germany offered this presentation to the delegates and the presentation was held jointly with WMO.
Due to heavy workload and budgetary constraints, further public relation activities with regard to the translation of the GRDC brochure in the French and Spanish language as well as informative articles in Newsletters etc. have been lagging behind.

Collaboration

The widening scope of GRDC activities furthered collaborative agreements with researchers and research institutions. Several of these working agreements resulted in GRDC-Reports. Recent collaborative research has been undertaken/is in progress with:

Prof. Cluis, University of Quebec, Canada (Impact of El Nino in hydrological regimes in Asia and the Pacific);
Prof. Vörösmarty, University of New Hampshire, U.S.A. (Development of global gridded runoff fields);
Dr. (Mrs.) Döll, University of Kassel, Germany (Development of a gridded model: Runoff, water availability and use);
Mr. Krahe, Federal Institute of Hydrology, Germany (Water Balance Model for Europe)

Mr. Fraser, GEMS/Water Collaborating Centre, Burlington, Canada (Transport of suspended solids from major rivers into receiving water bodies).

Cooperation in major programs of the United Nations

GEWEX
The Centre is represented in the GEWEX Hydrometeorological Panel (GHP) and contributes to the Continental Scale Experiments of GEWEX as well as for ISLSCP.

GTOS
The Head of GRDC is member of the Steering Committee of GTOS and advises on hydrological issues in GTOS with a focus to the establishment of a global hydrological observation network to meet observational demands of the G3OS, complementary to WHYCOS.

GEMS/Water
GRDC is represented in the Steering Committee of GEMS/Water. In the past, numerous joint activities related to the establishment of water quality monitoring networks, country missions, the establishment of a joint data catalog and linking water quantity and quality issues. Through the re-defined role of UNEP in freshwater issues, GRDC is ready to even more intensify its cooperative links with this important program.

FRIEND
In the past two years, following developments took place:

- Participation in Steering Committee meetings of FRIEND;
- Membership of GRDC in the Hindu-Kush Himalaya FRIEND and active contribution in two working groups of HKH-FRIEND (Database and Snow and Glacier Hydrology);
- Decision of AMHY FRIEND to transfer the database to GRDC (technically this has not yet been implemented);
- Establishment of GRDC as regional data centre for Northern European FRIEND. One of the tasks will be the collection of hydrological data for FRIEND from Austria, Chechk Republic, Germany, Switzerland.

Projects

WHYCOS
GRDC has collaborative links to Med-HYCOS. Med-HYCOS countries in 1997 have agreed to send HYCOS data to GRDC in addition to selected historical data sets. GRDC has submitted to Med-HYCOS its entire data base of the participating countries as a start-up for the Med-HYCOS Database system. No data have so far been received from Med-HYCOS. Contacts to SADC-HYCOS are rather informal, no agreement exists at present between SADC-HYCOS and GRDC for exchange of data. GRDC views the regionalization of WHYCOS with concern as there might be trends to restrict access to WHYCOS data for the global research community contrary to the spirit and objective of WHYCOS.

INTAS

This project within the EU family of programs aimed to support countries of the Former Soviet Union to collect and archive hydrological data in their region (Russia, Belorussia, Ukraine). The data acquired through the project is meant to supplement the FRIEND European Water Archive. GRDC participated in this project in cooperation with the Institute of Hydrology, Wallingford. The project formally ended in September 1998. INTAS data will be transmitted to GRDC in July 1999

ACSYS

The Centre is actively involved in ACSYS activities such as the assembly of the Arctic Runoff Data base (ARDB), computation of surface runoff into the Arctic Ocean and chairing the ACSYS Data Management and Information Panel (ACSYS-DMIP). Expansion of the ARDB is hampered to the non-delivery of further hydrological data mainly from the territory of the Russian Federation and updates of already delivered time.-series. In the next few months, gauging stations with discharge time series (new rivers and updates) will be incorporated in the ARDB as a contribution of Canada.

GWP

On behalf of the German Ministry of Economic Cooperation (BMZ); BfG/GRDC and the German Agency for Technical Cooperation are implementing the German contribution to the Global Water Partnership (GWP). The contribution concentrates on Integrated Water Resources Management (IWRM). In this cooperation, GRDC is establishing an Information Management System building on documents and know how in IWRM and to operate a question and answer service to users of the system. The regional focus of the project is at present the Southern African Development Community (SADC)

Research and Development (R&D)

In the past two years, GRDC has largely expanded its base for R&D. Many R&D activities have been carried out in the context of collaborative agreements as outlines above. Generic R&D at the GRDC focused on

- Assessment of water availability in Asia and the Pacific (finalized);
- Development and customizing software for statistical time series analysis for selected rivers of the world (finalized);
- Development of a model for balancing water availability, demand and use in large river basins (Pilot Basin: Danube), (on-going);
- Re-Engineering of the GRDC Database system (on-going);
- Applications of GIS in GRDC (in conception phase).

Annex 5

Vision statements

ORGANISATION MÉTÉOROLOGIQUE MONDIALE

WORLD METEOROLOGICAL ORGANIZATION

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Annex(es):

Dr W. Grabs
Global Runoff Data Centre (GRDC)
Bundesanstalt für Gewässerkunde
Kaiserin-Augusta-Anlagen 15-17
56068 Koblenz
Germany

GENEVA, 20 May 1999

Dear Wolfgang,

Many thanks for your letter of 4 May and my compliments on the very comprehensive plans you have laid for the forthcoming meeting of the GRDC Steering Committee.

Janet expects to come to Koblenz with me. We will arrive on 22 June and depart on the evening of 25 June and I would therefore be grateful if you could make the necessary hotel booking.

As regards the Vision Statement, I would offer the following few sentences which are in no particular order, as an input to what I expect to be a lively and constructive debate in Koblenz on this important topic.

That GRDC has widespread recognition.
It will be well known and widely recognized at national level within countries throughout the international community as the definitive global centre for the compilation and distribution of runoff (and evapotranspiration?) data.

That GRDC has an active programme.
It receives a steady stream of quality-controlled data from countries and from regional and global projects and maintains an active programme of projects, undertaken jointly with various other national and international bodies and based on the study of the data it holds which produce a series of technical reports and other outputs.

That GRDC has a secure future.
It receives financial and other practical support for its operation from Germany, from other countries and from other bi-lateral and multi-lateral donors.

I look forward to seeing you in Koblenz.

Yours sincerely,

Arthur J. Askew
Director
Hydrology and Water Resources Department

Proposal of Dr Gustard

Von: Alan Gustard[SMTP:AGU@wpo.nerc.ac.uk]
Gesendet: Montag, 21. Juni 1999 10:35
An: grabs@bafg.de
Betreff: GRDC Steering Committee Vision Statement

* To focus on the core activity of a global data base of river flows

* To give priority to data base development in data sparse areas

* To review the incorporation of associated data sets - abstractions, discharges and spatial data

* To continue to develop links between GRDC, FRIEND and associated international programmes, particularly in newly emerging FRIEND regions.

Proposal of Dr Pilon

Von: Paul.Pilon@ec.gc.ca[SMTP:Paul.Pilon@ec.gc ca]
Gesendet: Donnerstag, 10. Juni 1999 14:51
An: grabs@bafg.de
Betreff: RE: 4th GRDC Steering Committee

As per your request, please find below a vision statement for the GRDC. I am sure that further wordsmithing would be in order.

GRDC Vision

Recognised globally as maintaining a global archive of select discharge and water level data of known quality and their associated metadata and for the promotion of the use of these data for scientific studies addressing regional and global issues.

Regards,

Paul

Proposal of Dr Savtchenko

Von: Victor Savtchenko[SMTP:Savtchenko_V@gateway.wmo.ch]
Gesendet: Dienstag, 25. Mai 1999 14:37
An: grabs@bafg.de
Betreff: Re: ACSYS messages

Many thanks , Wolfgang, for your prompt actions. Hartmut passed all the relevant documents to me. He prepared also two statements which he requested me to pass to you. I am doing it with a great pleasure.

1. Major objectives of the GRDC

(i) To collect , assemble, quality control , archive and disseminate run-off data from major world rivers; and
(ii) To evaluate -jointly with other groups- the run-off data base for applications in hydrology, water resource management, climatology and environmental assessments.

2. Vision of GRDC

River run-off is vital for mankind , deternimes - among other factors - global ocean circulation and reacts more strongly than most environmental parameters to climate variability and change. By disseminating consistent and timely information on river run-off (up to a global scale) GRDC contributes to the approach to sustainability.

Regards,
Victor

Proposal of Dr Rudolph

A-grdc99

Statement of GPCC to the 4th GRDC SC Meeting 1999:

GRDC should put all possible efforts on updating the database onto a near real-time temporal coverage for the Earth's large river systems.

The cooperation of GRDC and GPCC in comparison of catchment area-mean precipitation derived from raingauge observations and runoff data is acknowledged and should be enhanced.

New satellite-based precipitation estimates covering the entire globe are in development and will soon be available from the GPCP via GPCC and the ICSU World Data Centre A for Meteorology (Asheville, NC, USA).

"Vision Statement" for the 4th GRDC - Steering Committee 23 - 25 June 1999, Koblenz, Germany

UNEP Approach to freshwater observation and assessment

One of the UNEP comparative advantages as far as freshwater assessment is concerned is: water quality and UNEP is trying to focus on that. One of our overall objectives is to strengthen the existing cooperation.

Brainstorming is currently underway with a new strategy under development within the Division of Environmental Information, Assessment and Early Warning strategy so that the GEMS/Water programme will become an integrated component of the Global Terrestrial Observing System. The idea is to continue to reinforce the GEMS/Water collaborating center in Canada, which remains a key component but at the same time to better fit in the new DEIA & EW strategy by:

- meeting immediate local needs for water quality data, including watershed basins (Ref UNFIP Habitat/UNEP project on Water for African Cities);
- reinforcing the capacity of selected regional and thematic collaborating centres; already in the new working programme;
- developing value-added products in terms of tools (Global meta-data for users), rapid methodology assessments (and early warning systems), modeling and mapping which could return to data collectors and suppliers;
- strengthening the whole global participative assessment network in internet-based interaction and delivery of information products to users;
- contributing to the needs of GIWA & GPA, other users of freshwater quality data assessment and decision-support tools;
- strengthening collaborative efforts with other water-related programs: i.e. with water quality programmes which will help for the preparation of atlas/map for freshwater and river basins (water quantity and quality issues). GRDC and the GEMS/Canadian water center need to further strengthen their cooperation and collaborative programmes.

GRDC[1] could likewise in the water quantity side develop a parallel approach/strategy for meeting local needs, realizing value-added products and contributing to GIWA/GPA, while ensuring data quality assurance technique and closer collaboration with DEIA & EW/UNEP within its new strategy.

E.S. DIOP
SENIOR PROGRAMME OFFICER
DIVISION OF ENVIRONMENTAL INFORMATION, ASSESSEMNT
AND EARLY WARNING
UNEP, NAIROBI

[1] *To be developed as a center of excellency*

Vision Statement

Personal

Dr. Takeo Kinosita,Japan

1. *Data Quality:*
Quality of data stored in GRDC should be strictly assured.

The data check system must be established in GRDC. In addition, GRDC must ask all data providers to check the data before sending to GRDC.

I already presented this concept at the past SC of GRDC. I want to present it again because of its importance.

2. *Future Development of the Organization:*
How the GRDC grows up in the future in order to satisfy the expanding requirement of data users?

Which is more preferable to develop the central organization or to establish local organizations (branch offices)? This item must be discussed from the users' viewpoint.

3. *Users' Workshop:*
Users' workshop should be held in the future on the voluntary basis.

GRDC should know users' real opinions and promote the use of data, moreover make the users' community for better management of GRDC.

Annex 6

List of GRDC-reports

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 1997)	The GRDC Database. Concept and Implementation.
Report No. 17 (Sept. 1997)	Report on the Third Meeting of the GRDC Steering Committee, Koblenz, Germany June 25-27, 1997
Report No. 18 (July 1998)	GRDC Status Report 1997
Report No. 19 (August 1998)	Evaluation of Statistical Properties of Discharge Data of Stations Discharging Into the Oceans - Europe and Selected World-Wide Stations - (F. Portmann)
Report No. 20 (July 1998)	Water Resources Development and the Availability of Discharge Data in WMO Region II (Asia) and V (South-West Pacific)
Report No. 21 (Sept. 1998)	Analysis of long runoff series of selected rivers of the Asia-Pacific region in relation with climate change and El Niño effects (Prof. Daniel Cluis)
Report No. 22 (Mai 1999)	Global Composite Runoff Fields on Observed River Discharge and Simulated Water Balances.

Annex 7

Data Imports from July 1998 to July 1999

Data Imports July 1998 to July 1999

Country	Date	GRDC-No.	River	Station	from - to	D/M	N/U
Cote D'Ivoire	01.07.98	1426600	Agneby	Agboville	1993	D	U
	01.07.98	1426200	Bandama	Bafecao	1993	D	U
	01.07.98	1426140	Bou	Boron	1993	D	U
	01.07.98	1426300	Marahoue	Bouafle	1993	D	U
	01.07.98	1426210	Bandama	Brimbo	1993	D	U
	01.07.98	1427200	Sassandra	Dabala	1993	D	U
	01.07.98	1427600	Davo	Dakpadou	1993	D	U
	01.07.98	1434700	Kankelaba	Debete	1993	D	U
	01.07.98	1426320	Kan	Dimbokro	1993	D	U
	01.07.98	1427130	Tienba	Dioulatiedougou	1993	D	U
	01.07.98	1434300	Baoule	Djirila	1993	D	U
	01.07.98	1425100	Cavally	Flampleu	1993	D	U
	01.07.98	1426050	Nero	Grande Bereby	1993	D	U
	01.07.98	1426260	N'zi	Fetekro	1993	D	U
	01.07.98	1434200	Kouroukele	Iradougou	1993	D	U
	01.07.98	1428200	Comoe	Kafolo	1993	D	U
	01.07.98	1426250	N'zi	Route Katiola-Dabakala	1993	D	U
	01.07.98	1434810	Bagoe	Kouto Aval	1993	D	U
	01.07.98	1427370	Ko	Logouale	1993	D	U
	01.07.98	1426100	Yani	Madji	1993	D	U
	01.07.98	1434390	Degou	Manankoro	1993	D	U
	01.07.98	1426180	Marahoue	Mankoro	1993	D	U
	01.07.98	1427100	Sien	Massadougou	1993	D	U
	01.07.98	1428500	Comoe	Mbasso	1993	D	U
	01.07.98	1425450	Hana	Niebe	1993	D	U
	01.07.98	1434850	Bagoe	Papara	1993	D	U
	01.07.98	1434750	Niangboue	Ponondougou	1993	D	U
	01.07.98	1427350	Sassandra	Semien	1993	D	U
	01.07.98	1428300	Comoe	Serebou	1993	D	U
	01.07.98	1427500	Sassandra	Soubre	1993	D	U
	01.07.98	1425300	N'ce	Tai	1993	D	U
	01.07.98	1425500	Cavally	Tate	1993	D	U
	01.07.98	1425380	Bandama	Tiassale	1993	D	U
	01.07.98	1427150	Boa	Vialadougou	1993	D	U
	01.07.98	1431300	Volta	Vonkoro	1993	D	U
	01.07.98	1434500	Doundian	Wahire	1993	D	U
	01.07.98	1426010	Tabou	Yaka	1993	D	U
	01.07.98	1434370	Banifing	Ziemougoula	1993	D	U
	01.07.98	1426350	N'zi	Zienoa	1993	D	U

Country	Date	GRDC-No.	River	Station	from - to	D/M	N/U
Mali	14.07.98	1134450	Bani	Beneny-Kegny	1993-1994	M	U
	14.07.98	1134300	Bani	Douna	1993-1994	M	U
	14.07.98	1134480	Bani	Sofara	1993-1994	M	U
	14.07.98	1134505	Bani	Mopti	1989-1992	M	U

Country	Date	GRDC-No.	River	Station	from - to	D/M	N/U
Senegal	14.07.98	1813200	Gambie	Gouloumbou	1989-1994	M	U
	14.07.98	1813780	Gambie	Kedougou	1989-1994	M	U
	14.07.98	1813700	Gambie	Mako	1989-1994	M	U
	14.07.98	1813500	Gambie	Simenti	1989-1994	M	U
	14.07.98	1813460	Gambie	Wassadou amont	1989-1994	M	U
	14.07.98	1813450	Gambie	Wassadou avant	1989-1994	M	U
	14.07.98	1813300	Koulountou	Gue du P.N.N.K.	1971-1994	M	U
	14.07.98	1813320	Koulountou	Missirah Gounas	1971-1995	M	N
	14.07.98	1815020	Corubal	Saltinho amont	1977-1994	M	N
	14.07.98	1815070	Corubal	Tche-Tche	1977-1994	M	N
	14.07.98	1814070	Geba	Sonaco amont	1979-1993	M	N

Data Imports July 1998 to July 1999

Country	Date	GRDC-No.	River	Station	from - to	D/M	N/U
Spain	15.07.98	6217100	Guadalquivir	Alcala del Rio	1942-1994	M	U
	15.07.98	6227500	Jucar	Masia de Pompo	1911-1987	M	U
	15.07.98	6226800	Ebro	Tortosa	1912-1993	M	U

Country	Date	GRDC-No.	River	Station	from - to	D/M	N/U
United Kingdom	24.2.1999	6604610	Tay	Ballathie	1995 - 1997	D/M	U
	24.2.1999	6604601	Tummel	Pitlochry	1995 - 1997	D/M	N
	24.2.1999	6603500	Lagan	Newforge	1995 - 1996	D/M	U
	24.2.1999	6604690	Tweed	Boleside	1995 - 1997	D/M	U
	24.2.1999	6605510	Leven	Leven Bridge	1995 - 1997	D/M	U
	24.2.1999	6605540	Wharfe	Addingham	1995 - 1997	D/M	U
	24.2.1999	6607750	Mimram	Pashanger Park	1995 - 1997	D/M	N
	24.2.1999	6607800	Darent	Hawley	1995 - 1997	D/M	U
	24.2.1999	6607500	Stour	Throop Mill	1995 - 1997	D/M	U
	24.2.1999	6607200	Exe	Thorverton	1995 - 1997	D/M	U
	24.2.1999	6608500	Wye	Ddol Farm	1995 - 1996	D/M	U
	24.2.1999	6605200	Irwell	Adelphi Weir	1995 - 1997	D/M	U
	24.2.1999	6604500	Annan	Bryderkirk	1995 - 1997	D/M	U
	24.2.1999	6604610	Ewe	Poolewe	1995 - 1997	D/M	U
	24.2.1999	6606300	Ise Brook	Harrowden Old Mill	1995 - 1996	D/M	U
	24.2.1999	6607600	Thames	Eynsham	1995 - 1997	D/M	U

Country	Date	GRDC-No.	River	Station	from - to	D/M	N/U
Ukraine	1.3.1999	6942200	Siret	Storozinec	1953 - 1995	D/M	U
	1.3.1999	6942100	Prut	Chernovtzsy	1971 - 1995	D/M	U

Country	Date	GRDC-No.	River	Station	from - to	D/M	N/U
Sweden	1.3.1999	6233200	Oesterdalaelven	Groetsjoen	1993 - 1998	D/M	U
	1.3.1999	6233450	Faxaelven	Ankarvattnet	1993 - 1998	D/M	U
	1.3.1999	6233150	Fyllean	Simlangen	1994 - 1998	D/M	U
	1.3.1999	6233300	Velenan	Velen 2	1994 - 1998	D/M	U
	1.3.1999	6233500	Jovattenan	Nedre Jovattnet	1993 - 1998	D/M	U
	1.3.1999	6233550	Kassjoean	Storsillret	1993 - 1997	D/M	U
	1.3.1999	6233780	Raneaelv	Niemisel	1993 - 1998	D/M	U
	1.3.1999	6233400	Ammeran	Fyras	1994 - 1998	D/M	U
	1.3.1999	6233600	Vattholmaan	Vattholma 2	1994 - 1998	D/M	U
	1.3.1999	6233680	Vindelaelven	Sorsele	1993 - 1998	D/M	U
	1.3.1999	6232100	Torneaelv	Nedre Abiskojokk	1993 - 1998	D/M	U
	1.3.1999	6229100	Nedre Bullaren	Vassbotten	1993 - 1998	D/M	U
	1.3.1999	6233350	Alsteran	Getebro	1994 - 1998	D/M	U
	1.3.1999	6233750	Lule	Boden Waterworks	1993 - 1995	D/M	U
	1.3.1999	6233650	Angerman	Solleftea	1993 - 1998	D/M	U
	1.3.1999	6233100	Viskan	Asbro	1994 - 1998	D/M	U
	1.3.1999	6229500	Vaenern-Goeta	Vaenersborg	1993 - 1998	D/M	U
	1.3.1999	6233800	Lapptraesket	Ytterholmen	1993 - 1997	D/M	U

Country	Date	GRDC-No.	River	Station	from - to	D/M	N/U
Mexico	2.3.1999	4353300	Yaqui	El Novillo	1976 - 1979	D/M	U
	2.3.1999	4355300	Fuerte	San Miguel Zapotitlan	1976 - 1981	D/M	U
	2.3.1999	4356100	Santiago	El Capomal	1965 - 1981	D/M	U
	2.3.1999	4358300	Panuco	Las Adjuntas	1965 - 1979	D/M	U
	2.3.1999	4362600	Usumacinta	Boca del Cerro	1965 - 1983	D/M	U
	2.3.1999	4351900	Bravo	Matamoros	1976 - 1979	M	U
	2.3.1999	4352100	Colorado	Limite Internacional Norte	1976 - 1979	M	U

Data Imports July 1998 to July 1999

Country	Date	GRDC-No.	River	Station	from - to	D/M	N/U
Cote d'Ivoire	18.3.1999	1426380	Bandama	Tiassale	1970 - 1996	D	U
	18.3.1999	1428500	Comoe	Mbasso	1970 - 1996	D	U
	18.3.1999	1427500	Sassandra	Soubre	1970 - 1996	D	U
	18.3.1999	1425500	Cavally	Tate	1970 - 1996	D	U

Country	Date	GRDC-No.	River	Station	from - to	D/M	N/U
Russian Fed.	25.2.1999	2999910	Olenek	d/s River Pur	1985 - 1992	D	U
	25.2.1999	2999500	Pur	Samburg	1939 - 1964	D	U
	25.2.1999	2998110	Yana	Ubileynaya	1972 - 1978	D	U
	25.2.1999	2999250	Taz	Sidorovsk	1962 - 1977	D	U
	25.2.1999	6970500	Mezen	Malonisogorskaya	1920 - 1977	D	U
	25.2.1999	6970100	Onega	Porog	1944 - 1977	D	U
	25.2.1999	2998500	Kolyma	Sredne-Kolymsk	1927 - 1994	D	U
	25.2.1999	2906901	Amur	Bogordskoye	1963 - 1987	D	N
	25.2.1999	2902850	Kamchatka	Bolshie Scheki	1937 - 1987	D	N
	25.2.1999	2901201	Anadyr	Snezhnoye	1958 - 1988	D	N
	25.2.1999	2901300	Penzhina	Kamenskoye	1957 - 1987	D	U
	25.2.1999	2999200	Nadym	Nadym	1955 - 1991	D	U
	25.2.1999	2903150	Anabar	Saskylakh	1954 - 1994	D	U

Annex 8

Presentation of Dr Gustard, overview of FRIEND

FLOW REGIMES FROM INTERNATIONAL EXPERIMENTAL AND NETWORK DATA

An international collaborative study into regional hydrology

Aims to develop a better understanding of hydrological variability and similarity across time and space in order to improve practical design methods.

Project 1.1 of UNESCO IHP-V

FRIEND - A GLOBAL PROJECT

Northern European FRIEND

The first of the FRIEND projects, includes 5 research themes with participants from over 50 organisations in 24 countries

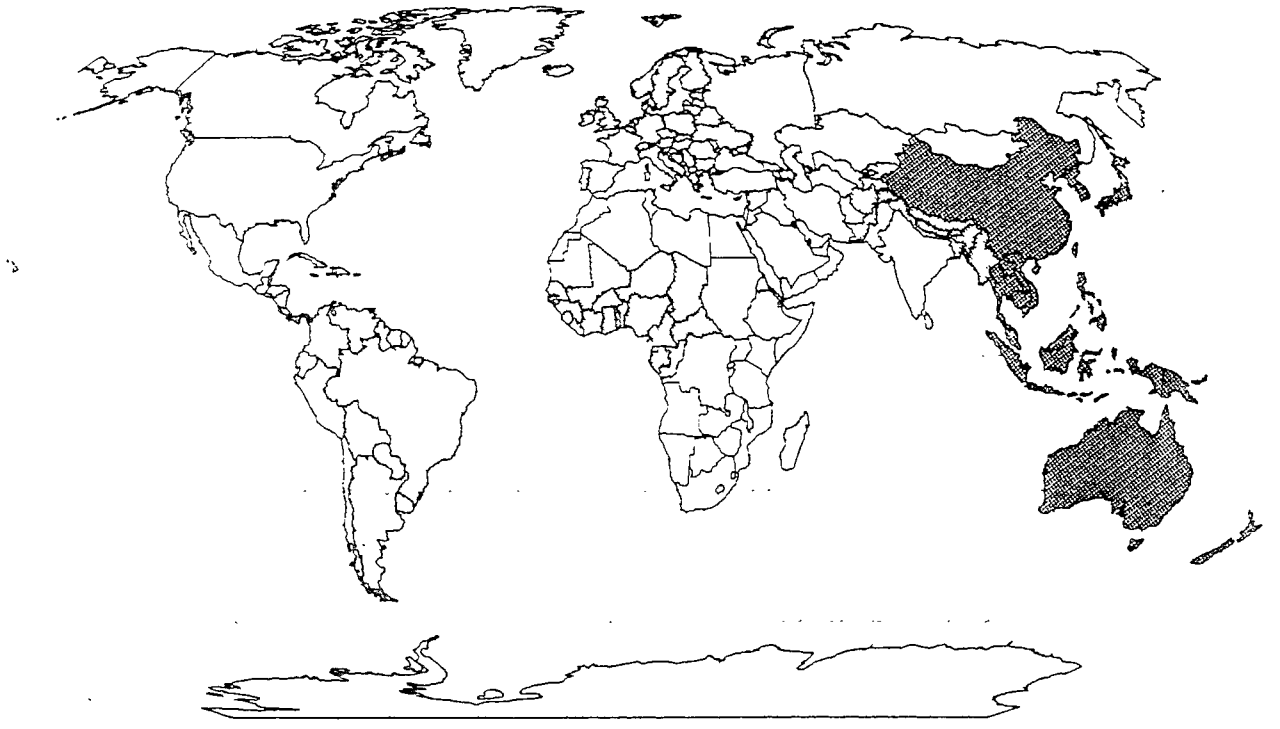
Alpine & Mediterranean (AMHY)

Launched in 1991, this project involves 23 countries in southern Europe and north-west Africa

Emerging projects
- South America
- Central America
- Caribbean

Asian Pacific FRIEND

This project covers a wide geographic area, involving 14 countries from China to New Zealand



West & Central Africa (AOC) FRIEND

Fifteen countries participate in this project which was launched in 1994

Southern Africa FRIEND

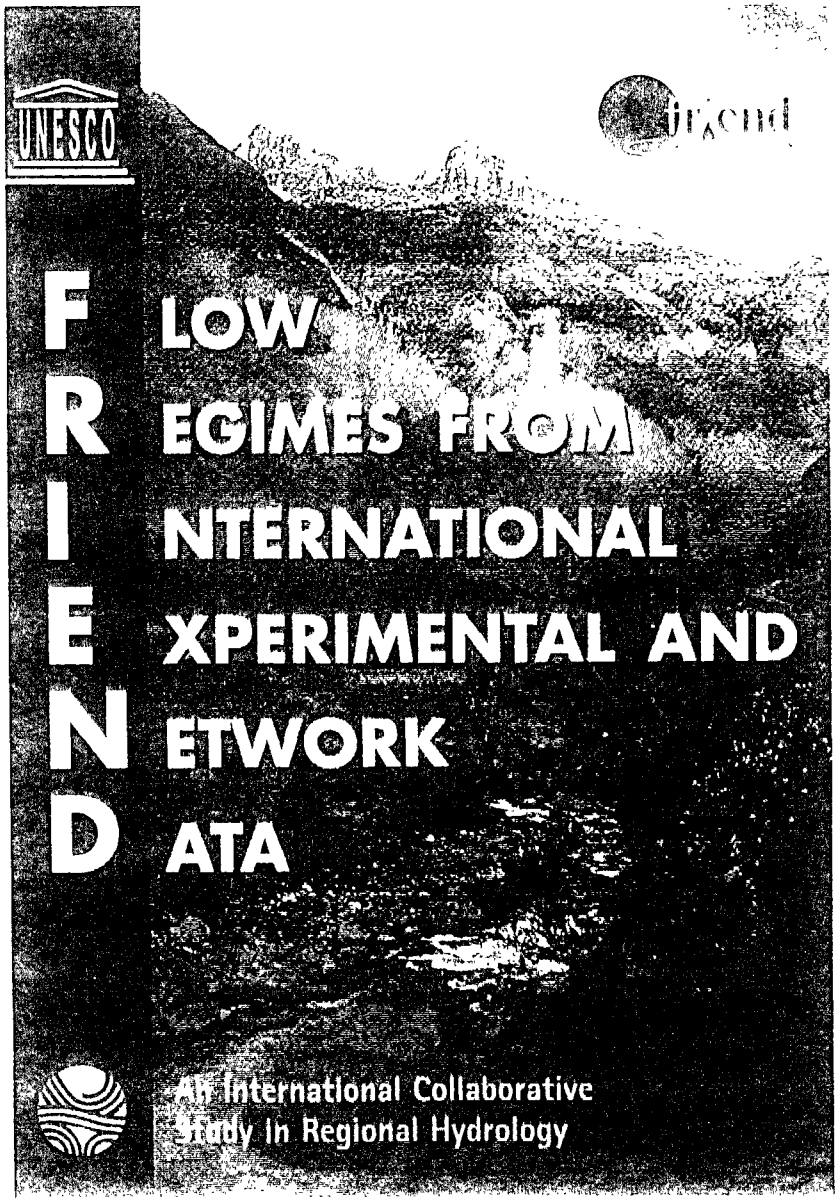
Initiated in 1990, the project includes organisations from 11 countries in Southern Africa

Nile Basin FRIEND

This new project, launched in 1996, involves six countries of the Nile basin

Hindu Kush - Himalayan FRIEND

Established in 1995, HKH FRIEND involves eight countries in central and southern Asia



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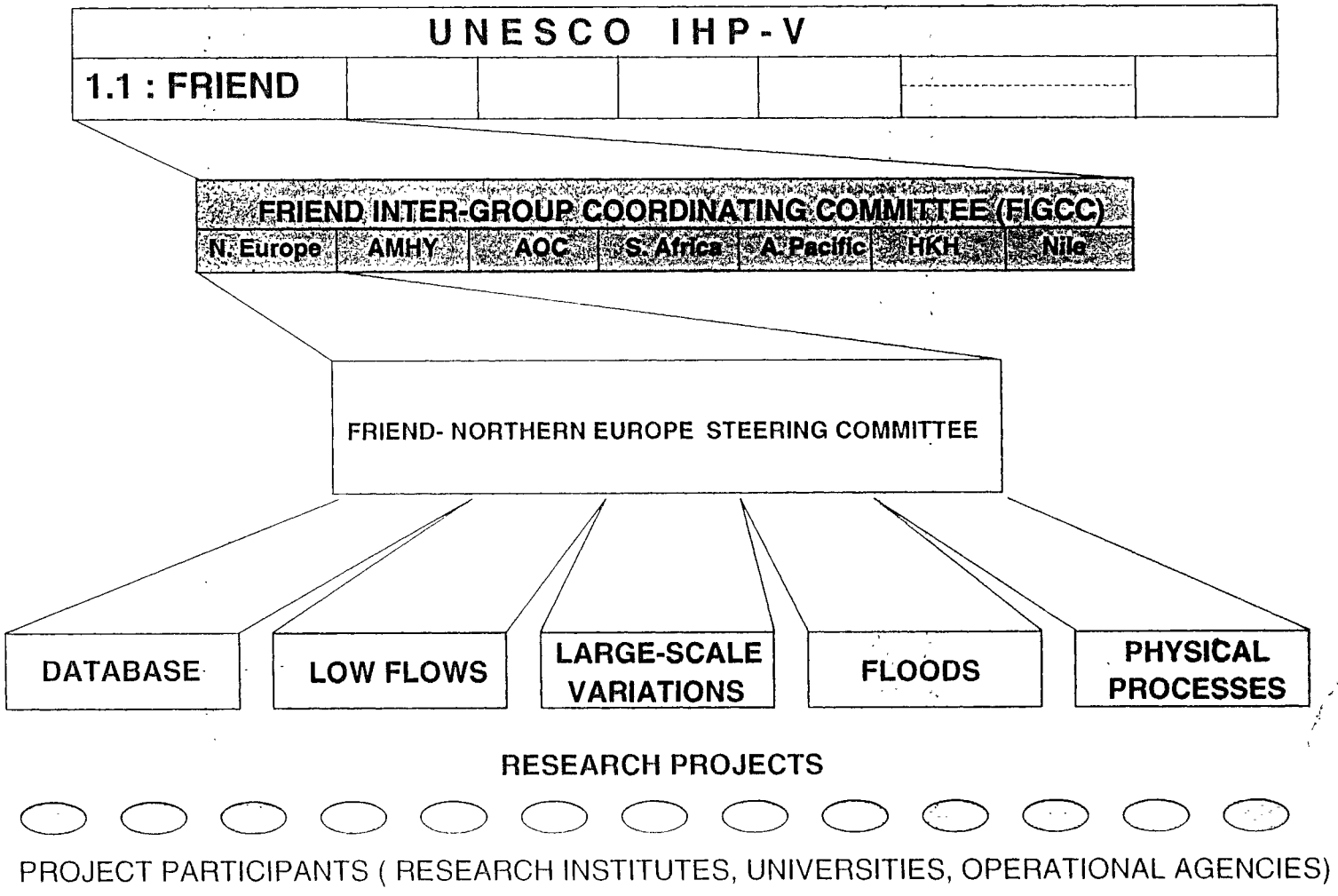

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Countries within FRIEND Groups

Northern Europe (24 countries)	Austria Belarus Belgium Czech Republic Denmark Estonia	Finland France Germany Hungary Iceland Ireland	Latvia Lithuania Luxembourg Netherlands Norway Poland	Russia Slovak Rep. Sweden Switzerland Ukraine UK
AMHY (23 countries)	Albania Algeria Austria Bulgaria Bosnia-Herz. Croatia	France Greece Hungary Italy Malta Macedonia	Moldova Morocco Portugal Romania Serbia-Mont. Slovenia	Spain Switzerland Tunisia Turkey Yugoslavia
Hindu Kush-Himalayan (8 countries)	Afghanistan Bangladesh	Bhutan China	India Myanmar	Nepal Pakistan
West & Central Africa (15 countries)	Benin Burkina-Faso Cameroon C. Afr. Rep.	Chad Gabon Ghana Guinea	Guinea Biss. Ivory Coast Mali Niger	Nigeria Senegal Togo
Southern Africa (11 countries)	Angola Botswana Lesotho	Malawi Mozambique Namibia	South Africa Swaziland Tanzania	Zambia Zimbabwe
Asian Pacific (14 countries)	Australia China Indonesia Japan	DPR Korea Rep. Korea Laos Malaysia	New Zealand Papua N.G. Philippines Thailand	Taiwan Vietnam
Nile (6 countries)	Egypt Tanzania	Congo Kenya	Sudan Uganda	

FRIEND COORDINATION CENTRES

Northern European FRIEND Dr A. Gustard Institute of Hydrology Wallingford, Oxon, OX10 8BB, United Kingdom Tel/Fax: +44 1491 838800/ +44 1491 692424 E-mail: friend@ceh.ac.uk	**AMHY** Dr G. Oberlin CEMAGREF - Groupement de Lyon 3 bis, quai Chauveau CP220,69336, Lyon CEDEX 09, France Tel/Fax: +33 72 20 87 72/ +33 78 47 78 75 E-mail: guy.oberlin@cemagref.fr
Southern Africa FRIEND Mr S. Mkhandi University of Dar es Salaam PO Box 35131 Dar es Salaam, Tanzania Tel + Fax: +255 51 410029 E-mail: wrep@udsm.ac.tz	**Nile FRIEND** Dr R.K. Kachroo University of Dar es Salaam PO Box 35131 Dar es Salaam, Tanzania Tel/Fax: +255 51 410029 E-mail: wrep@udsm.ac.tz
Hindu Kush-Himalayan FRIEND Prof S.R. Chalise International Centre for Integrated Mountain Development (ICIMOD) PO Box 3226 Kathmandu, Nepal. Tel/Fax: +977 1 525 313/ +977 1 524 509 E-mail: chalise@icimod.org.np	**Western and Central Africa FRIEND** Dr M. Sakho Sous-Directeur de l• Hydrologie BP V.161 Abidjan, Côte d• Ivoire Tel/Fax: +225 22 77 19/ +225 21 68 98 E-mail: sakhoma@globeaccess.net
Asian Pacific FRIEND Prof K. Takeuchi Yamanshi University Takeda 4 Kofu 400 Japan Tel/Fax: +81 552 52 1111/ +81 552 53 4915 E-mail: takeuchi@mail.yamanashi.ac.jp	**UNESCO** Division of Water Sciences 1 Rue Miollis F-75732, Paris, France Tel/Fax: +33 1 456 83 998/ +33 1 456 85 811

FRIEND PUBLICATIONS

- FREND: 1985-1989, 2 volumes, Institute of Hydrology, 1989. *(First Report)*

- FRIEND: 1990-1993, 3 volumes, Institute of Hydrology, 1993. *(Second Report)*

- FRIEND:1994-1997, 1 volume, CEMAGREF, France, 1997. *(Third Report)*

- Southern Africa FRIEND, Technical Documents in Hydrology No. 15, UNESCO, Paris, 1997.

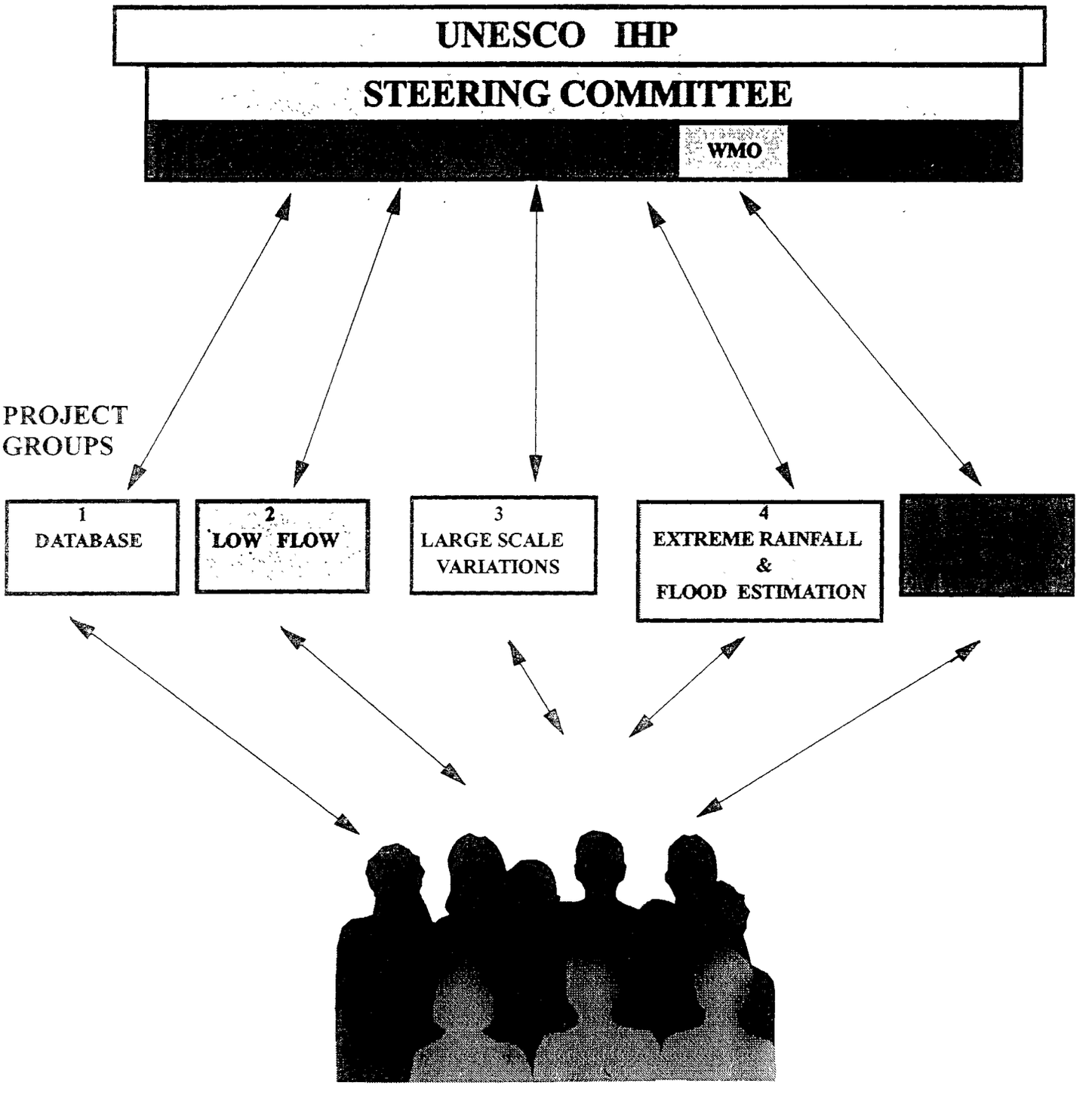
- Proceedings of three International FRIEND Conferences in IAHS (Red book) Publ. Nos. 187 (1989), 221 (1993) and 246 (1997).

- Advances in Regional Hydrology through East European Cooperation, Institute of Hydrology, 1997

- Seminaire International Annuel du Groupe AMHY de FRIEND, Annual Report No. 5(1995-1996), IHP-V Technical Documents in Hydrology No. 11, UNESCO, 1997.

- Inventory of FRIEND Research Basins, Report 97.1, Netherlands National Committee for IHP and OHP, 1997.

FRIEND PROJECT MANAGEMENT



NORTHERN EUROPEAN FRIEND
PHASE IV: 1997-2001

PROJECT 2 - LOW FLOWS

Six main areas of research

0. The ARIDE project

1. Defining drought at a point of a river

2. Physically based models to understand hydrological processes at the catchment scale

3. Statistical modelling to estimate low flow and drought parameters at the regional scale

4. Applying statistical approaches to analyse spatial and temporal characteristics across Europe

5. Applying physical-based approaches to analyse spatial and temporal characteristics across Europe

6. Future streamflows/droughts and environmental changes for specific regions

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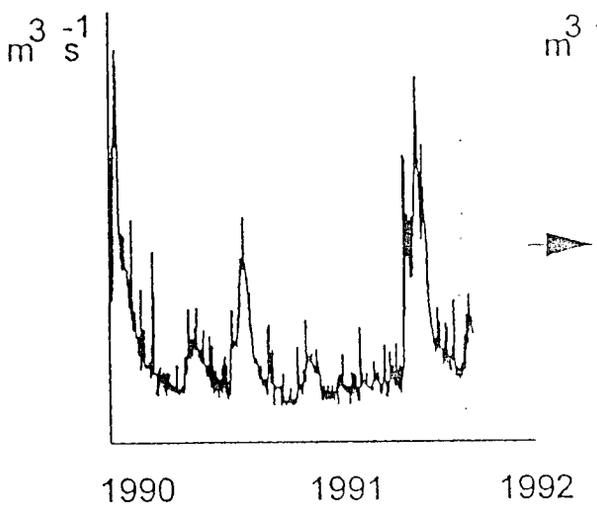
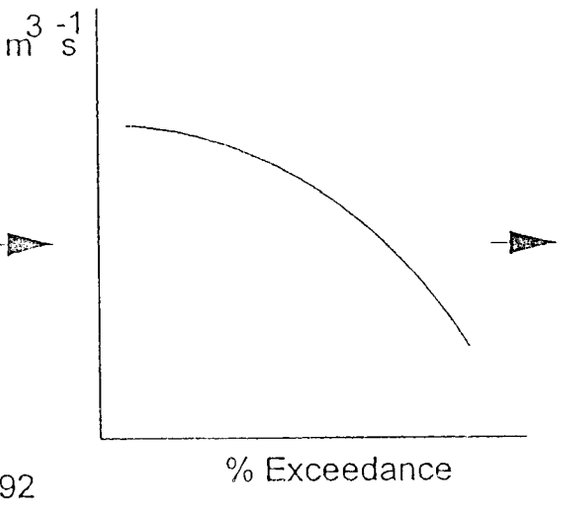
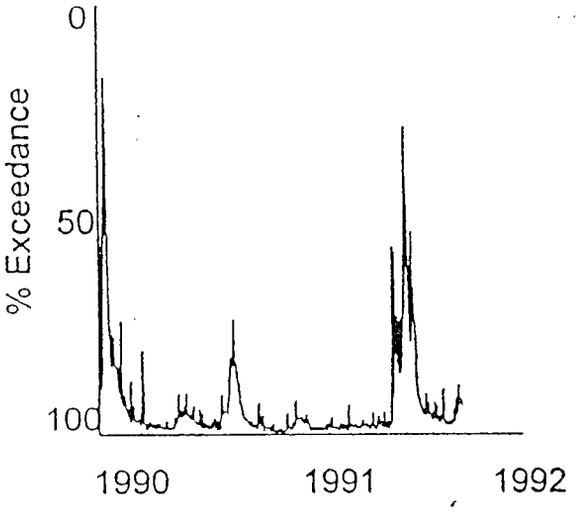


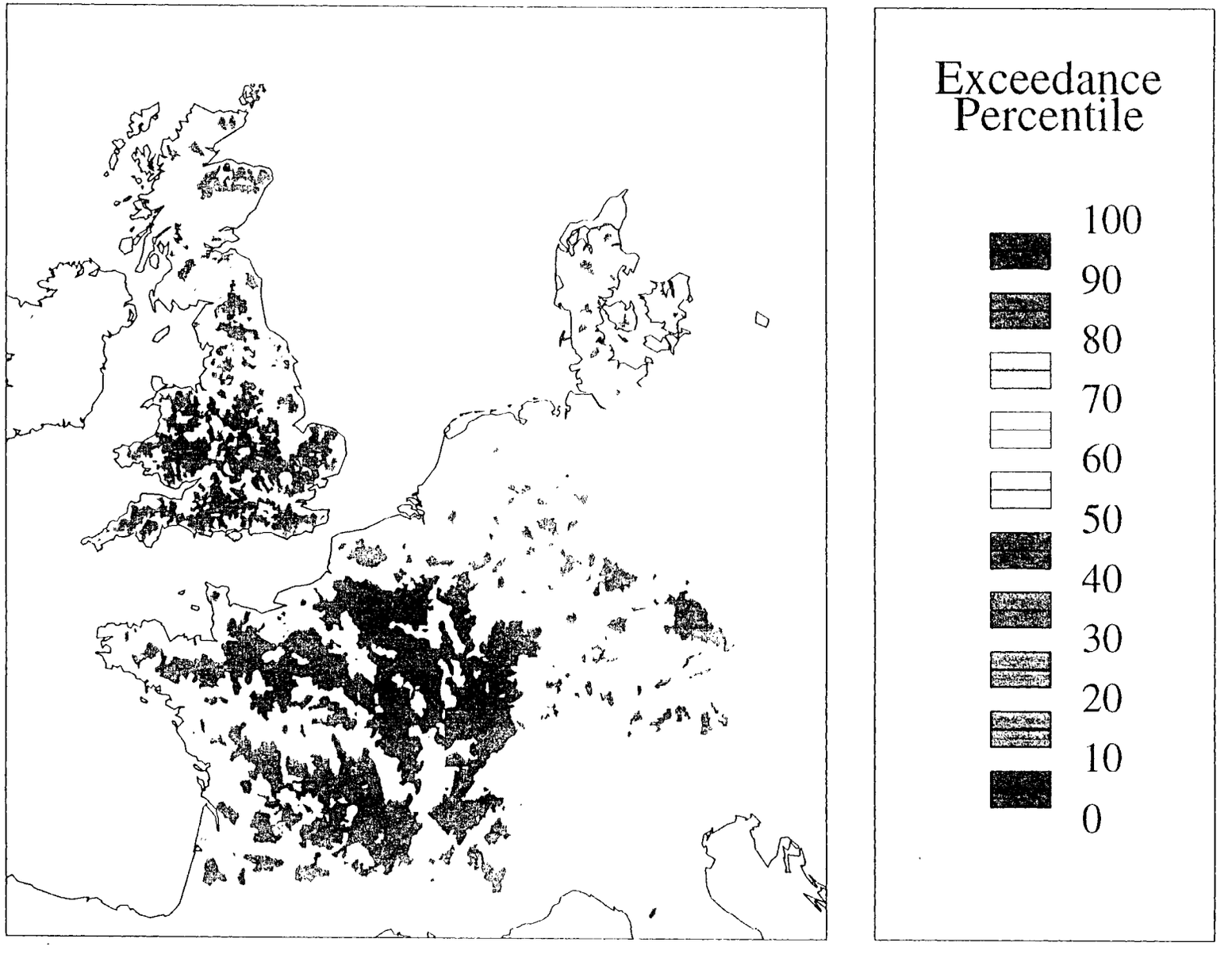
Observed Hydrograph Time Series



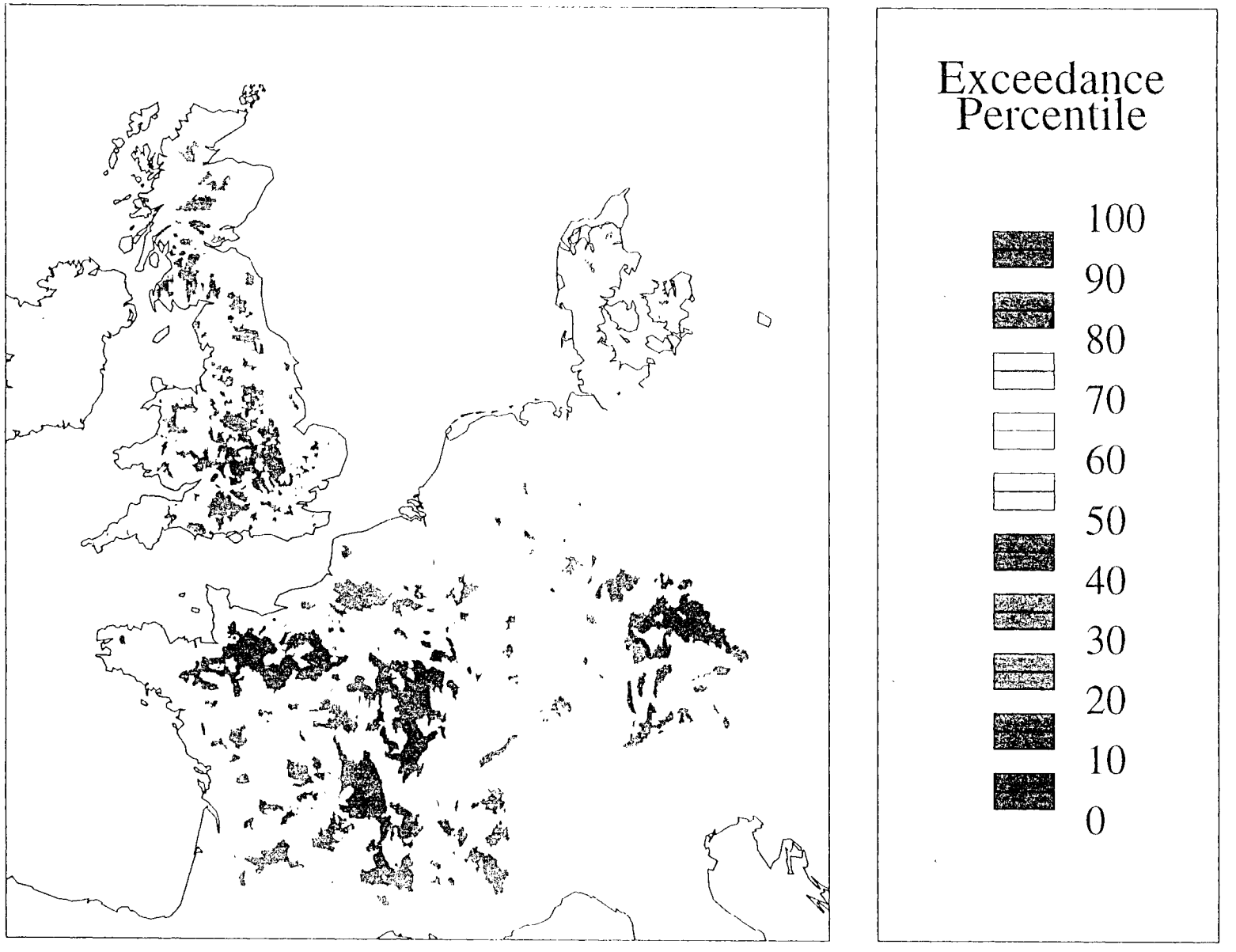
Flow Duration Curve



Observed Drought Frequency Time Series

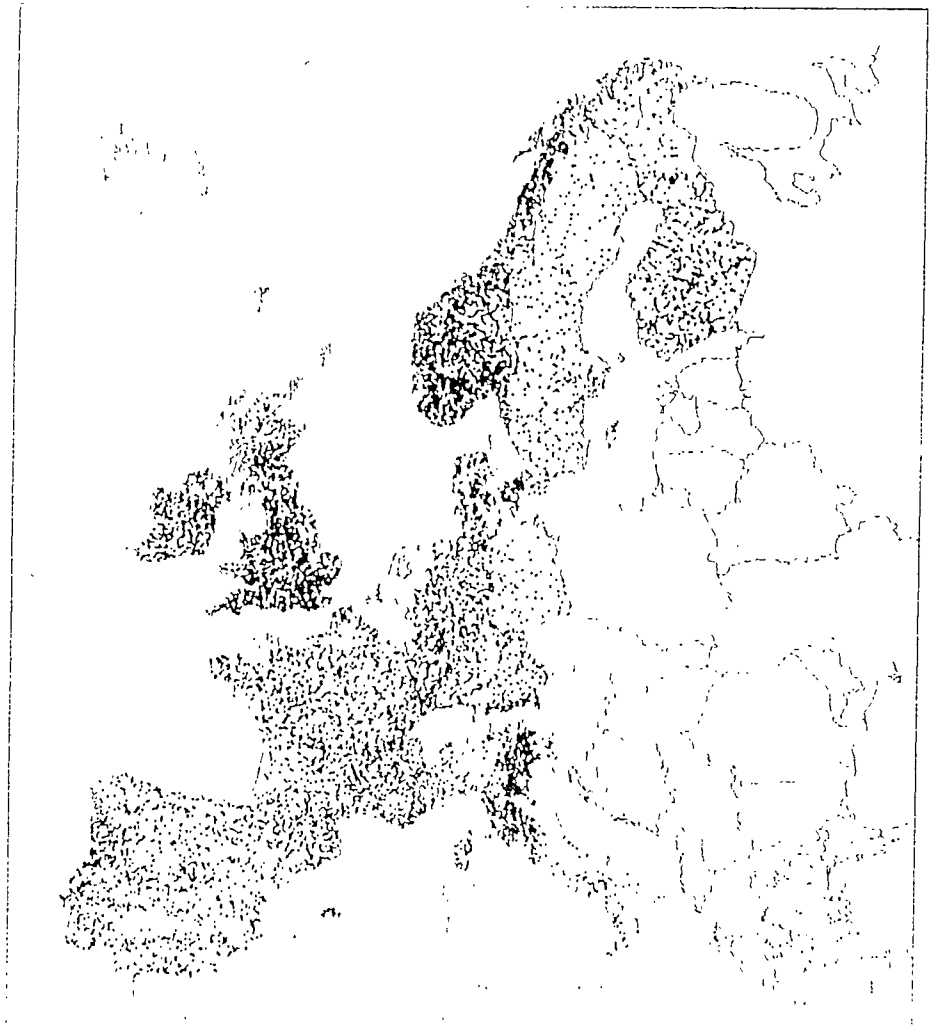


Exceedence percentiles of flows occurring on 10 June 1976



Exceedence percentiles of flows occurring on 10 March 1976

EUROPEAN GAUGING STATIONS



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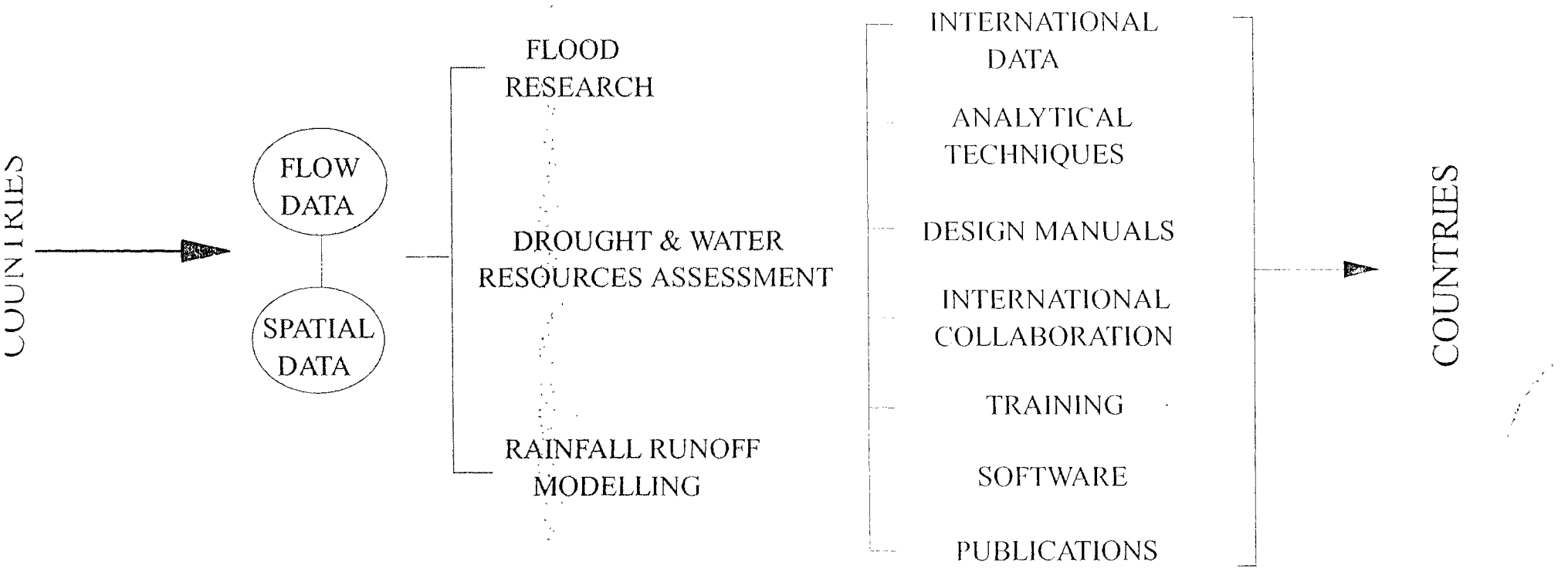
friend

STRUCTURE OF SOUTHERN AFRICA FRIEND

UNESCO IHP
STEERING COMMITTEE
COORDINATION CENTRE



DATA BASES → **ANALYSES** → **OUTPUTS** →

Figure 4.49 Spatial variability of hydrological drought severity across Southern Africa on 1st April 1987

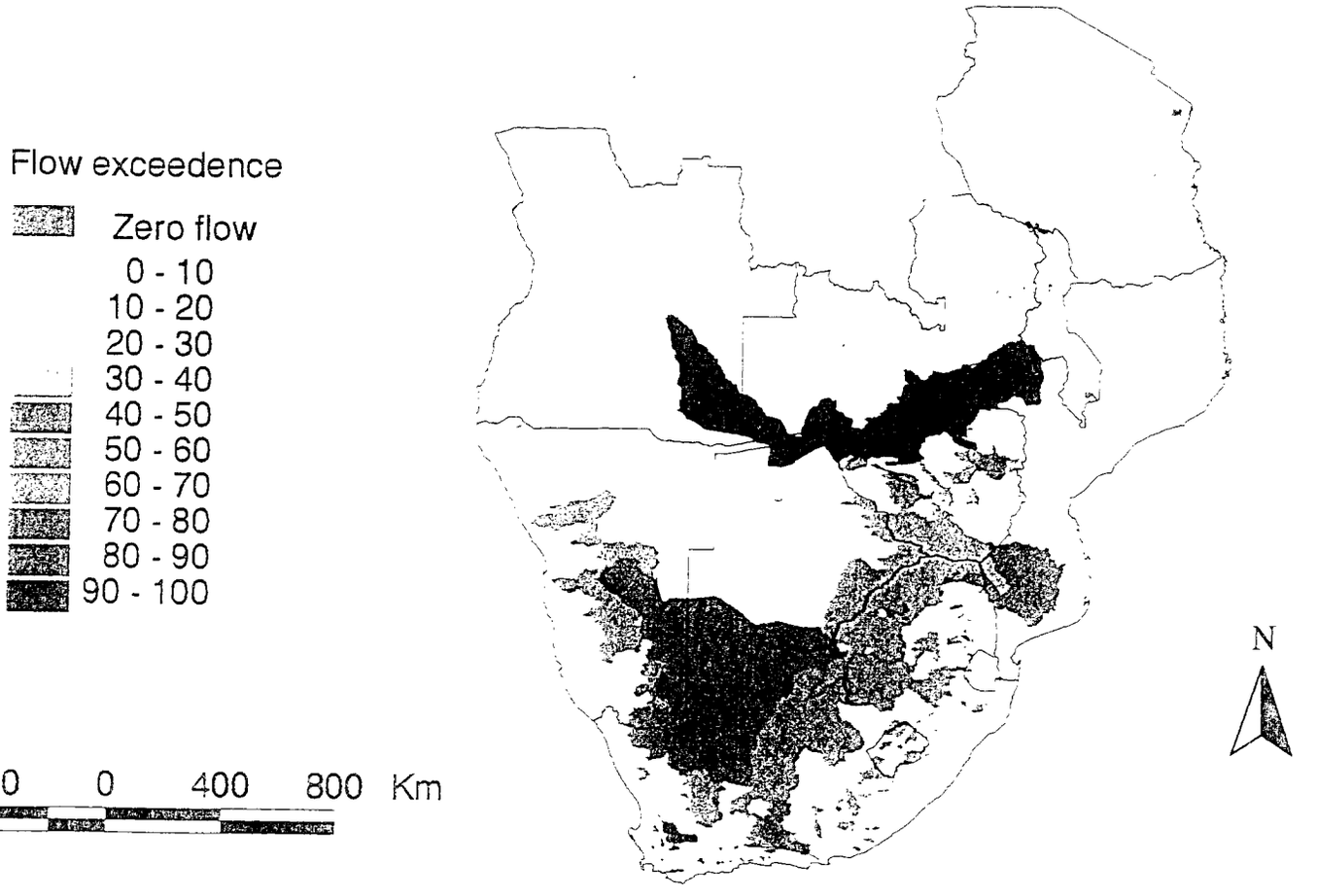
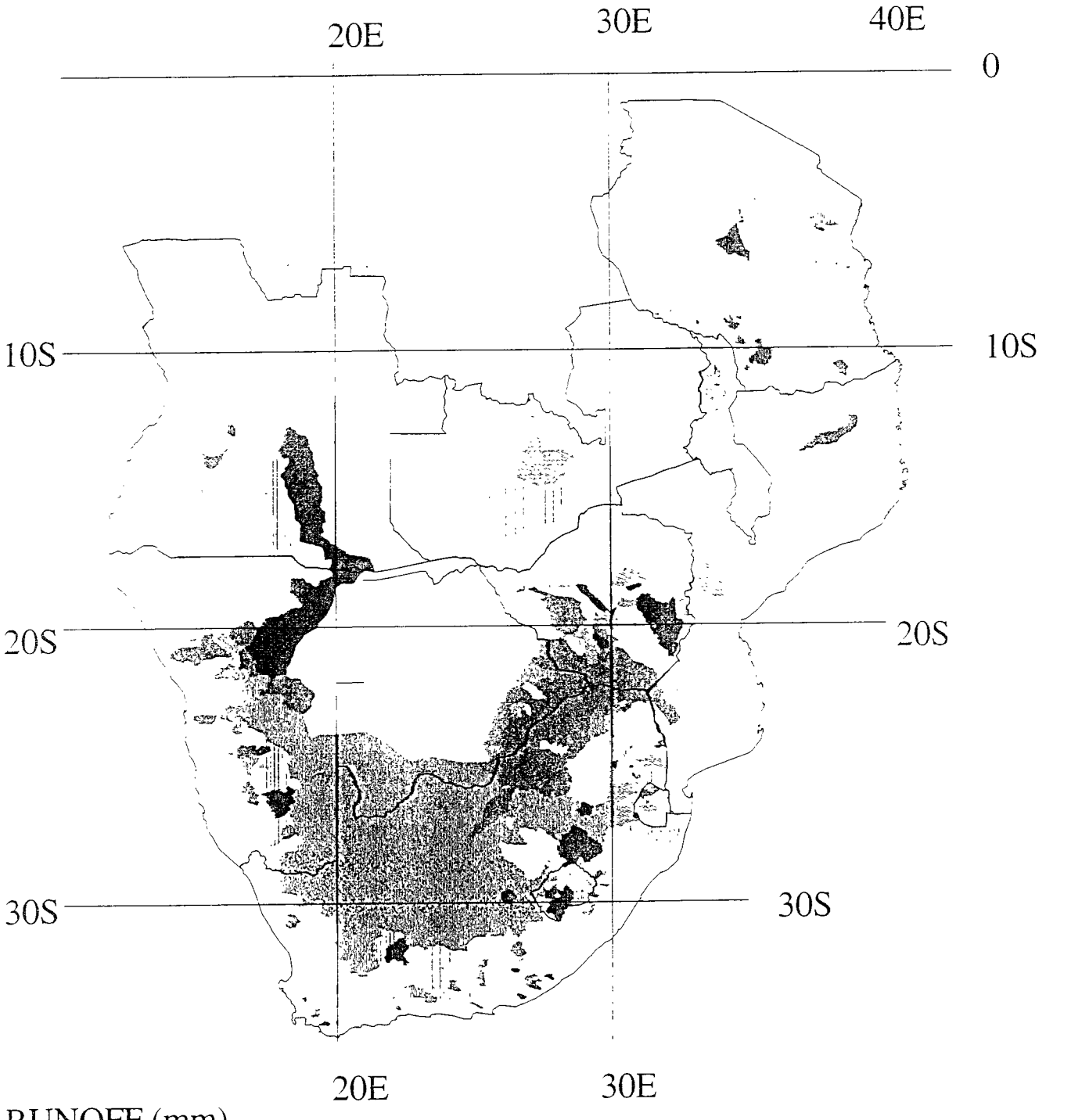
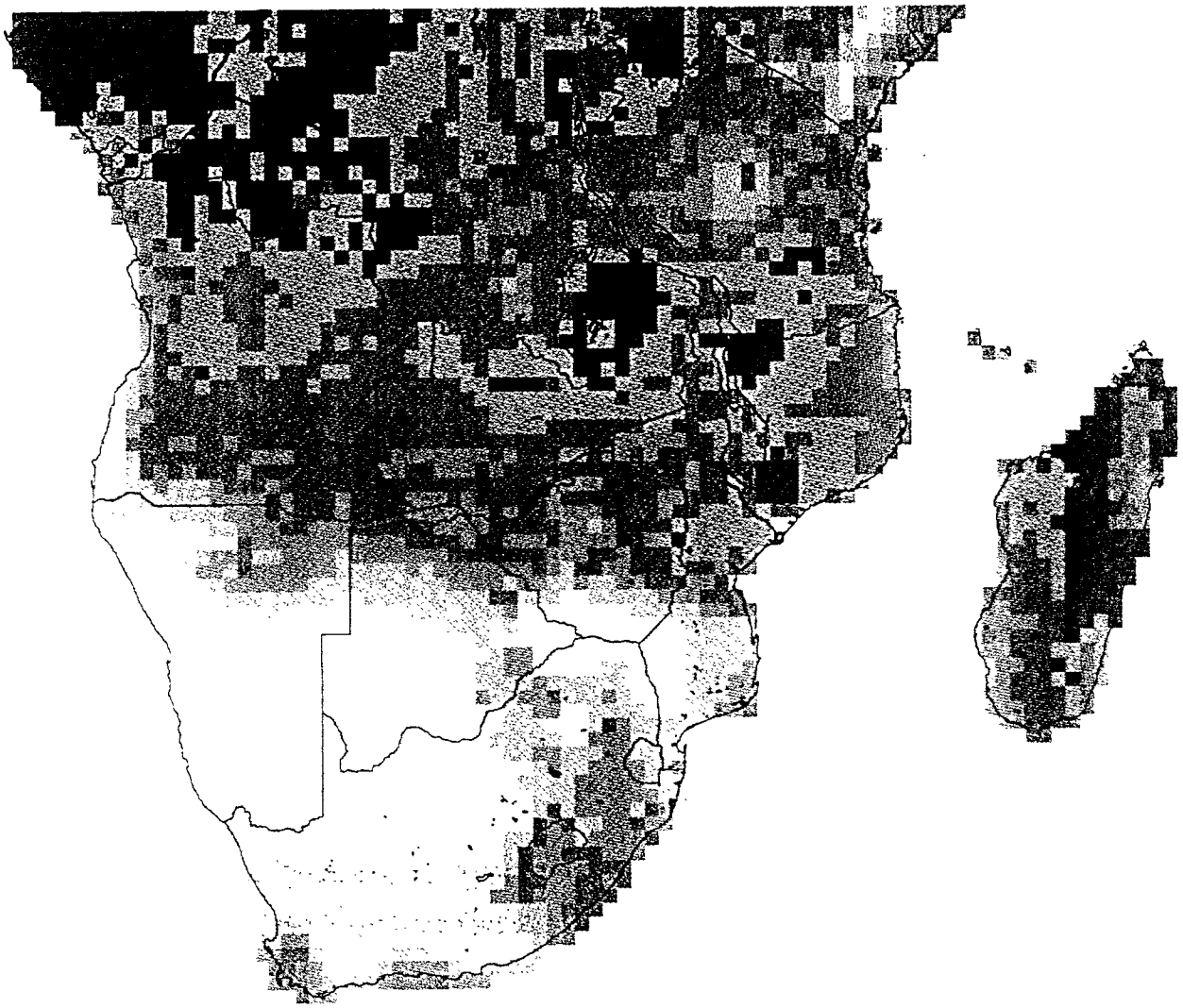


Figure 4.1 Spatial variability of mean annual runoff by FRIEND gauged catchments



Average annual runoff (mm) – 1961-90



runoff (mm)

< 10 | 10 to 25 | 25 to 50 | 50 to 100 | 100 to 150 | 150 to 200 | 200 to 300 | 300 to 500 | 500 to 750 | 750 to 1000 | 1000 to 1500 | 1500 to 2000

WATER AVAILABILITY INDICES (WAI)

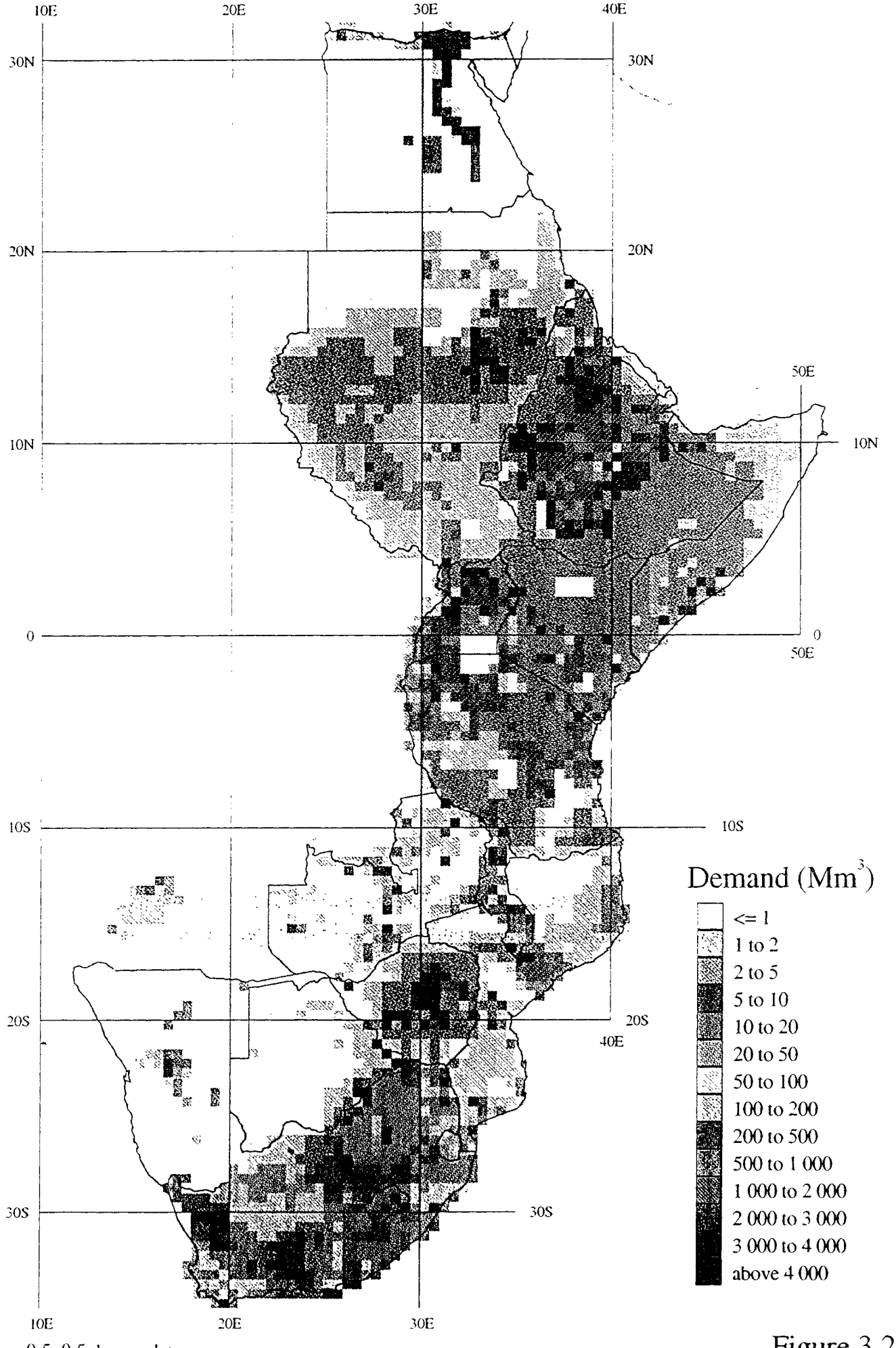
TYPE 1

$$\frac{\text{ANNUAL RUNOFF}}{\text{ANNUAL DEMAND}}$$

TYPE 2

$$\frac{\text{Q90 + GW - DEMAND}}{\text{Q90 + GW + DEMAND}}$$

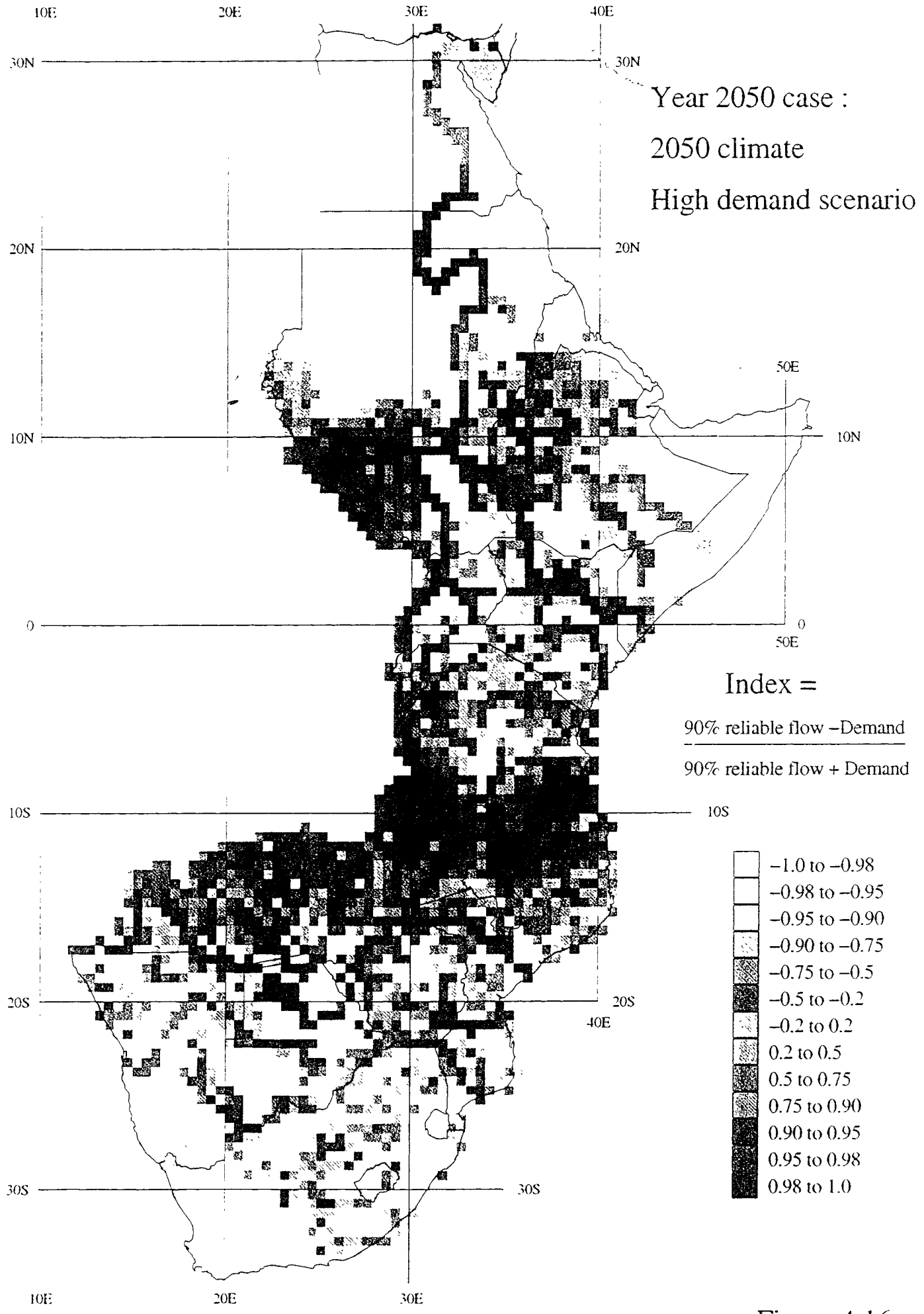
Annual water demand –2050, high scenario



0.5x0.5 degree data

Figure 3.21

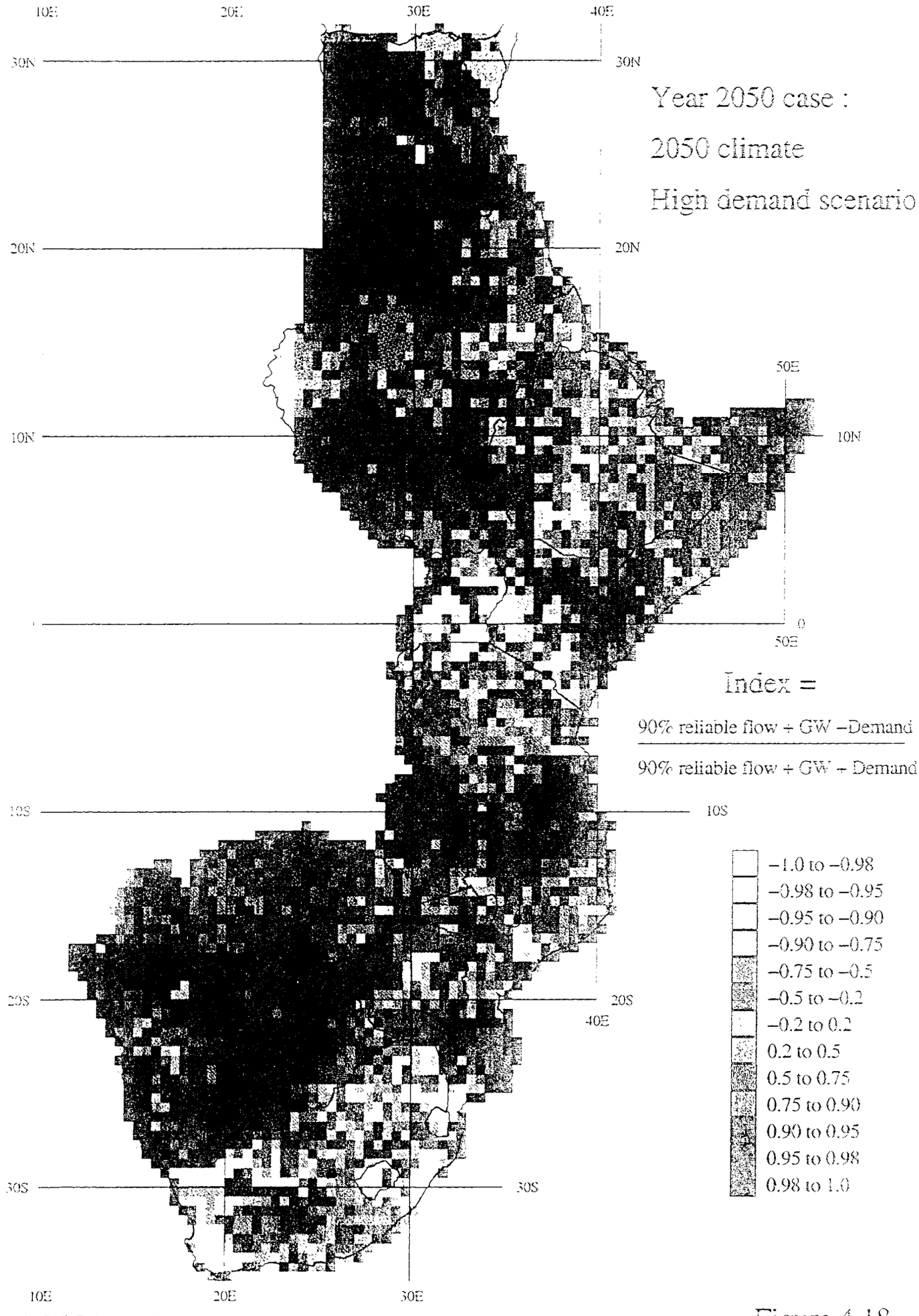
Water Availability Index (Surface Water Only)



0.5x0.5 degree data

Figure 4.16

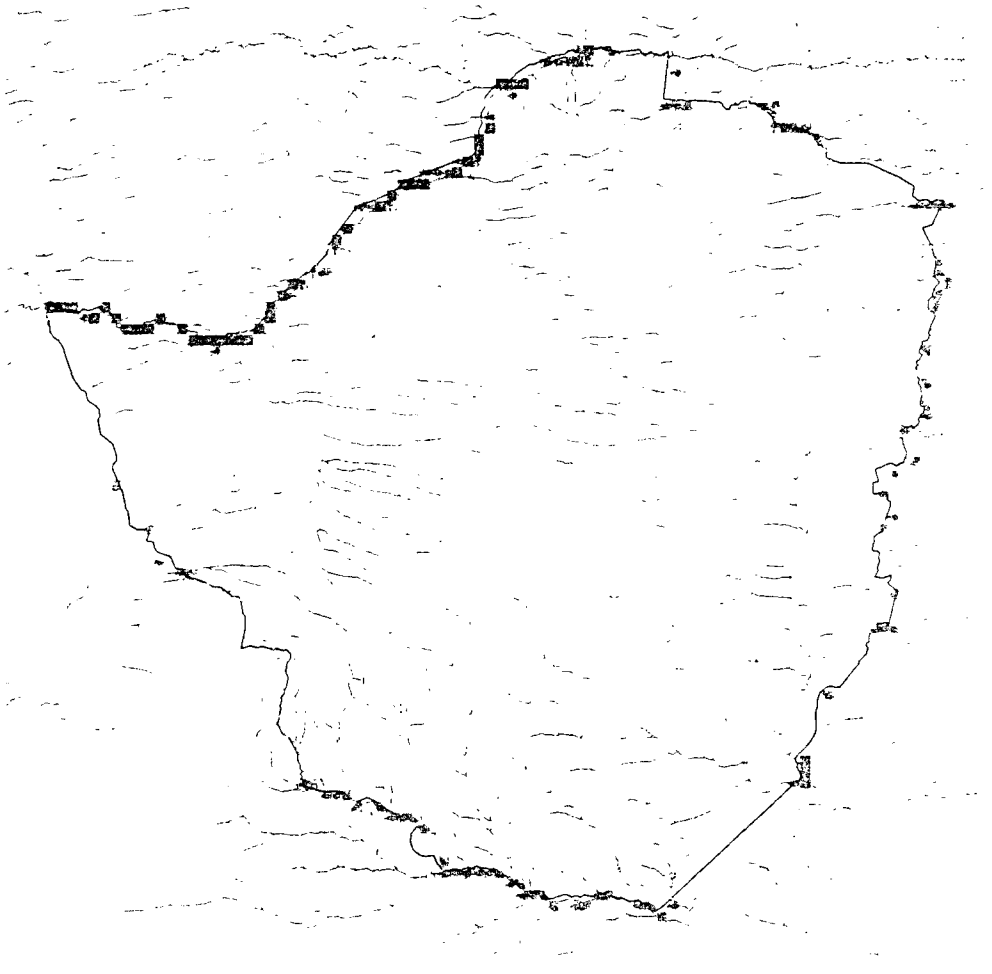
Water Availability Index (Combined Water Sources)



0.5x0.5 degree data

Figure 4.18

Transboundary Flow Accumulation and Direction into and out of Zimbabwe



RUNOFF (mm)

< 250	750 to 1000	> 2000
250 to 500	1000 to 1500	
500 to 750	1500 to 2000	

Gauging Stations in Southern Africa FRIEND

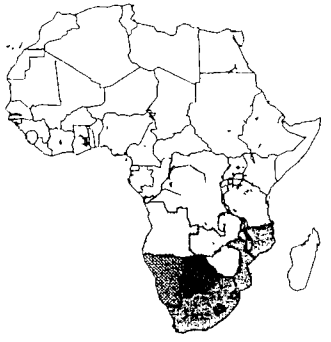
SOUTHERN AFRICA FRIEND

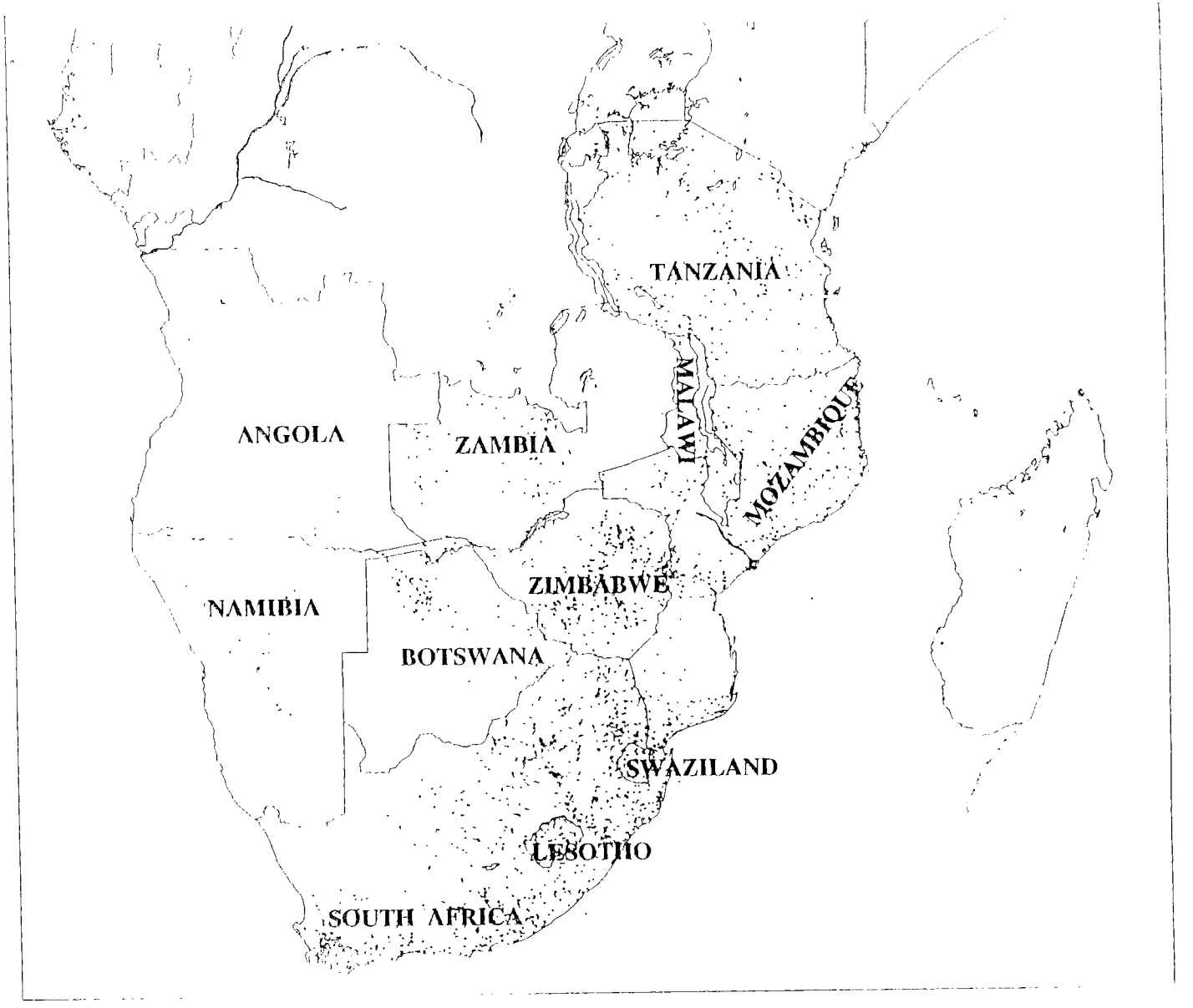
Co-ordination Centre
University of Dar-Es-Salaam
Dept. Civil Engineering
P.O. Box 35131
Dar-Es-Salaam
Tanzania

SOUTHERN AFRICA FRIEND

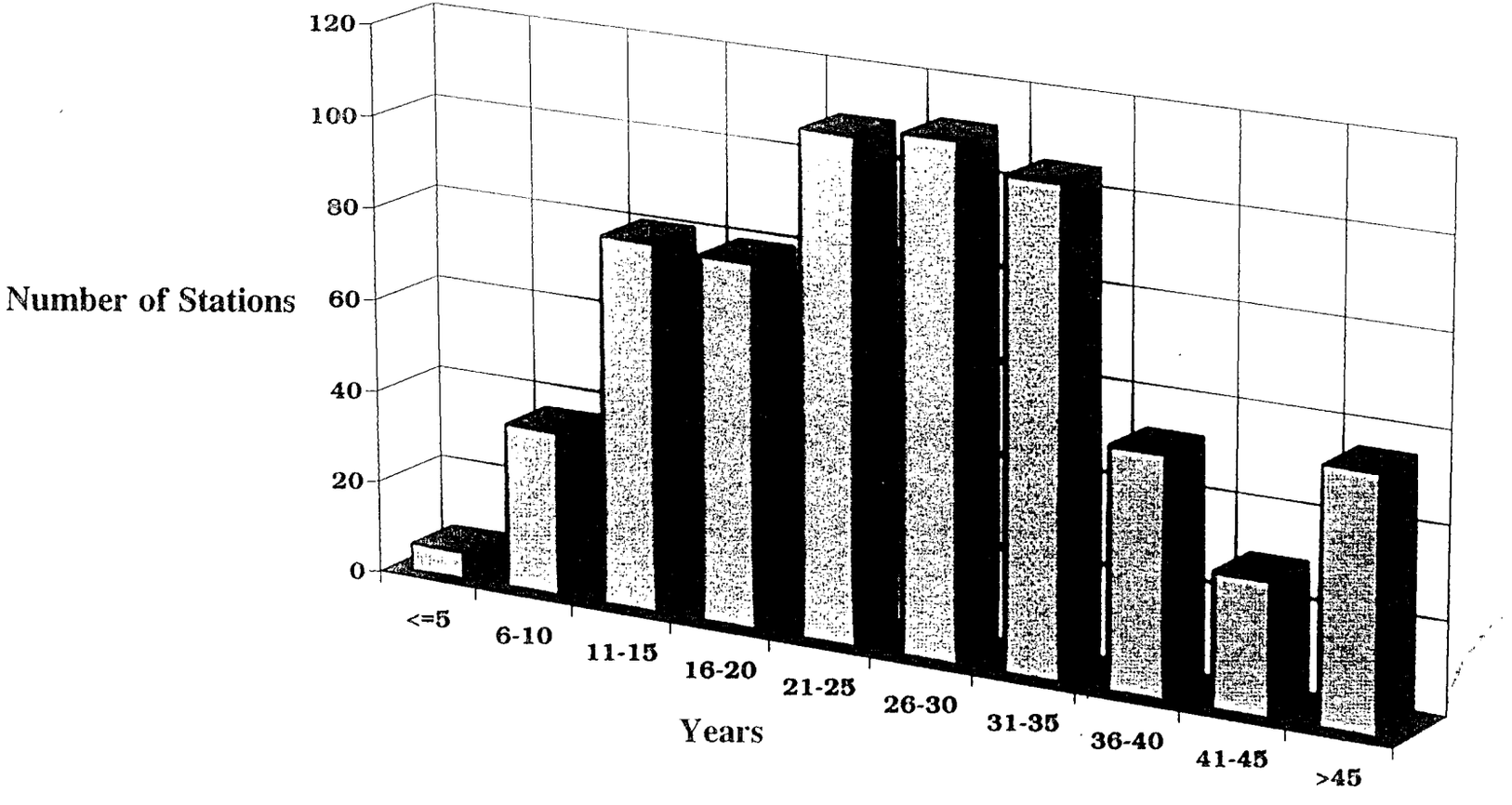
Contact:
Institute of Hydrology
Wallingford
OX10 8BB
UK

July 1994





Distribution of Record Length for Gauged Daily Flow Data



SOUTHERN AFRICAN FRIEND

Distribution of gauging stations within countries and primary river basins

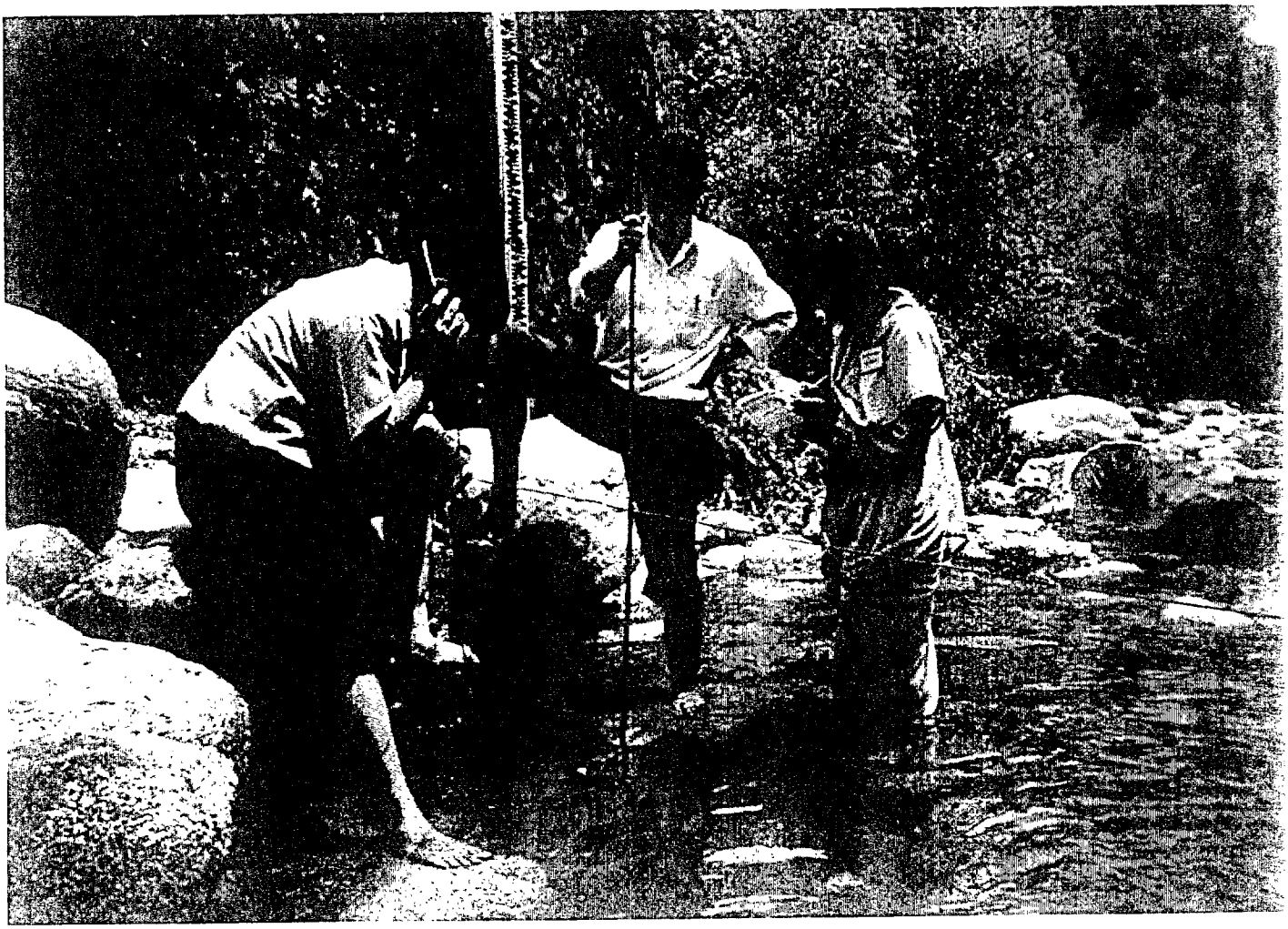
	Angola	Botswana	Lesotho	Malawi	Mozambique	Namibia	South Africa	Swaziland	Tanzania	Zambia	Zimbabwe	Total
Nile/Rift	-	-	-	-	-	-	-	-	12	-	-	12
N. Indian Ocean	-	-	-	3	2	-	-	-	53	-	-	58
Zambezi	0	0	-	34	1	1	-	-	11	19	40	106
C. Indian Ocean	-	-	-	-	4	-	-	-	-	-	29	33
Limpopo	-	14	-	-	3	-	39	-	-	-	15	71
S. Indian Ocean	-	-	-	-	6	-	184	35	-	-	-	225
Atlantic Coast	12	-	-	-	-	23	33	-	3	6	-	77
Orange	-	-	23	-	-	19	31	-	-	-	-	73
South Interior	7	10	-	-	-	3	-	-	-	-	1	21
Total	19	24	23	37	16	46	287	35	79	25	85	676

FRIEND HKH Low Flows Training

Dilution Gauging at Sundarijal

FRIEND HKH Low Flows Training

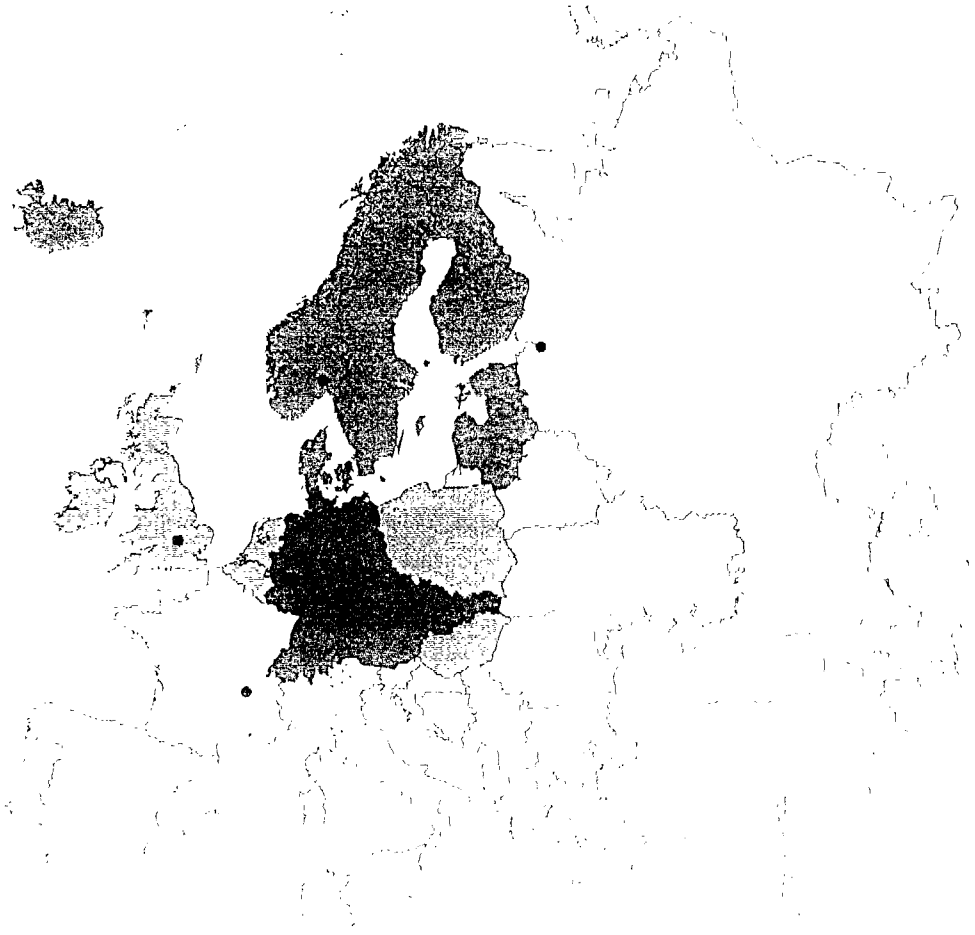
Current Metering at Sundarijal



FRIEND in the new Millenium

- User Issues
- Process understanding
- Decision support systems
- Capacity building
- User Implementation
- Review

DATA CENTRES OF THE FRIEND EUROPEAN WATER ARCHIVE



Institute of Hydrology, Wallingford
European Water Archive Coordination Centre
Belgium, Hungary, Ireland, The Netherlands.
Poland, United Kingdom

Federal Institute of Hydrology, Koblenz
Austria, Czech Republic, Germany, Slovakia,
Switzerland

Norwegian Energy Administration, Oslo
Denmark, Estonia, The Faroes, Finland, Iceland
Latvia, Lithuania, Norway, Sweden

State Hydrological Institute, St. Petersburg
Belarus, Russia, Ukraine

CEMAGREF, Lyon
France and countries exclusive to AMHY

Institute of Hydrology

friend

CONDITIONS FOR ACCESS TO FRIEND DATA

- Free access to FRIEND participants
- Use restricted to FRIEND research
- New participants must submit proposals to project co-ordinator
- Written approval required from data provider for use outside FRIEND project

THE FRIEND METADATA CATALOGUE

FRIEND EUROPEAN WATER ARCHIVE

GAUGING STATION INVENTORY - JANUARY 1998

Country	FID	River	Site	LAT	LNG	Area km2	Alt m	Runoff mm	GDF from	GDF to	Nyrs
AUSTRIA	410001	BRAUNAU	HOHENEICH	48.78	15.03	291.5		240	1951	1994	44
	416006	LAINSITZ	EHRENDORF	48.76	14.96	267.6	482	256	1971	1994	24
	501016	OBERSULZBACH	SULZAU	47.23	12.25	80.7	882	1782	1961	1994	34
	501017	LAMMER	OBERGAEU	47.58	13.18	399.5		1416	1951	1994	44
	501018	TORRENERBACH	TORREN	47.59	13.16	70.8		1492	1961	1994	34
	501019	GLANBACH	MOOS	47.76	13.00	26.5		1321	1951	1994	44
	501020	LOFERBACH	LOFER	47.59	12.69	117.3		1347	1961	1994	34
	501021	MOOSACHE	ASG SALZBURG	47.99	12.88	89.5		381	1951	1994	44
	501022	BERNDORFER BAC	NECKREITH	48.01	13.10	12.4		661	1966	1986	21
	501023	WALDZELLER ACH	WALDZELL	48.13	13.42	23.5		711	1971	1994	24
	501024	ANTIESEN	HAGING	48.27	13.45	164.9	379	513	1951	1994	44
	501025	SAALACH	VIEHHOFEN	47.37	12.74	150.8	847	1096	1961	1994	34

Institute of Hydrology

friend

ARC/INFO COMPONENTS

- Digitised catchment boundaries for over 2,500 gauging stations
- Hydrometric region and area boundaries
- A soils map of the European Communities
- Gridded maps of land-use, rainfall, and potential evaporation
- Rivers, coastlines and national boundaries for European Countries

OPPORTUNITIES FOR COOPERATION BETWEEN GEWEX AND FRIEND

- Improved understanding of the two research programmes

- Further exchange of time-series and spatial data between FRIEND and the GRDC

- Cooperative interpretation of catchment model results and model development

- Further development and testing of techniques for estimating regional water resources using grid scale modelling

- Development of joint GEWEX/FRIEND projects

IMPLEMENTATION OF GEWEX/FRIEND COOPERATION

- FRIEND Inter Group Coordination Committee (FIGCC)

- Through the regional FRIEND groups

- Individual coordinators of research projects

Annex 9

Resolution 25 (Cg-XIII)

W O R L D M E T E O R O L O G I C A L O R G A N I Z A T I O N

Thirteenth WMO Congress, Geneva, May 1999

RESOLUTION 25 (Cg-XIII)

EXCHANGE OF HYDROLOGICAL DATA AND PRODUCTS

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 Technical Regulation [D.1.1] 8.3.1(*k*), states that, in general, the routine functions of NHSs should include, *inter alia*, "making the 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,

(4) That the nineteenth Special Session of the United Nations General Assembly agreed, in its overall review and appraisal of the implementation of Agenda 21, that there is an urgent need to "...foster regional and international cooperation for information dissemination and exchange through cooperative approaches among United Nations institutions, ..." (A/RES/S-19/2, paragraph 34(*f*)),

(5) That the fifty-first session of the United Nations General Assembly adopted, by resolution 51/229, the Convention on the Law of the Non-navigational Uses of International Watercourses, Article 9 of which provides for "regular exchange of data and information",

(6) 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 International Conference on Water and the Environment (ICWE) (Dublin, 1992) to extending the knowledge base on 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)(Rio de Janeiro, 1992) for a significant strengthening of, and capacity building in, water resources assessment, for increasing global commitment to exchange scientific data and analyses and for promoting access to strengthened systematic observations,

(3) That the United Nations Commission on Sustainable Development (CSD) in its Decision 6/1 "Strategic Approaches to Freshwater Management" has strongly encouraged States to promote the exchange and dissemination of water-related data and information, and has recognized "the need for periodic assessments ... for a global picture of the state of freshwater resources and potential problems",

(4) The call by the nineteenth Special Session of the United Nations General Assembly "for the highest priority to be given to the serious freshwater problems facing many regions, especially in the developing world" and the "urgent need ... to strengthen the capability of Governments and international institutions to collect and manage information ... and environmental data, in order to facilitate the integrated assessment and management of water resources",

(5) The requirements for full, open and prompt exchange of hydrological data and products in support of various international conventions, such as the Convention on Biological Diversity, the United Nations Framework Convention on Climate Change, and the Convention to Combat Desertification,

(6) The requirement for the global exchange of hydrological information in support of scientific investigations of world importance such as those on global change and the global hydrological cycle, and as a contribution to relevant programmes and projects of WMO, other United Nations agencies, ICSU and other organizations of equivalent status,

(7) 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,

(8) The increasing recognition through scientific and technical endeavours, such as GEWEX, of the importance of hydrological data and products in improving the understanding of meteorological processes and subsequently the accuracy of meteorological products,

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 potential benefits of enhanced exchange of hydrological data and information within shared river basins and aquifers, based on agreements between the Members concerned,

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

(4) 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,

(5) The right of Governments also to choose the extent to which they make available internationally data which are vital to national defense and security. Nevertheless, Members shall cooperate in good faith with other Members with a view to providing as much data as possible under the circumstances,

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

(7) 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[1] international exchange[2] of hydrological data and products, in consonance with the requirements for WMO's scientific and technical programmes;

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 and products which are necessary for the provision of services in support of the protection of life and property and for the well-being of all peoples;

(2) Members should also provide additional hydrological data and products, where available, which are required to sustain programmes and projects of WMO, other United Nations agencies, ICSU and other organizations of equivalent status, 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 countries;

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

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

(5) Members should make known to all Members, through the WMO Secretariat, those hydrological data and products which have such conditions as in (4) above;

(6) 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;

(7) Members shall ensure that the exchange of hydrological data and products under this resolution is consistent with the application of 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;

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 (7);

---

1 "Free and unrestricted" means non-discriminatory and without charge. "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 "Exchange", in the context of this resolution, means the movement of data and products between countries or, as is more likely the case in the field of hydrology, the movement of data and products from one country to another.

3 "Re-export", in the context of this resolution, means 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

(2) Assist other Members, to the extent possible, and as agreed upon, in developing their capacity to implement the practice described in FURTHER ADOPTS (1) to (7);

REQUESTS the Executive Council to:

(1) Invite the Commission for Hydrology 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.

Annex 10

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

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), specifically the WMO Commission of Hydrology (Chy) on the advice of the International Steering Committee and in cooperation with organizations such as UNESCO, UNEP, WHO and ICSU. This Guideline regulates the acquisition and dissemination of hydrological data and costing of services in the Global Runoff Data Centre under the Terms of Reference stipulated during the First Session of the Steering Committee of the GRDC and the decisions of WMO at its Twelfth and Thirteenth Congress in 1995 and 1999 respectively.

The Guideline does not infringe on the ownership rights on the 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.

At its Twelfth Congress in 1995, 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." At Thirteenth Congress, WMO adopted Resolution 25 (Cg-XIII) and thus extended this commitment to cover hydrological data and products. With regard to the Global Runoff Data Centre, Congress also adopted Resolution 21 (Cg-XII) which encourages Members "to support the GRDC through the provision of the hydrological data and related information that it needs". Thirteenth Congress retained this resolution in force, thereby maintaining its call to Members to support the Centre.

Through its Resolution 25 (Cg-XIII), WMO Congress adopted the practice that countries that Members should provide to the research and education communities, for their non-commercial activities, free and unrestricted access to all hydrological data and products exchanged under the auspices of WMO with the understanding that the commercial use of these data may be subject to conditions.

1. Principles of data acquisition and access

1.1 The GRDC operates under the principles laid down in Resolution 25 (Cg-XIII) of WMO Congress with the aim of encouraging the widespread use of the data for national, regional and global studies.

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

1.3 When requested by a contributing agency, the GRDC also accepts and stores restricted data. In such cases, the agency concerned specifies the relevant restrictions and the GRDC flags the restricted data and uses them under the conditions specified by the contributing agency.

2. Dissemination of GRDC-Data

2.1 GRDC data are available to users under the principles laid down in Resolution 25 (Cg-XIII) and following the practice specified in 2.2. to 2.6 below.

2.2 Requests for data should 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 (proforma in annex 2).

2.4 GRDC data shall not be used for commercial purposes without the prior consent of the national hydrological service(s) and/or other contributors of the 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 national hydrological service(s) supplying the data about the use to which their data have been put and will transfer the name and address of the data user to the hydrological service(s) 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 will be referred to the WMO-Secretariat so that advice may be sought by Chy.

3. Cost of services

3.1 Information about the GRDC, including the yearly status reports and the database contents (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 staff time being based on a per hour rate which in June 1995 was set at DM 75,--.

3.5 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 is cost and incorporated in the MoU.

3.6 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 1995) :	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 1995) :	DM 375,--

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

3.7 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: 1207/11902 GRDC

Cheques sent by registered mail are also acceptable.

4. Disclaimer

4.1 While the GRDC makes every effort to eliminate errors from the data base, there are errors in the data unknown to the GRDC. Neither the GRDC nor the institutions providing the data, nor any of the institutions/agencies associated with the Centre can be held responsible for the consequences of the use of GRDC data, error free or otherwise.

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, 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) Rational 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 responsible for the use of the data provided by the GRDC and 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 national hydrological service(s) and/or other data contributors.

3. The dataset will be not accessible to unauthorized persons and after completion of the specified studies, the dataset will be kept seperate 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 are errors in the data unknown to the GRDC. Neither the GRDC nor the institutions providing the data, nor any of the institutions/agencies associated with the Centre can be held responsible for the consequences of the use of GRDC data, error free or otherwise.

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

Place and date :_____

Signature :_____

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 catalogs and yearly status reports
- Database queries and response to data requests
- Compilation of project/programme related sub - databases
- Production of tables and graphs to illustrate and enhance the understanding of the content of the database
- Monitoring of global/regional runoff on a comparative basis
- Production of reports in the GRDC - Report series on global/regional hydrological issues on demand from 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.

An example for specialized services would be the detailed statistical analysis of regional time-series for specific studies.

Annex 11

Summary of the presentation of Mrs. Dornblut

Modelling the Balance of Water Availability, Supply and Demand in Large Basins : a case study for the Danube River

Irina Dornblut / Federal Institute of Hydrology, Global Runoff Data Centre

1. Background

Global climate change and increasing population form the background for water scarcity and impairment of quality of available water resources by their extensive use. The latter impact could be mitigated by a consequent water allocation based on the analysis of water availability concerning quantity and quality of water, water management systems and priorities for water demands in river basins.

Water balances and long term water management models which balance water supply and water demand in a drainage basin are necessary tools for that purpose. Based on the analysis of the hydrological and the water management system information to water availability and water supply be derived. Long term water management models are complex models. They require an adequate simulation of the hydrological and water management system including the anthropogene influence as well as the detailed representation of water use and definition of water demand on the system by competing requirements.

The GRDC-database collects runoff data from more then 3800 gauging stations all over the world. This is a unique starting point to compute the balance between water availability, supply and demand in major river basins.

2. Objective

Main objective of the study is the methodical set up for the modeling of the balance of water supply and water demand for large river basins in different climatic zones of the world. The simulation of the hydrological and water management system of large river basins in the various climatic zones is the basis for computing different versions of water management scenarios. In addition approaches for defining water demands will be derived.

GRDC will use water management models for modeling the balance of water availability, demand and consumption in large river basins for rapid assessments of the criticality of river basins with respect to water scarcity. Such a model aims to identify and periodically review potential conflict situations in selected river basins and demonstrate the effects of different management rules on the water body. On the basis of the balance of available water resources, water demand and consumption probabilities of water availability and water supply for different water user sectors will be computed in a monthly time step for different planning horizons.

For modeling the balance of water supply and water demand in large basins the program system ArcGRM (WASY GmbH Berlin) will be used. This program system up to now is used for water management balances in small and medium size river basins as for instance for the river Elbe, Saale and for water management of the Federal Waterways of Germany. In a pilot study the data requirements and the algorithms of this program system are being tested in the Danube basin and adapted and refined for their practicability in large river basins.

3. Main Characteristics of the program system ArcGRM

ArcGRM is a long term water management model which analyzes the reaction of the water management system in a river basin under changing conditions based on the information of the river basin (i.e. river topology) and the hydrological and water management processes by simulating the hydrological versus the water management system as well as water demand.

The core of ArcGRM is the long term water management model GRM which is based on a stochastic simulation of river discharge and the deterministic reproduction of the anthropogene influences on the river system. Modeling will be supported by the functions of the ArcVIEW GIS. Model data are stored in an internal database.

The program system is based on Monte-Carlo-Simulation method and allows the modeling of water management processes in a river basin on a monthly time step for long time periods. Parallel to the model computations, the program system registers all changes of the model parameter and stores them for recursive balance calculations and statistics (see below).

Model input is the monthly observed discharge of selected gauging stations or of interbasins between two or more stations which can be supplemented by meteorological data. The model requires long time series of hydrological (meteorological data are optional to improve the simulation accuracy of the model), which were corrected for i.e. large abstraction or impoundment schemes. Because time series of observed discharge are inhomogeneous and corresponding time series are usually not available, the stochastic generation of long time series with respect to chronological correlation is recommended. The stochastic simulation of available water resources is not part of the management model itself, but is a preparatory step in advance of the modeling of the water management balance.

For statistical analysis and time series generation, the program SIKO/SIMO by WASY GmbH Berlin is used. Following the stochastic characteristics of hydrological and meteorological processes the available water resources are simulated as periodically unsteady Markov-process which is determined by the chosen conditional distribution function. The simulation model consists of a multidimensional auto-regression model based on auto- and cross-correlation and a transformation model based on the chosen distribution functions.

The stochastic simulation of available water resources is the base for the deterministic simulation of water use and water demand. Simulation of water management and use is based on the division of the river basin into interbasins. To every interbasin, a spatially weighted portion of the simulated available water resources is allocated. By the way of summation of the interbasin discharge in flow direction, the discharge at selected gauging stations in the river system is computed. Reservoirs, water diversions and abstractions, water users and water requirements are related to these balancing profiles with their volume or quantity. Rules for reservoir management and water requirements of different water users such as potable water supply, irrigation, navigation, power generation and ecology are deterministically defined from available information. The spatial structure of the river basin is visualized in an abstract scheme relating to river basin geography.

Using a recursive calculation algorithm, the model calculates the balance between water availability, demand and use to optimize the simulation at the balance cross sections (=

location of selected gauging stations). As a result of the simulation, the monthly balance of water supply and water demand is checked against water requirements, gives preferences and considers reservoir management. Water from the reservoir is taken as much as required by the model, un-used water will be given back into the reservoir with regard to the water requirements downstream. Consequently, some water requirements may not be satisfied at all times. The registration of this state and the consequences are then the basis of comparison of varying management scenarios.

A special feature of ArcGRM are the so-called „Dynamic elements", which complement the standard algorithms of the program system by individual FORTRAN algorithms. They allow the integration of additional processes in the river basin complementary to standard algorithms such as: operational weir regulation, special management rules for reservoirs and waterways in extreme situations, inclusion of additional input data like evaporation, water quality, conversion of model input or output, definition of water diversion rules, or internal tests of model parameters.

Result of balancing water supply and water demand with ArcGRM are probability distributions of storage capacity, deficits of water supply and maintenance of minimum allowable discharge, frequency distributions of events with defined frequency-duration and minimum and maximum of computed monthly discharge at optional balancing profiles in the river as well. By comparative analysis of system variants (water availability and management scenarios) consequences of changing management rules on the availability of water as well as sector-specific water demand and supply can be analyzed.

4. Characteristics of large river basins with regard to water management options

For large river basins available information varies largely in both: quantity and quality. This applies to hydrological and meteorological data and the information of anthropogene influences on the hydrological system as well as water management systems.

The modeling of water availability versus water management as a balance in large basins requires a generalization in the structure of the model and constrains a reduction of model depth referring to the simulation of the hydrological and water management system. Availability of data and the size of the analyzed basin are restricting factors in model formulation. Nevertheless, the flow regime of a river system determined by varying climatic and runoff conditions and human influences should be reflected in the water management model.

Model input are time series of discharge without gaps for a common time period as observed discharge corrected for water uses. These time series are simulated by climatic water balance, deterministically simulated discharge or stochastically generated time series. In large basins the density of gauging stations varies largely and the time series of observed discharge are often not corresponding. A correction of observed time series for water use mostly is not possible because of unavailability of suitable collateral information.That is why the compilation of a set of representative time series as basis for the simulation of available water resources is difficult and the simulation in most cases will be based on the uncorrected time series of observed discharge in the main stream and the significant tributaries which in fact represents a status-quo for further simulations. To reflect varying characteristics of the ideal

natural flow regime, time series of precipitation or evaporation for different climatic regions can optionally be included prior to the simulation.

The applicability of the preferred distribution function for the stochastic generation of time series to the simulation of available water resources in other climatic regions has to be validated. For the river Danube as pilot region the model of the conditional distribution function is applicable.

The division of large basins into interbasins aims to reflect the natural structure of the basin and the river system, but is based on pragmatic consideration with respect to the quality and availability of data. Monthly balance of water supply and water demand requires the consideration of flow times in the river system at the balance cross section. Flow times longer than a month have to be considered already during the generation steps of time series for water balance simulations.

Following the stochastic simulation of river discharge based on the uncorrected time series of observed discharge, the deterministic reproduction of water use transfers all existing management rules of the observation period into the simulation. Therefore a status quo is simulated and in the water management balance only modifications of water uses or water demands are included.

The water management system consists of reservoirs and diversions from or into the river basin. In many large river basins reservoirs alter the natural flow regime. An overview of the location, size and purpose of reservoirs of the world is included in the World Register of Large Dams of the International Commission on Large Dams (ICOLD). For modeling reservoir management in river basins this basic information is complemented by reservoir management rules, where these are available. Available data of water diversions complete the model.

For the balance of water supply and water demand in large basins the reproduction of water use and water demand is simulated only for large schemes, where amounts of water storage, diversion, losses or inter-basin transfers are known from available sources or can be estimated from different sources of information. Inland navigation, recreation and ecology make demands for minimum discharge. If actual data are not available the water requirements could be estimated from published statistical data.

5. Modeling the water management balance for the river Danube as pilot study

The practicability of the program system described above for large basins will be tested for the 800.000 km² basin of the river Danube. The Danube is the 21 largest river of the world in terms of discharge.

The Danube basin was selected because for the Danube river the data base is comparatively good. The number of gauging stations with data in the GRDC database is sufficient for model purposes. With gaps in the time series with 60 years duration filled by regressive methods, 13 gauging stations at the main stem and 5 stations on major tributaries were compiled as base of the stochastic simulation of the hydrological system. In addition, the existing methodological basis of the stochastic generation of time series under the climatic conditions of Central

Europe could be applied. Flow times longer then a month for the 2800 km long Danube are not to considered. The correction of observed time series for the influence of water use, storage and losses was not carried out. Therefore, the simulation of the hydrological and water management system represents the present state of the discharge regime as reference against further future changes in water resources management in the Danube basin.

Reproduction of the water management system and water use schemes is essentially based on information published by the 'Conferences of the Danube Countries for Hydrological Forecasting and Hydrological Bases of Water Management' and an intensive literature review. Only for the reservoir Djerdap I/II reservoir management rules are defined and incorporated in the model in a generalized way. Minimum allowable discharge is determined by minimum allowable discharge necessary for inland navigation.

The water management model for balancing water supply and water demand for the Danube river as pilot study is in the building phase now. Final results will be available by the end of 1999. Up to now, the statistical analyses of observed runoff, stochastic generation of time series and the reproduction of water use in the basin have been completed. These steps required most of the time for the final development of the model. The generated time series and water management schemes will be included into the water management model as the next step of modeling. First results of model testing are still available not before September 1999.

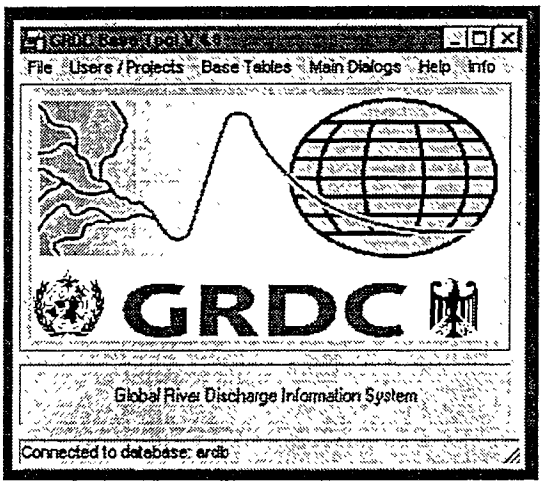
Annex 12

Summary of the presentation of Mr. Pauler

THE GRDC DATABASE MIGRATION PROCESS 98-99

Status: June 1999

Johannes Pauler



REASONS TO MIGRATE

In early 1997 the GRDC Database changed from a single-user to a multi-user system, where the Data Base System (DBS) still resided on a UNIX server, while the clients based on WINDOWS 3.11 using a proprietary library provided by INFORMIX to manage the database access. This lead to many problems, especially because of the 640-KB lower RAM limitation of MS-DOS. Therefore the GRDC started planning for migration towards a new Operating System in late 1997.

At that time the company IABG was engaged to report the present situation and to show a way to solve the present and forthcoming tasks in the GRDC. The main points in this report, published in January 1998, were:

- Migration of the server's OS to WINDOWS NT Server for a better integration into the Local Area Network of the FIH
- Update of the DBS to INFORMIX Dynamic Server 7 for better data and user management especially in the view of the forthcoming opening of the database to the Intranet and Internet
- Changes in the database and tables design needed only to be made to manage additional information (meta data) and user access
- Tools accessing the database directly should be written by using standard application programming interfaces for easier updates in future and the linkage to standard software like Excel or ArcView.
- The tools need to be more user-friendly and less time consuming

Because of budget constraints, all works with regard to the migration and re-engineering of the GRDC database system had to be handled by the GRDC staff in addition to all common tasks

THE MIGRATION CONCEPT

In February 1998 the GRDC started the concept phase.

Database and Table Design

It was agreed that only small changes should be made in the existing database and table design. Main points were

- the fixing of data type inconsistency (fields of the same information were of different type in the different tables),
- providing referential integrity by using foreign keys in information depending tables
- deleting fields where the GRDC won't be able to receive information for,
- adding fields for additional information,
- re-defining the meaning of information (e.g. the accuracy of measurement became a classification of the condition of the time series the GRDC holds).

Additional tables were designed for providing yearly and long-term mean monthly extreme discharges, information about dams and reservoirs. For the user and project management a seperate database was designed.

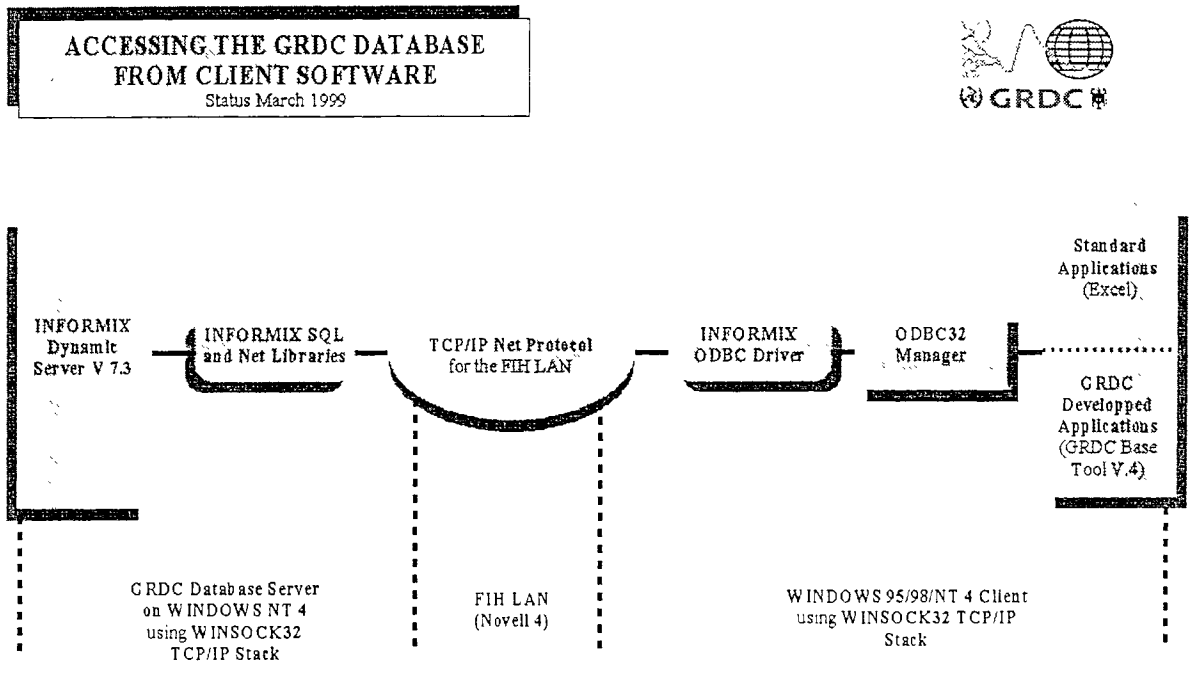
Software Design

At the state of 1997 the GRDC used four software tools directly accessing the database:

- The GRDC Base Tool V 2 to query the database for standard tasks
- The GRDC Plausibility Tool V 1 for checking the stored discharges
- The GRDC Monitoring Tool V 1 to visualize the GRDC data in a grid map

- The GRDC Import Interface (UNIX based version)

Due to changes in the database design, table design, and the changed net drivers it became necessary to develop these tools new. The GRDC decided that the tasks solved with the aid of the GRDC Monitoring Tool should be realized now by using standard GIS software (ArcInfo and ArcView) because of more flexibility and therefore a better adaptation to the problems. It was decided, too, that in a first step only the GRDC Base Tool and a new Import Interface should be realized. For the GRDC Plausibility Tool a new concept should be worked out in 1999 to make the software more user friendly, efficient and flexible.



To support the database access from standard software the usage of ODBC (a quasi standard in the WINDOWS world) was supported. Meanwhile this interface can be used in Java, too.

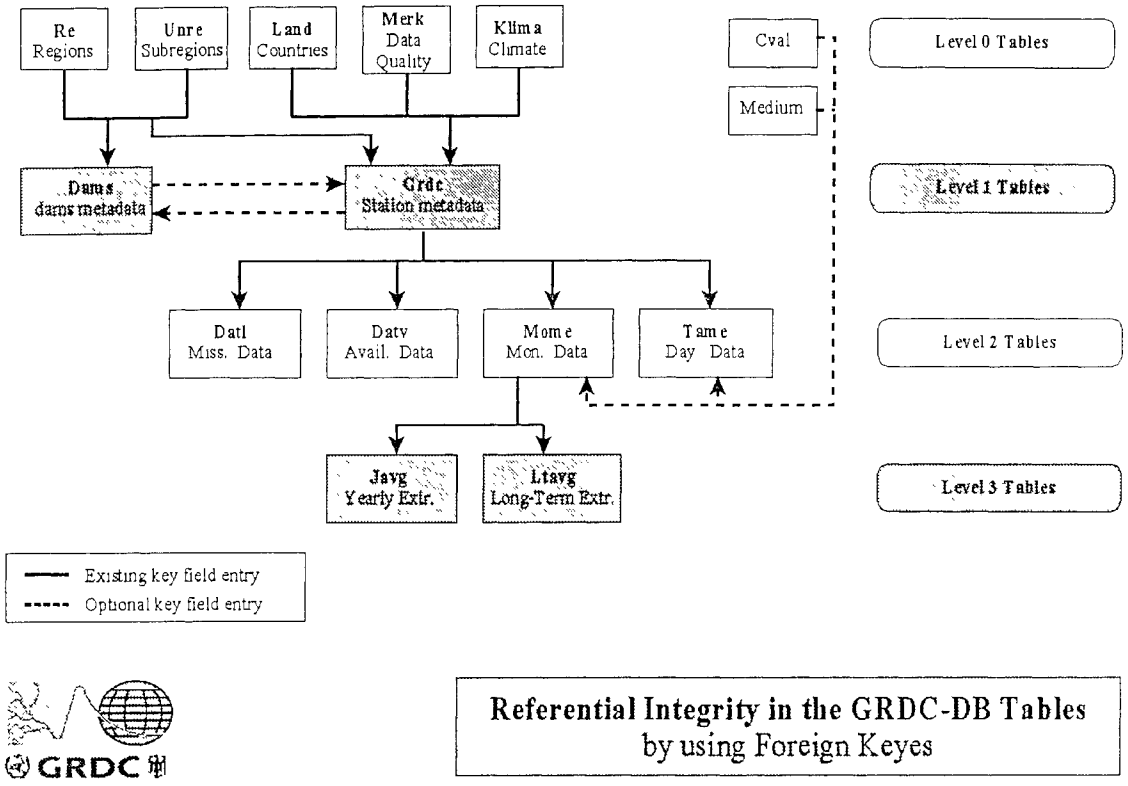
As development environment the decision fell on Borland Delphi 4.0 for WINDOWS applications and IBM VisualAge for Java 2.0 for Intranet/Internet. Both are so called Rapid Application Development (RAD) environments, and work on the base of highly efficient components

The concept phase finished in June 1998 and again was discussed and accepted by the head of the IT division of the FIH.

DATABASE MIGRATION

The server's hard- and software was ready installed in August 1998. The server was configured using only the TCP/IP protocol to prevent the FIH's LAN from high networking traffic. By this time programs needed to be written to migrate the content of the former GRDC database (GRDCDB) and ACSYS database (ARDB) to the new database system. At the same

time it was recognized that the tools provided by INFORMIX for database administration were not that satisfactory to GRDC tasks, especially for database backups. Therefore new tools needed to be developed for these tasks, too. The GRDC took this occasion to check the data consistency and referential integrity in both the GRDCDB and ARDB.



In late September the new system was configured and a first (rather rough) release of the GRDC Base Tool V 3.0 was ready to phase out the old system.

THE USER AND PROJECT MANAGEMENT

The User and Project database (UPDB) was implemented during October and early November 1998. Even though the INFORMIX DBS allows user access controlling even down to table field the GRDC need to develop a solution of its own. This is because standard user control is only available for data browsing, deleting, editing and inserting. The GRDC additionally needs to manage the export of data to a text file. Another task of the UPDB is the management of projects in the way that a certain user may only have view on a subset of the database content (= project), or one user may have different access rights on different projects.

The solution the GRDC found was the use of four tables encapsulated in a seperate database. These tables are:

- dbuser: managing the user-id, username, and a description of the user
- projects: managing the project-id, project name, database location, and the database alias
- zugriff: managing the user access rights for each user on the different projects
- projstat: managing the station-id according to the different projects

These UPDB features are only available in software packages developed by the GRDC. Therefore standard user control is configured for database access from standard software. The

UPDB is not visible or accessible to common users; it works in a background mode. Its implementation in the GRDC's software tools is discussed later in the GRDC Base Tool chapter.

EXTREME DISCHARGE DATA

The GRDC now provides extreme discharge data directly from the database. The reason of this feature is first the use of data for checking new data imports, second to provide data for free download when opening the GRDC in the Internet.
There exist two forms of extremes that are available: yearly extremes and long term mean monthly extremes. These values are stored in two different tables. Both are calculated by the GRDC using the mean monthly discharges under the following limitations:

- yearly extremes: there must be a minimum of 10 values available
- long term mean monthly extremes: there must be a minimum of 5 years available

The extremes are of three values: the minimum, the maximum and the mean. For the minimum and maximum additionally the affected date of occurrence is stored.

PLANNED DEFINITION OF A DATA QUALITY CODE

Because the GRDC itself will hardly be able to estimate the quality of the incoming discharge data, it planned to define a quality code depending on the available time series. The following categories are on discussion:

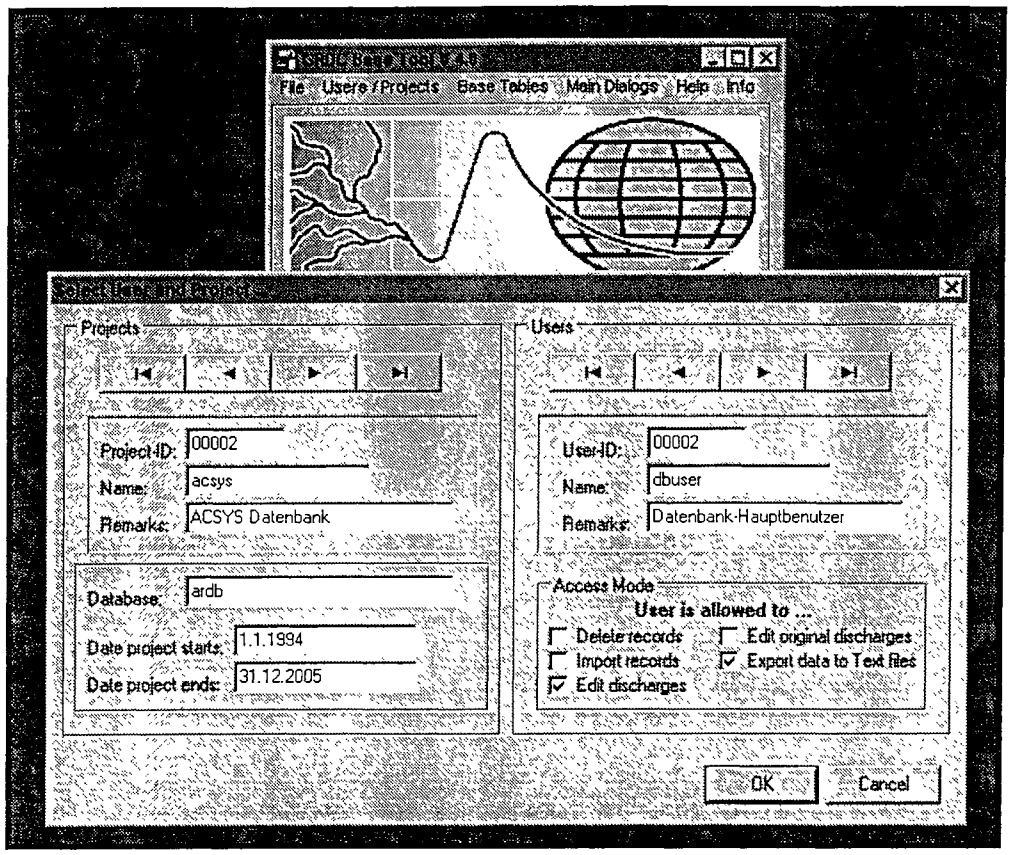
Code	Miss. Values	Monthly Series	Daily Series
0	Not processed	Not processed	Not processed
1	0 – 5 %	> 50 years	> 30 years
2	0 – 5 %	> 50 yr. (or not available)	>30 yr (or not available)
3	0 –5 %	> 20 yr. (or not available)	>10 yr. (or not available)
4	5 – 10 %	> 50 yr. (or not available)	> 30 yr. (or not available)
5	5 – 10 %	> 20 yr. (or not available)	>10 yr. (or not available)
6	0 – 5 %	> 10 yr. (or not available)	> 5 yr. (or not available)
7	0 – 5 %	< 10 yr. (or not available)	< 5 yr. (or not available)
8	> 10 %	> 50 yr. (or not available)	> 30 yr. (or not available)
9	> 10 %	< 50 yr. (or not available)	< 30 yr. (or not available)

THE GRDC BASE TOOL V 3 AND 4

As mentioned above the first rough version was ready for use in late September. In January 1999 this version (V 3) was completed. On this basis a new version was developed as an information center in April within 3 weeks. The software tool was designed to give the user the most comfort in handling and information retrieval. On the other hand the data security is implemented on an acceptable high standard.

Implementation of the User and Project Management

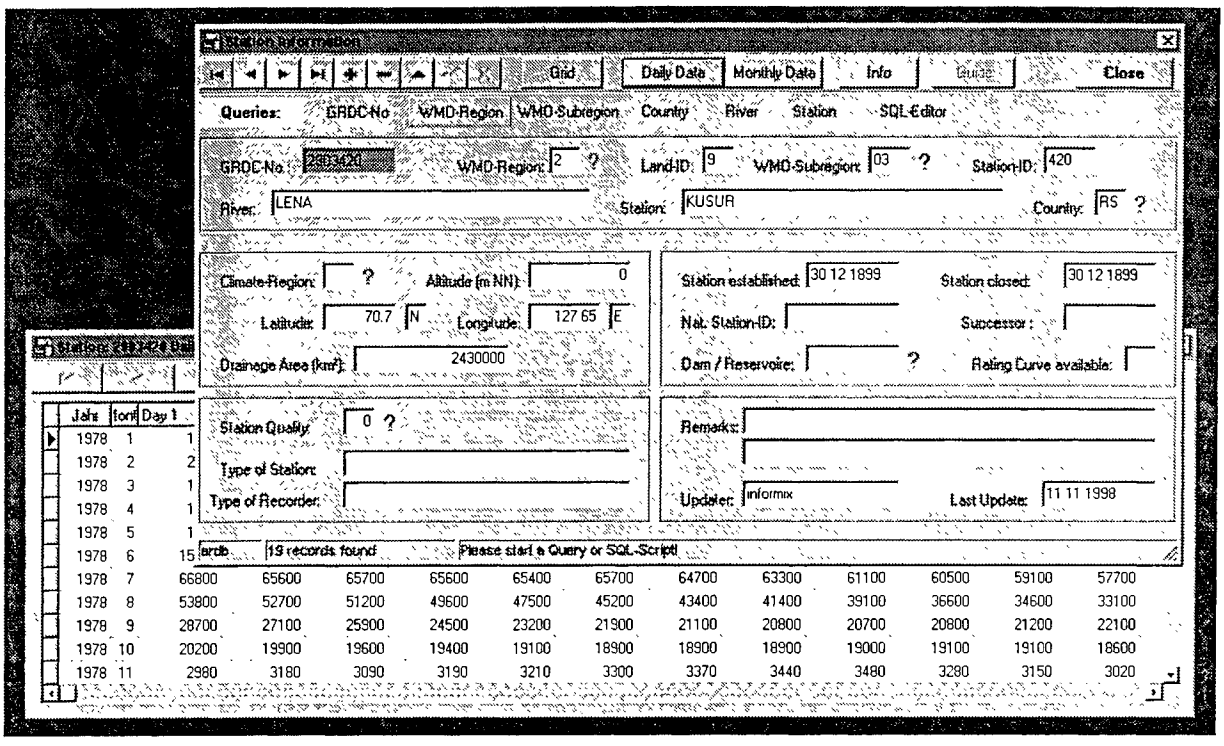
Before starting to work the user needs to select his login name and the project he wants to work with by using the Connect-Dialog. This dialog connects automatically the UPDB, the user even doesn't need to type in a password at this point. In the left box the user can select the project he likes to work with and receives the necessary information about the project. In the right box the user needs to select the database user he wants to work with, getting automatically the information about what this user is allowed to do in this project.



On clicking the OK button another dialog appears where the user has to enter his password. After successful connecting the proper database all relevant user and project information is loaded to the program. From now on each action that affects the database will be checked for granting before it is executed. In every dialog there exists a special button where the user is able to call information about what he is allowed to do.

The Dialog Station Information

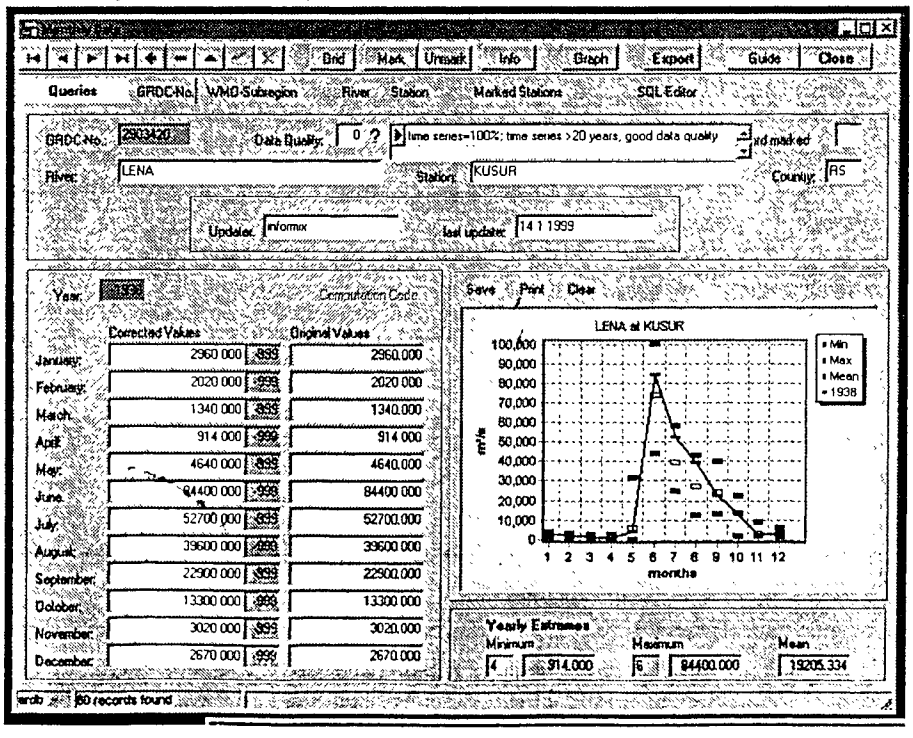
This dialog allows the user to get any meta information available for the selected station. Commonly used queries are already designed, so the user need not to define SQL scripts by himself. For complex queries a special SQL editor was designed with which the user may create, save his script or reload a for another execution.



Using the button *Daily Data* or *Monthly Data* will bring up a window containing the appropriate discharge data for the presently selected station. Within this window the user is able to export the data to a text file.
Clicking the buttons marked with a *?* will show additional information about the field left to the button.

The Dialogs Daily / Monthly Data

Functionally the dialogs for retrieving Daily or Monthly discharges work in the same way.



Here again the standard queries are embedded in the program, and for complex queries the SQL-Editor mentioned above is available.

In these dialogs it is possible to mark records for export. This allows the user to define an overlapping time series for different stations. Using the button *Unmark* will redraw these marks from the database table again.

The result of the actual query can be viewed in a tabled form by using the button *Grid.*

As a special feature in this dialog a graphical comparison of the actual data set to the long-term mean monthly extremes (minimum, maximum and mean) is available. These graphs can be printed on a local or network printer, and saved to a WINDOWS bitmap file.

NEW DATA EXPORT FORMATS

Besides the standard export formats for daily and mean monthly discharges, which are still supported, the GRDC now has developed new formats to give the users more information, to present the information in a more friendly way, and to support the import into standard software packages like spreadsheets.

New Format for Daily / Monthly Discharges

The new export formats for daily and monthly discharges look quite similar. A fixed delimiter separates each data field (|). The Header of each data set (time series of a station) consists of two lines. In the first line are the GRDC's station-ID, the river name, and the station name. In the second line there is the GRDC's data quality code followed by its denotation. The first column of the data block is the year, the second is the month, the third is the day (daily data only) or the discharge data (monthly data), and the forth is the discharge data (daily data). The discharges are now formatted as a field of 10-character length including 3 decimals.
If the file contains the data for the header lines separate more than one station, each block of data.

Example for a monthly data export file:

```
2903420|LENA|KUSUR
1|time series=100%; time series >20 years; good data quality
1935|  1|   3130.000
1935|  2|   2480.000
1935|  3|   1400.000
1935|  4|   1310.000
1935|  5|   4720.000
1935|  6|  71100.000
1935|  7|  48400.000
1935|  8|  32500.000
1935|  9|  40500.000
1935| 10|  22600.000
1935| 11|   3690.000
1935| 12|   2980.000
1936|  1|   2910.000
1936|  2|   2130.000
:
```

Format of Mean Monthly Extreme Discharges

This is a new feature for GRDC customers. The files contain for each station the yearly extreme data and in a separate block the long-term data. Here again the delimiter | is used.

Example for an extreme data file:

```
LENA                                                    KUSUR
year|mo|Min        |mo|Max        |Mean
1935|  4|   1310.000|  6|  71100.000|  19567.500
1936|  4|   1210.000|  6|  63700.000|  16060.000
1937|  4|   1160.000|  6|  64300.000|  16607.500
1938|  4|    914.000|  6|  84400.000|  19205.334
1939|  3|   1030.000|  6|  70500.000|  14571.667
1940|  4|    429.000|  6|  64700.000|  13667.083
:

mo|year|Min        |year|Max        |Mean
01|1946|   1530.000|1991|   4198.300|   2783.033
02|1943|   1020.000|1991|   3529.200|   2136.785
03|1944|    692.000|1994|   2968.700|   1651.777
04|1940|    429.000|1994|   2730.000|   1350.187
05|1940|    563.000|1943|  32000.000|   6235.892
06|1943|  44400.000|1989|100480.000|  73917.336
07|1979|  25000.000|1978|  58100.000|  39683.484
08|1986|  12854.000|1988|  42906.000|  27339.900
09|1987|  13219.000|1935|  40500.000|  24126.018
10|1970|   2300.000|1935|  22600.000|  13771.788
11|1970|   1900.000|1965|   9360.000|   3502.048
12|1977|   1890.000|1965|   6530.000|   2927.863
```

OUTLOOK

In 1999 the GRDC plans the following activities to further extending the database system:

- Concept and realization of the upgrade of the existing GRDC Data Import Tool adding the ability to run automatic plausibility check (planned be finished by September)
- Concept of the new GRDC Plausibility Tool
- Concept and realization of a JAVA based Catalog Tool as a pendant to the Windows based tool.
- Concept of a Java based Internet tool that allows the users to query the station information stored in the GRDC database and probably download extreme data sets.
- Preparation of a new technical report that is expected to be published in 2000

LAST BUT NOT LEAST

In ist effords to assist clients of the GRDC as well as hydrological services to improve or set-up database systems the author welcomes any comments and questions about the GRDC Database System. These could be sent to:

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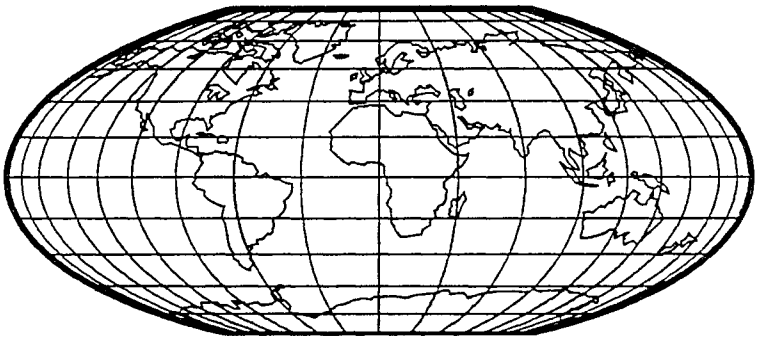
Email:	**pauler@bafg.de**

Annex 13

Summary of the presentation of Mr. de Couet

GIS - related activities at GRDC



Thomas de Couet

JUNE 1999

INTRODUCTION:

In past years GIS activities of the GRDC were confined to
visualize the stored gauging stations of the database in context to their location
in continents or in their catchment areas.
At first the GRDC was using the geographical analysis tool RAISON including
about 80 digitized catchment areas as snapshots.
With this program the GRDC was able to create thematic maps using the meta datafiles
of our catalogue datasets and compute simple statistics of discharge data using the integrated
statistic tool of RAISON

By increasing collaborating relations to other international institutes, the
GRDC had to exchange often digitized maps.
In most cases these digitized maps were vector files or gridded files created
by ARC VIEW or ARC INFO .
To avert great expense by converting ARC VIEW files to RAISON or
RAISON files to ARC VIEW the GRDC decided to work in future times with ARC View and
ARC INFO with regard to our GIS activities.

The ARC VIEW GIS is the leading software for desktop GIS and mapping
It is also going up to house standard software; so the GRDC has the possibility to exchange
our experiences with other departments of the institute.
The program provides to visualize,explore,query and analyze data geographically.
A great advantage is the compatibility with a lot of data sources and software environments.
With geographical combined techniques the user is able to research vector files or gridded
files to its relation to other objects .
One of the most advantages for the GRDC to use ARC-VIEW is the add on software tool
called SPATIAL ANALYST which includes a large number of hydrologic functions.

UNH GRDC REPORT

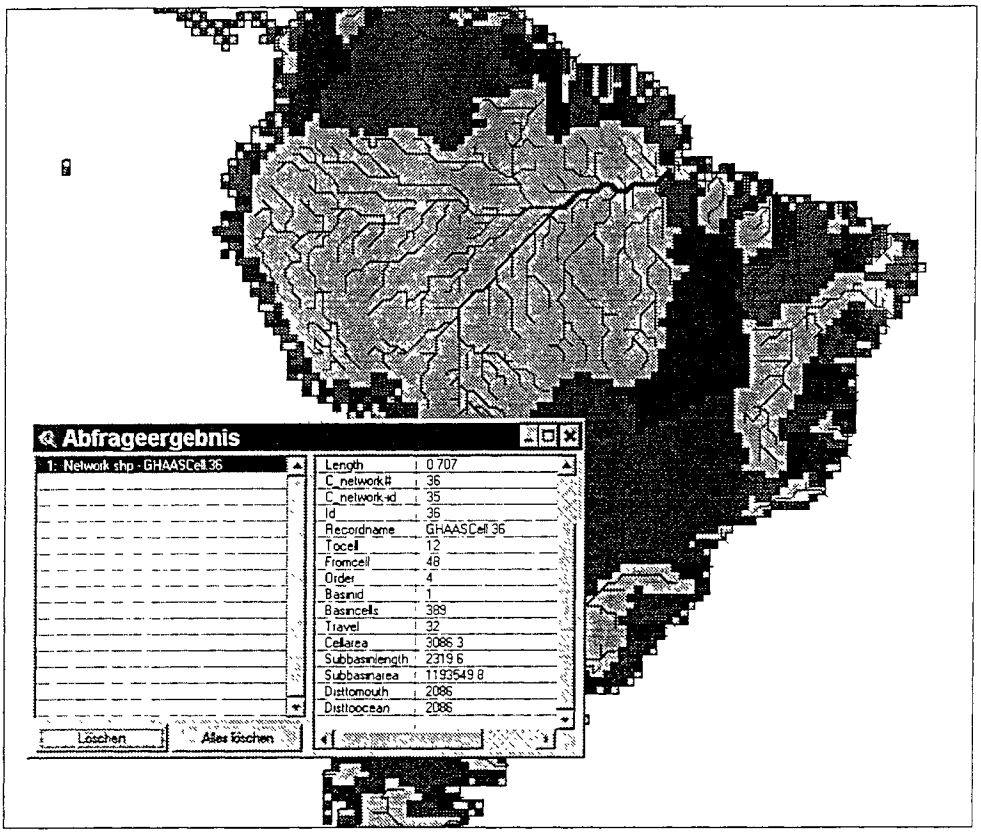
The first contact with a real GIs application was the joint report of the UNH and the GRDC
Report „Global , Composite Runoff Fields on Observed River Discharge and Simulated
Water Balances".

In this report gauging stations from the GRDC database were selected and co-registered
to a simulated topological network(STN-30p,[simulated topological network at 30 minutes
spatial resolution]).
Inter station regions between the gauging stations were identified and the corresponded
discharge and runoff were calculated to compare observed runoff with outputs from a
Water balance model simulation.
By calculating correction coefficients based on the ratio of observed and simulated runoff
for the inter-station areas, annual and monthly composite runoff fields could be created.

FURTHER GIS ACTIVITIES

Due to the collaboration between the UNH and the GRDC we have now the opportunity
to use the STN-30p network also for other applications.
It is not only based on a 30 minutes elevation grid, but it is corrected
This is most important , because suspicious cell heights and problematic

regions like areas near the mouth of rivers are corrected.
Thinking to Watersheds the STN.30p Network represents river basins with >= 25000km² accurately.
Beside this the network is not simply a flow direction grid at 30 minutes resolution, but a set of derived data sets which makes the representation of river systems more comprehensive.
So linked attributes for each cell like basinname,streamorder,subbasinarea distance to the ocean and more are available.



Amazons Sub-Basin with Cell Attributes

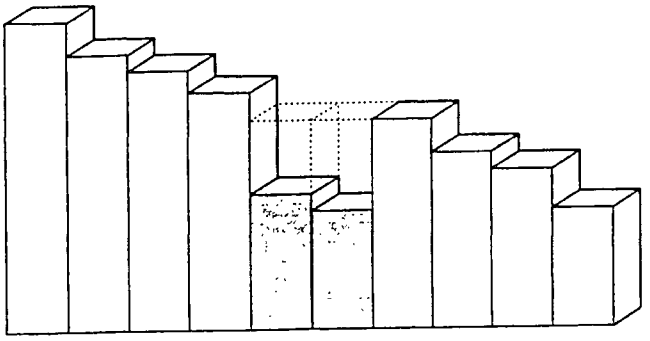
For the GRDC Gauging stations we can get more metadata information using the attribut-files,compromising that we have to move the GRDC station into the next neighbor cell of the grid.

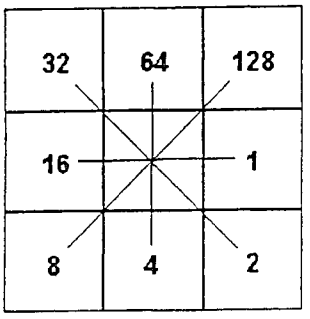
COMPUTING WATERSHEDS

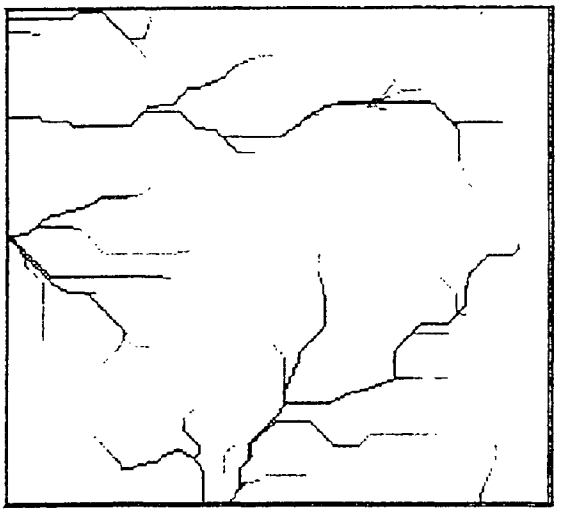
Reasons:
Visualization of watersheds related to gauging stations
Combining other metadata or model results to the point related watersheds

The shape of a surface determines how water flow across it.
The hydrologic modeling functions of ARC INFO and of the Spatial Analyst of ARC VIEW provide methods to describe the physical components of a surface and to compute the flow direction.

In step one a digital elevation model is to be converted into a elevation grid







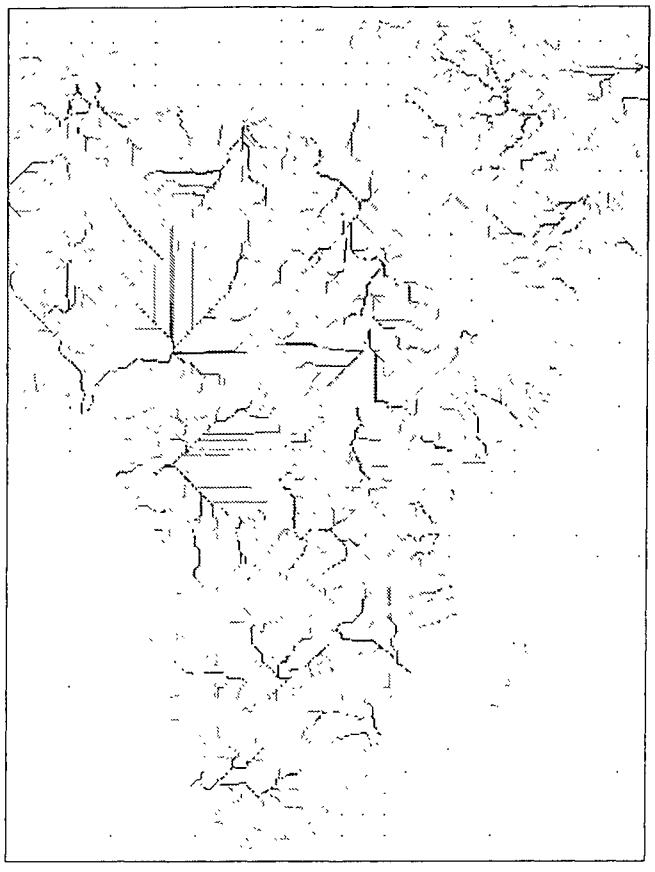
Sinks/Flow Direction /Flow Accumulation

In step two all sinks in the elevation grid have to be identified and filled.
A sink is usually an incorrect elevation value that is lower than its surroundings. This is problematic, because any water that flows into them cannot flow out,and would create errors in the river flow direction.

In step three the flow direction of each grid cell has to be computed based on a filled elevation grid.
For each cell a vector code is allocated,depending in which neighbor cell it flows into. If there is no flow direction in neighborcells found, the window will be expanded until a flow direction is found.

In step four a stream network is created.

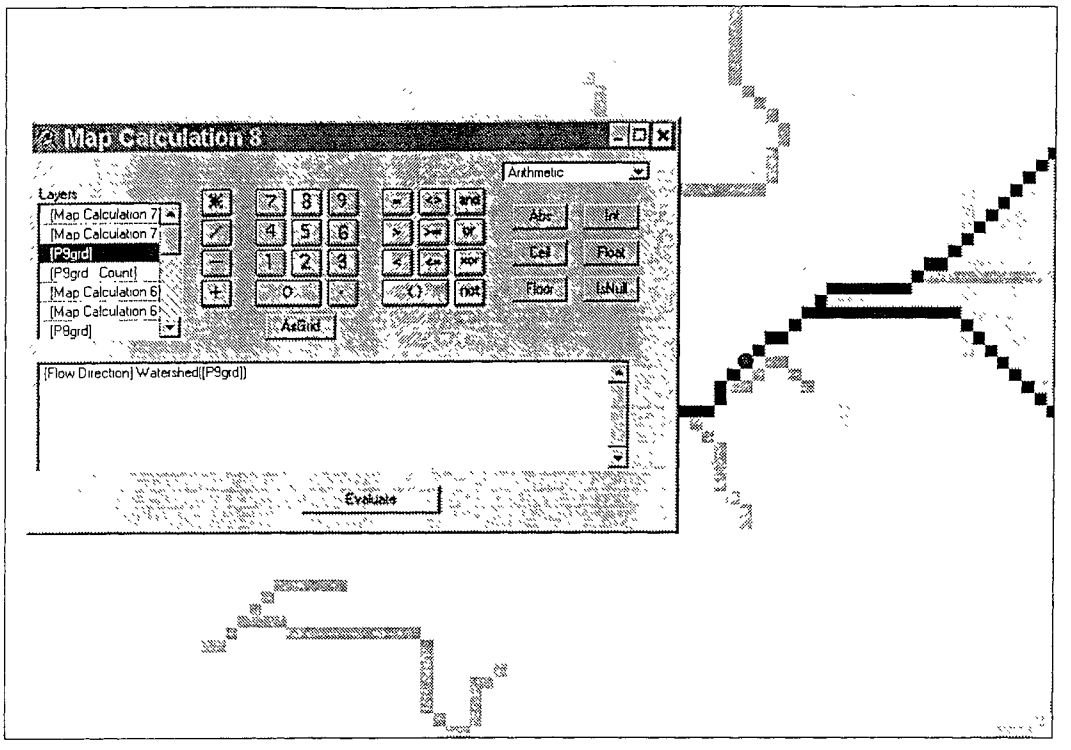
Based on the results of a flow Direction grid a flow Accumulation request calculates the number of upslope cells following to a location.



Accumulation grid created using ETOPO5 elevation model

Etopo 5 is published from the NATIONAL GEOPHYSICAL DATA CENTER,Colorado
It is a 5 minutes elevation model, which vertical resolution is 1 meter nominally.

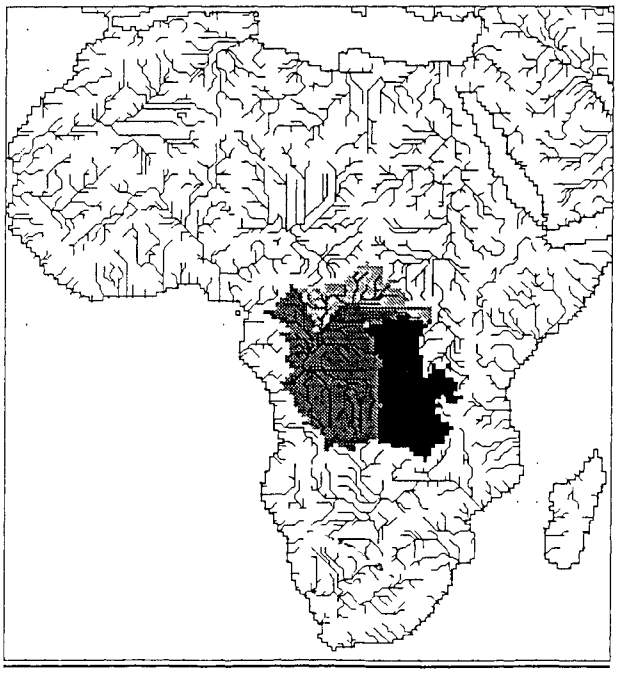
Based on a calculated stream network we are now able to compute watersheds
which are related to desired points, that means to the location of gauging stations.

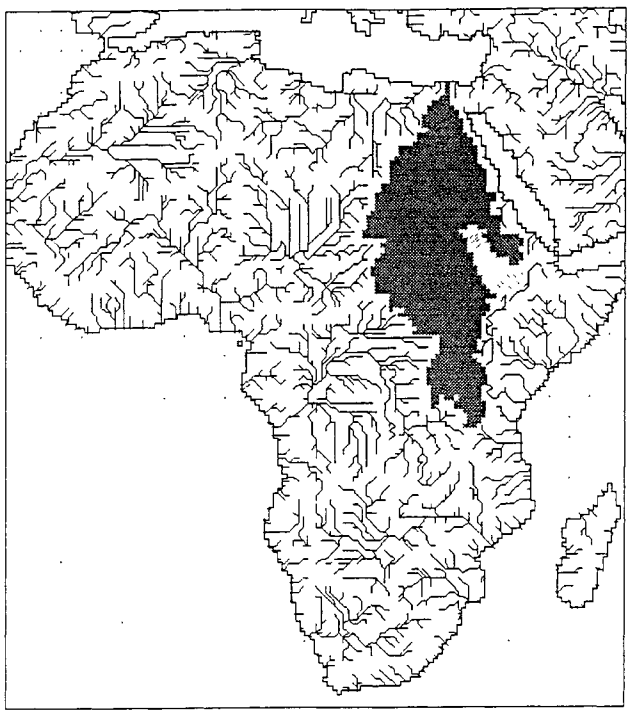


Map calculator

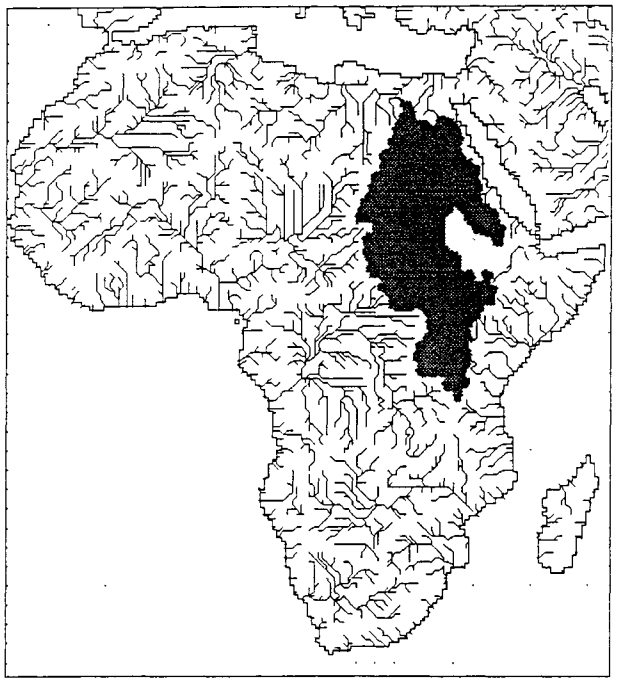
With the map calculator AVENUE requests are available,which allow the user to modify computations to his special requirements.
Assumption is that the reference point correspond to a grid cell which is part of the created stream network.
So we have to move our point of a gauging station to the nearest grid cell of the stream network.This is possible by manual clicking or by using an special AVENUE request.

STN 30 p Network with computed watersheds of the Zaire Basin





STN 30p Network with watersheds of the Nile basin



STN-30p Network with computed Nile Watersheds using Etopo5 elevation model

Problems of ETOPO 5 :

Etopo 5 is an not corrected elevation model (no virtual walls in flat areas)
The accuracy of the data set is hard to define,due to the disparate sources of the data.
Data sets of USA,W.Europe,Japan and Australia are most precise(vertical resolution of 1m), while data sets of Africa,Asia, and South America vary in resolution from +/- few meters to only 150 meters ,depending on the available source.

CONCLUSIONS AND INTENTIONS

The status is actually that the GRDC is able to create related watersheds by using the corrected STN-30p network.
The correction of the ETOPO5 model would involve a big expense of labor and time what would be hard to realize.
GRDC activities are on the way to test an elevation model of the NGDC which had a 1km resolution.
Getting more accurately computation results from this model , it could be the base of related watersheds in the future.

Outlooking, selected watersheds could be used to visualize the results of the WATER MANAGEMENT MODEL and could be used as input of the WATER BALANCE MODELS.

Annex 14

German contribution to GWP

Global Water Partnership (GWP)

German Contribution

Information Network on Integrated Water Resources Management (IWRM)

1. Background: GWP and its Associated Programs

Water as a basic requirement of life on earth and as an economic commodity becomes increasingly scarce under conditions of growing population and demands for every sector of life. In many parts of the world the supply of water in sufficient quantity and quality can no longer be guaranteed .

On the basis of the water conferences in Rio de Janeiro and Dublin, the Global Water Partnership (GWP) was founded in 1996 in Stockholm. GWP's main activities are carried out through "Associated Programs" (APs), which have the following principal objectives:

- **Exchange of Information**: APs are designed to facilitate both the exchange of information between partners and the transfer of information to GWP members and end-users.
- **Provision of Synthesized Information**: APs are focusing on "Good Practices", and in support of this, on "Lessons Learned". Good Practices may of course vary according to environmental and economic conditions.
- **Strategic Advice**: APs are expected to provide strategic and technical advice that is generally not provided by consultants, universities or multilateral agencies active in the sector. The scope of assistance may range from assisting governments to develop an appropriate legal framework and institutional organization of the water resources sector to more detailed assistance with the development or application of specific management instruments.
- **Support of Public Awareness**: APs must be proactive, promoting public awareness as an essential basis to support acceptance of the IWRM approach.
- **Human Resources Development and Research**: In many developing countries adequate technical knowledge is available, but practical experience on institutional and organisational matters must be enhanced. Therefore, capacity building of local institutions to manage water resources more effectively is essential and must cover human resource development and institutional improvement. This requires expert assistance in problem analysis, capacity assessment and training. Training should comprise the exchange of skills and experience through courses and workshops, including study tours to other countries with similar conditions.

2. Integrated Water Resources Management Information Network (IWRM Network)

An essential objective of GWP is the promotion of Integrated Water Resources Management (IWRM), particularly in developing countries. One essential requirement among different aspects to be taken into account is to provide the stakeholders and decision-makers with necessary access to information on IWRM. Although one can assume the basic con-cept of IWRM to be generally and globally accepted, specific information is often fragmented and badly documented. Improved collection, analysis and dissemination of such information is therefore needed.

Against this background, GTZ is developing, on behalf of BMZ and in cooperation with BfG/ GRDC, an information network on IWRM practices (called the "IWRM Network") as one of the APs within GWP. This IWRM Network is expected to act as an incentive for governments and institutions to optimize water resources management.

Of the aforementioned five principal objectives of the APs, the IWRM Network will cover the first four, while the last will be dealt with by a Dutch-sponsored AP ("CAPNET"). Regarding the other objectives, the IWRM Network will (a) be the communication link between supply and demand for synthesized information on IWRM, (b) provide access to IWRM practices, and (c) ensure, through linkages with the regional TACs, a field-oriented approach .

In a 12-month pilot phase, the IWRM network AP will be conceptualized and first applied in Southern Africa as a pilot region. Active support from SATAC (Southern African TAC) and of the Water Unit of SADC (South African Development Community) is expected.

3. Problem

Practical application of the IWRM concept is often faced with a multitude of interlinked problems (i.e. lack of financial and other means to obtain basic data and to establish the necessary information systems; institutions not sufficiently capable to put IWRM concepts into practice; resistance by some groups of society against concrete decisions on water use and allocation).
For decision-makers, the first bottleneck in the IWRM process is often lack of specific information on relevant IWRM aspects, tailored to their own situation. This information problem can be characterized in three different ways:

BMZ: Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung (Federal German Ministry for Economic Cooperation and Development),
GTZ: Deutsche Gesellschaft für Technische Zusammenarbeit (German Technical Assistance Agency)
BfG: Bundesanstalt für Gewässerkunde (Federal Institute of Hydrology)
GRDC: Global Runoff Data Centre
TAC: Technical Advisory Committee of GWP

- Information is insufficiently accessible/available to interested parties, particularly in many governmental institutions in developing countries.
- Information is often too general, i.e. not specific to the problem (each IWRM decision is a unique decision and advice from similar situations ("lessons learned") is rarely available in the public domain.
- Available information is often too voluminous to process and filter out specific and relevant parts for given problems.

4. Objectives

The principal goal of the IWRM Network in the pilot phase is to ensure that the services of the IWRM Network are requested by the target groups and influence the decision-making process in the pilot region. Physically, the IWRM Network is being developed on the basis of an Infor-mation Management System (IMS) as the nodal point for acquisition, assessment, collection and dissemination of specific information to users of the IWRM Network in the pilot region.

The following steps are planned:

- Documents on water resources management activities, projects, concepts etc. will be collected and analyzed with respect to their relevance for IWRM.
- An IMS will be installed and operated to provide value-added information to users, eventually also through a Question-and-Answer Service.
- Potential users, i.e. decision makers in governmental, non-governmental institutions, local water user organizations and other stakeholders in the pilot region, will be made aware of the capacity of the system and will be encouraged to use the services.

5. Approach

The German contribution focuses on the generation and supply of specific IWRM information on the basis of an IMS using the Internet. The information to be collected, processed and disseminated through this IMS will not be centered on the usual spectrum of technical data (i.e. discharge, groundwater, water quality etc.) but on the collection, processing and dissemination of **transferable and value-added information** about

- Planning procedures in water resources
- Principles of water allocation
- Institutional set-up to handle the problems
- Legislation and its way of handling the problems

The IMS will provide for the IWRM Network documented experiences by decision-makers, assessments by experts and exam-ples on lessons learned and on good practices. Decision-makers will be assisted to think in terms of options rather than to apply ready-made solutions.

IWRM can only function in a framework of options and alternatives using a participatory approach, where all stakeholders are involved in the decision-making process. Isolated decisions which disregard the linkages between natural processes, technical requirements, economic feasibility and socio-economic interests would be contrary to this concept.

Value-added information in this context means that the information will be provided problem-specific and oriented on the IWRM concept . Examples are:

- Processes rather than ready-made solutions
- Guidelines for administrative procedures and management practices, such as arrangements to involve users effectively in the management of water resources
- Terms of Reference for consultancies
- Relevant components of legal provisions
- Results of studies, evaluated according to specific criteria.

The IWRM Network is innovative because it aims to provide users with evaluated and quality-controlled information compiled from documents, expert's advice, good practice guidelines and comparative assessments of IWRM practices. All information will be available on electro-nic media but it can also be obtained through conventional means of communication.

In the pilot phase, activities will concentrate in the pilot region of the SADC, which include Angola, Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe. This is a region where:

- All large river basins are transboundary basins with specific but similar problems;
- Several multilateral and international donors and many bilateral donors are engaged in national projects and regional programs related to the water sector
- A broad acceptance by the "IWRM actors" (i.e. ministries, administrations, public and private partners) can be expected.
- Particular support can be expected from SADC in promoting the IWRM concept and management idea (a promising indication of this support is the SADC contribution to the EXPO 2000, with strong emphasis on the water sector).
- The first regional TAC-Group of GWP (SATAC) was established
- The whole water sector is in a redefinition phase, leading to many experiences which should be documented and disseminated, such as the new water legislation in South Africa.

GTZ and BfG/GRDC are jointly managing the IMS for the IWRM Network. Within the framework of GWP structure, GTZ will act as Network Manager and BfG/GRDC as Task Force Manager. Both institutions will provide their technical and scientific expertise and utilize their worldwide contacts in building up the information database. The eventual Question-and-Answer-Service will be operated jointly.

6. Activities

The information gathering and evaluation activities will cover

- Management of shared river courses and river basins and lessons learned
- Water sector policies and legislation – water acts, enforcement regulations, methods with a model character
- Valuation of water under multi- or competitive-use conditions incl. ecosystem requirements;
- Water use in conflicting situations
- Participatory institution-building (cooperation of decision-makers and water users)
- Privatization of water-related services.

The first phase activities have started in early 1999 and include:

- Collection, analysis and evaluation of a first set of documents
- Establishment of the IMS.

A GTZ/BfG mission will visit some SADC countries to assess specific needs and expectations in this pilot region, to ensure support from SATAC, SADC-Water Unit and potential end-users of the IWRM Network and to take account of the organizational and technical framework of the various regional, national and local institutions.

The experience from the pilot phase will help to review the IMS concept.

Main potential benefits for the users of the IWRM Network are:

- Access to IWRM information and active involvement in the IWRM process of all interested institutions and stake-holders, irrespective of their professional or institutional affiliation
- Non-hierarchical information structures;
- Information crossing national, administrative and institutional borders and across sectors
- Quick delivery of information via electronic media
- Question-and-Answer Service for provision of tailored information.

Potential support by the end-users of the IWRM Network is expected by

- Supply of documents on specific IWRM topics, preferably in English
- Supply of individual information and own or other experts' assessments
- Information on, and contacts with, potential resource persons and institutions with special competence in IWRM related matters
- Active propagation of the Internet and e-mail addresses of the IWRM Network
- Active propagation of the IWRM concept.

Annex 15

Establishment of a global centre for lakes and reservoirs

ESTABLISHMENT OF A GLOBAL CENTRE FOR LAKES AND RESERVOIRS

Below is an outline of the global centre for hydrological data on lakes and reservoirs, which it is proposed to establish at the State Hydrological Institute.

The purpose of the centre is to collect, store and generalize observational data on the hydrological regime of the world's lakes and reservoirs to make possible real-time assessment of their water resources, temperature regimes and ice conditions, as well as the preparation of regular generalized status reports on the world's water bodies.

Main objectives of the centre

1. To create and keep up a global database of observations of the main elements of the hydrological regime of the world's lakes and reservoirs;

2. To maintain the data set and to update it in on a yearly basis;

3. To carry out a regular scientific generalization of the data on the status of water resources and the temperature and ice regimes of the world's large lakes and reservoirs, with an analysis of trends and changes. To draw up the corresponding publications.

Composition of the database

Section 1 – Catalogue data on water bodies under observation

- Locations of the water body and of the observation point;
- Bathymetric data;
- Volume and area curves;
- Physical, geographic and morphological characteristics of catchments;
- Information on anthropogenic impacts on water bodies.

Section 2 – Hydrological observation data sets

- Water levels (monthly mean, annual mean, 1 January of each year);

- Water surface temperature (monthly mean, annual mean for water bodies without freeze-up);

- Ice phenomena (annual dates of the beginning of ice formation, date freeze-up begins and its duration, date ice phenomena end, and maximum thickness of ice);

- Inflow of water into water bodies from rivers (monthly mean and annual mean discharges); and outflow (monthly mean and annual mean discharges).

Section 3 – Generalized calculated information

- Statistical characteristics of the series;

- Water body volume and changes in volume;

- Composite data on bodies in various water systems, countries, continents, geographical zones, water bodies of various types, etc.;

- Multiannual trends in the elements of the hydrological regime.

The basis for establishing the centre will be the hydrological database on lakes and reservoirs of the CIS countries and the Baltic States, which contains information from 750 stations collected since the beginning of observations, and is managed by the State Hydrological Institute.

Possible users of the information in the Global Centre will include:

- International organizations (such as UNESCO, ..., ..., ..., etc.);
- Administrative bodies responsible for the rational use and protection of water resources;
- Organizations which design and construct various installations on lakes and reservoirs;
- Scientific organizations.

As for the limnological organizations mentioned in your letter, none have compiled real-time hydrological information on the world's lakes and reservoirs in a single database.

Yours sincerely,

I. Shiklomanov, 1999

Annex 16

Proposal for the establishment of a
global hydrological and water resources meta database

WORLD METEOROLOCICAL ORGANIZATION

PROPOSAL FOR THE ESTABLISHMENT OF A GLOBAL HYDROLOGICAL AND WATER RESOURCES META DATABASE

Report of the Meeting
(Koblenz, Germany, 25 March 1999)

Introduction

1. During the International Conference on Quality, Management and Availability of Data for Hydrology and Water Resources Management (Koblenz, Germany, 22-26 March 1999), an informal meeting was held on 25 March at the premises of the Federal Institute of Hydrology (BfG) to discuss a proposal for the establishment of a Global Hydrological and Water Resources Meta-Database. This meeting was held following a recommendation of the Fifth UNESCO/WMO International Conference on Hydrology (Geneva, 8-12 February 1999) (see paragraph 5 below).

2. The meeting was attended by the following:

H.J. Liebscher (Germany)	BfG
R. Busskamp (Germany)	BfG
W. Froelich (Germany)	GRDC
F. Portmann (Germany)	GRDC
J.C. Rodda (UK)	IAHS
B. Rudolf (Germany)	GPCC
A. Fraser (Canada)	GEMS-Water
R. Moore (UK)	Institute of Hydrology
G. Rees (UK)	FRIEND-Institute of Hydrology
B. Stewart (Australia)	WMO Commission for Hydrology
S. Shaddock	WMO Secretariat
J. L Bassier	WMO Secretariat.

3. The agenda which was proposed for the meeting is given in Annex 1. However the discussions dealt largely with the concept of a global meta-database and was not structured according to the agenda. Never-the-less many of the points listed were covered. Dr Hans Liebscher was elected to chair the meeting and Mr John Bassier served as Secretary. A summary of the discussions is provided below.

Background

4. Dr Liebscher provided some background to the meeting. He noted that the need for a meta-database had arisen as a result of the pressure to make hydrological data readily available and the conditions being applied by the owners of the data. It was noted that at present there are a large number of individual hydrological databases or information systems at global level (UNO, INFOHYDRO, GRDC, GPCC, GEMS-Water), regional level (FRIEND, WHYCOS, EEA, River Commissions) or at national levels in which hydrological and related data are stored, and/or services for users are provided. A list of some such databases and the activities of the respective data centres is given in Annex 2. Many of these databases have already set up their own meta-databases. However, the diversity of such databases makes it difficult for potential users to find the data they need. The recent technological developments in telecommunication provide a basis for setting-up systems which can facilitate the search for data and information.

The proposal

5. The proposal presented to the Meeting was for the establishment of a Global Hydrological and Water Resources Meta-Database. It was suggested that this be achieved by means of a system of linked Internet Home Pages. A proposed structure of such a system is given in Annex 3.

It was further proposed that:

- WMO jointly with UNESCO should consider the possibility of establishing such a meta-database and to undertake appropriate steps for its development;

- Existing global and regional data centres should support this proposal by creating their own meta-databases on data and/or information available at their data banks;

- Member States should be invited to support this initiative also establishing meta-databases on the data stored in their national databanks.

6. The proposal for the establishment for the meta-database was made at the above-mentioned Fifth UNESCO/WMO International Conference on Hydrology. For information the relevant section of the report of that Conference is reproduced below, as follows:

> "Member countries, WMO and UNESCO are encouraged to improve the overall availability of meta-data on both new and historical data, products and networks. WMO and UNESCO should consider taking the necessary steps to set up a global meta-data bank on available hydrological, water resources and environmental data. This should consist of a service linking existing national, regional and global data bases by a common system via Internet. A task force should be established to consider further the needs for the meta-database. The Group noted the recommendations of the Espoo conference that increased efforts should be made in the establishment and maintenance of data networks and the development of reliable methods of trend analysis and their applications to suitable data sets including historical data".

Discussion

7. The meeting recognized that the essence of the proposal is for three web pages with a hierarchical structure. The top page would provide a focal point for searchers for hydrological data. This would link to two sub-ordinate pages – one for global data and one for continental data. These pages would contain further pointers to the home pages of the major organizations concerned.

8. Points raised in discussion were as follows:

- Who is the audience for the new pages?

- Would the new page provide a genuinely new and improved way of finding hydrological data? The meeting identified many existing meta-databases, some of which have a similar structure (see Annex 3);

- Many existing meta-databases begin with enthusiasm but the resources and funding are seldom sustained. How will this proposal differ?

- The cost of a meta-database is not merely the cost of the central team or individuals. The major burden falls on the national data centres. These centres receive many requests for them to contribute to meta-databases. They have grave difficulties in sustaining their own meta-databases, let alone supporting those of others;

- Is the proposal in reality a meta-database? A meta-database is a catalogue describing the data sets held, e.g., subject, variables, time span, geographic area, constraints on access, etc., etc...

- If resources are available would it not be better to support an existing initiative, such as GCOS, or a WMO or a NASA Database;

9. The meeting also considered whether hydrological meta-data is the real issue. A view that is gaining ground is that, as the world becomes more developed, a more holistic approach to environmental problems must be taken. In parallel with this view, a matching approach to data should be taken. This will lead to people needing data outside their area of specialization. However, any given database will inevitably have its own jargon, which external users cannot be expected to know. Therefore, systems will have to be designed that will enable the "external" users starting with every day language to find the technical data that they require. For example, biologists may not know that water levels are measured at "gauging stations" or that hydrologists call water level "stage" and river flow "discharge".

10. The meeting noted that there had been some discussion for a UN Water Database which would provide a linkage to the meta-databases of the UN organizations. It was felt that this proposal needed to be looked at and possibly raised at the next meeting of the UN/ACC Subcommittee on Water Resources.

Technical aspects

11. In considering the technical aspects of the proposal, the following points were noted:

- There is need for the existing databases to be set up according to specified standards, e.g. ISO Standards;

- Not all national databases have a corresponding meta-database; countries should therefore be encouraged to develop one;

- Existing Home Pages need to be looked at to see whether they contain the information needed, and if not, to take steps with the owners to have the information included;

- Who will host the meta-database and be responsible for its regular updating. Some way of automatic updating would be desirable. The host country/agency will need to employ at least one professional staff full-time for this purpose and this has financial implications (about US$100,000 annually);

- Water quantity and quality aspects should be promoted together and WMO and GRDC should work together on these aspects.

Recommended follow-up

12. The meeting proposed a number of follow-up actions:

- That a rapporteur be appointed to examine the existing situation and develop a strategy for moving forward on the proposal, including an estimate of cost;

- Dr J.C. Rodda, president of IAHS, recommended the WMO and UNESCO should present a joint paper on the proposal to the IUGG Assembly in Birmingham (UK) in July 1999 where a three-day workshop on global databases is planned to be held;

- WMO should ensure that the proposal is addressed at future meetings including, WMO Thirteenth Congress (May 1999), General Assembly of the IUGG (June 1999), WMO CHy Advisory Working Group/IHP Bureau (September 1999). WMO Commission for Hydrology, Eleventh session (December 2000);

- The report of the meeting should be published in the WMO Bulletin, the IAHS Newsletter, and UNESCO's Waterway.

Annex 1

INFORMAL MEETING ON GLOBAL HYDROLOGICAL META DATA BASE

Begin: 10.00 a.m. on 25th March 1999, Koblenz
Place: Meeting Room (Sitzungssaal) in the Federal Institute of Hydrology

Provisional Agenda

1. Opening
2. Discussion of needs
3. Technical aspects
4. Possible content of Global Meta Data Base
5. Organizational aspects
6. Follow-up actions
   - 6.1 Next steps (appointment of a rapporteur, development of a concept)
   - 6.2 Institutional aspects including links to other institutional organizations
   - 6.3 Financing
   - 6.4 Bodies (Steering Committee)
7. Closing

EXISTING GLOBAL DATA CENTRES AND THEIR ACTIVITIES

Global Precipitation Climatology Centre (GPCC)

- Compilation and archiving of precipitation data including quality control
- Calculation of area-mean precipitation on a grid
- Merging of satellite and rain gauge data
- Support to climatological studies

Global Runoff Data Centre (GRDC)

- Compilation and archiving of river runoff data
- Preparation of data sets
- Dissemination of data and information to users
- Publication of data products

Global Environment Monitoring System – Water (GEMS/Water)

- Compilation and archiving of water quality data
- Estimation of water fluxes to the oceans
- Preparation of reports

Proposals for possible future global centres

- Global Data Centre for Evapotranspiration
- Global Data Centre for Soil-moisture
- Global Data Centre for Groundwater

Other related global activities

WMO

- World Hydrological Cycle Observing System (**WHYCOS**)
- Global Climatological Observation System (**GCOS**)
- Global Terrestrial Observation System (**GTOS**)
- Global Energy and Water Cycle Experiment (**GEWEX**)
- Arctic Climate System (**ACSYS**)
- Hydrology and Water Resources Programme (**HWRP**) (INFOHYDRO)

UNESCO

- Publication of discharges of selected rivers of the world
- FRIEND (See regional activities below)

UNEP

- Global Programme of Action for the Protection of the Environment from Land-based Activities **(GPA)**
- Global Environment Outlook **(GEO1, GEO2)**
- Global International Water Assessment **(GIWA)**

ICSU

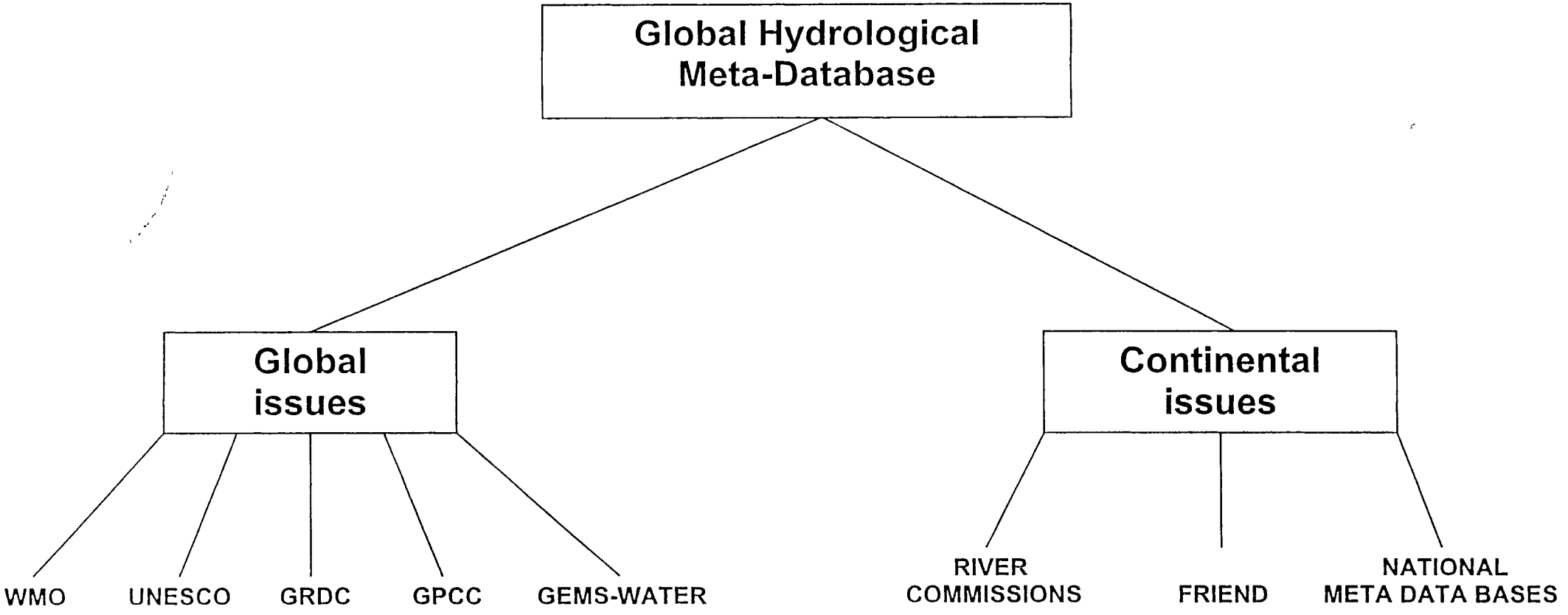
- World Data Centres **(WDC)**
- IGBP Data Integration Project (see IGBP newsletter 36)

Regional activities

- UNESCO's – FRIEND (Northern European FRIEND Meta-database available but not on the internet)
- International River Commissions
- OAS (Inter-American Water Resources Network –IWRN)

National activities

- national hydrological data banks


Global Hydrological Meta-Database
Global issues
Continental issues
WMO
UNESCO
GRDC
GPCC
GEMS-WATER
RIVER COMMISSIONS
FRIEND
NATIONAL META DATA BASES

Annex 3

Annex 17

GCOS Hydrological Network –
Global hydrological network for climate

GCOS HYDROLOGY NETWORK
GLOBAL HYDROLOGICAL NETWORK FOR CLIMATE

Position Paper Presented to the International Conference on Quality, Management and Availability of data for Hydrology and Water Resources Management

General Background

At the eighth meeting of the GCOS Steering Committee, the Terrestrial Observation Panel for Climate (TOPC) was requested to explore the possibilities for organising an expert group meeting to discuss and further develop a strategy on how to establish a *Global Hydrological Network for Climate*. In order to be successful, TOPC highlighted the need to incorporate the organizations/initiatives that are already involved in such activities (e.g., GRDC, FRIEND, and WHYCOS). It would also be advisable to include participants from other initiatives currently being developed to address similar issues (e.g., World Hydrology Initiative for Policy and Development (WHIPD) and MOPEX).

There has traditionally been a problem in acquiring hydrological data and information for climate studies, due to the lack of agreed procedures for the international exchange of such information. One effort to improve this situation is a resolution on exchange of hydrological data to be presented to the Thirteenth WMO Congress by the Commission of Hydrology. However, the increased urgency expressed by the GCOS Steering Committee for strengthening hydrological networks and improving the availability of hydrological data and information, should be seen in light of the recent recommendations from the 4th meeting of the Conference of the Parties (COP-4) to the United Nations Framework Convention on Climate Change (UNFCCC). To serve the needs of the Convention,COP-4 urged parties to undertake programmes of systematic observations based on the information developed by GCOS. Hydrological information and data are explicitly mentioned under paragraph 7 of decision 14/CP.4 of FCCC/CP/1998/16/Add.1 (www.wmo.ch/web/gcos/scVIII/resolutions.html). Parties are here urged "to actively support national terrestrial networks including observational programmes to collect, exchange and preserve terrestrial data according to the Global Climate Observing System and the Global Terrestrial Observing System climate priorities, particularly hydrosphere, cryosphere and ecosystem observations".

The sponsoring agencies of the Climate Agenda were also requested to assist SBSTA in informing the Parties of the Convention on the developments regarding observational networks and, through the secretariat of GCOS, "to initiate an intergovernmental process for addressing the priorities for action to improve global observing systems for climate in relation to the needs of the Convention...."

Before the COP-4 meeting, the GCOS/GTOS Terrestrial Observation Panel for Climate (TOPC) held its fourth session in May 1998. The meeting stressed the importance of hydrological data and information in relation to climate variability prediction and climate change studies. The Global Energy and Water Cycle Experiment (GEWEX) has clearly demonstrated that such data are crucial for calibrating and verifying climate models, including the calculation of regional and global water budgets. Although regional and global water budgets are of limited importance to water resources managers, improved climate models can potentially be of benefit to the hydrological and water resources communities through improved climate impact assessments on water resources (on a smaller spatial scale). The continental scale projects of GEWEX, e.g., GCIP and MAGS, have the demonstration of this as one of their objectives.

The TOPC also recognised that hydrological observations that could be beneficial to climate studies are carried out in most countries. A particular problem is that currently there is no established international (global) monitoring network. This is partly a result of limited (national and international) budgets, but probably due more to the fact that hydrological data are regarded as being of a national interest, with even political and strategic concerns. Furthermore, the fact that hydrological activities are carried out by many different agencies in most countries has not allowed the development of a focussed intergovernmental process in the field. The Panel agreed that it should increase its efforts to improve the situation as regards the availability of relevant hydrological data sets for climate studies, by exploring the possibilities of enhanced co-operation with existing international data and monitoring networks (GRDC, FRIEND, WHYCOS, etc).

A number of specific recommendations were presented at the TOPC meeting. These recommendations are all aiming at improving the availability of discharge data. It is, however, important to include other types of hydrological data and information that could be relevant for climate change studies, such as soil moisture, groundwater levels, lake levels, etc.

The Way Forward

TOPC is proposing an expert-group meeting to develop a strategy on how to establish a *Global Hydrological Network for Climate.* The Deutscher Wetterdienst has offered to host such a meeting during the autumn of 1999. It is well recognised that the climatological, meteorological and hydrological/water resources management communities will need to work in close collaboration in order to enhance the capability to understand and predict climate variability and possible climate change. To enhance such collaboration, a clear purpose and the establishment of mutual benefits to all involved groups must be discussed and further developed. This could be one of the main tasks of this proposed expert-group meeting. It would require that representatives from relevant groups (both on the user side as well as on the producer side in relation to hydrological data) be represented at the meeting. Some issues to be further considered could include:

1. Discuss the current availability of relevant hydrological data on a national and international level (e.g., GRDC, FRIEND, WHYCOS, and national data sets)[1]. This should be seen in the light of the fact that GCOS is not seeking ownership of the data, but to ensure that they are collected, stored and made accessible in a homogeneous way suitable for climate studies;

2. Explore possibilities to enhance co-operation between "hydrological interests" and "climatological interests" in providing relevant data and information on a mutual basis. This must include benefits relevant to all involved groups. If the "hydrological community" provide data and information to climate studies, how could they in turn benefit from such studies? It could include:

   - Enhanced quality data sets;
   - If a site is marked as a GCOS data site it could encourage governments to provide funding to keep the site operational (in light of the COP-4 recommendation);

3. Discuss a way of further developing hydrological networks and acquiring hydrological data sets that are in line with the requirements set up in the GCOS/GTOS Plan for Terrestrial Climate-Related Observations (GCOS-32, 1997); (www.wmo.ch/web/gcos/publist.html)

4. Discuss how best to respond to the requirements set down in COP-4 as they relate to terrestrial (hydrological) data and information;

5. Discuss the relationship between an initiative implemented through GCOS/GTOS and other ongoing initiatives, such as WHIPD and MOPEX, in order to avoid serious duplication in efforts and the risk of confusion;

6. Discuss ways to strengthen the representation of national hydrological interests in the intergovernmental process aiming at improving global observing systems as requested by COP-4;

7. Discuss financial implications of the above;

8. Establish a framework for implementation.

Meeting Details (to be developed)

Time: Early 2000
Place: ---, Germany
Title: ---
Proposed participants: ?

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[1] This should include a review of the information provided in the meta database INFOHYDRO