WORLD CLIMATE PROGRAMME

DATA • APPLICATION • IMPACT • RESEARCH

WORLD CLIMATE PROGRAMME

THIRD PLANNING MEETING ON
WORLD CLIMATE PROGRAMME - WATER

(GENEVA, 18-22 NOVEMBER 1985)

WCP – 114

WMO/TD-No. 106

UNITED NATIONS EDUCATIONAL
SCIENTIFIC AND CULTURAL
ORGANIZATION

WORLD METEOROLOGICAL
ORGANIZATION

The WCP consists of four major components implemented by WMO in conjunction with other international organizations:

The World Climate Research Programme (WCRP)
The World Climate Applications Programme (WCAP)
The World Climate Impact Studies Programme (WCIP)
The World Climate Data Programme (WCDP)

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1. OPENING OF THE MEETING

1.1 The Third Planning Meeting on the World Climate Programme-Water was held in the WMO Secretariat in Geneva from 18 to 22 November 1985. It was organized jointly by WMO and Unesco with the purpose of reviewing progress with WCP-Water projects and developing proposals for future activities under the sub-programme. A list of the participants is presented in Annex 1 to this report.

1.2 Mr. J. Nemec, Director, Hydrology and Water Resources Department of the WMO Secretariat, acting on behalf of the Secretary-General of the Organization, opened the meeting at 10 a.m. on Monday 18 November. In his opening remarks Mr. Nemec referred to the four components of the World Climate Programme: data, applications, research and impact, and noted that water-related activities were undertaken in all four of them. For co-ordination purposes, these activities had been grouped under the general title World Climate Programme-Water (WCP-Water). He recalled that the aim of WCP-Water was to assist Members to meet more effectively the socioeconomic needs which depend on water-resource systems, through the improved application of climate data and knowledge.

1.3 As an example of the recently renewed interest in the possible impact of climate variability and change, Mr. Nemec referred to the very important statement made by the UNEP/WMO/ICSU Conference which had been convened in Villach in Austria in October 1985 to assess the role of carbon dioxide and other greenhouse gases in climate variations. It stated that, as a result of the increasing concentration of greenhouse gases, it is now believed that in the next century a rise of global mean temperature could occur which would be greater than any in man's history. The assumption that past climate data can be used without modification as a reliable guide to the future can no longer be made. There is little doubt that a future change in climate of the order of magnitude obtained from climate models for a doubling of the atmospheric C02 concentration could have profound effects on water resources. In view of such statements, Mr. Nemec stressed the importance of increasing the support for research and focussing efforts on crucial unsolved problems on the role of the hydrological cycle in climate and the means of incorporating our knowledge of climate and its variability in the design and management of water-resource projects.

1.4 The meeting unanimously elected Mr. G. Cavadias as its chairman. The agenda adopted by the meeting is given in Annex 2 to this report. The meeting discussed all matters in plenary but the first draft of the material which appears in Annex 3 of this report was first prepared by small ad hoc groups.

2. REVIEW OF RECOMMENDATIONS AND DECISIONS OF GOVERNING AND ADVISORY BODIES

2.1 The meeting was informed of the recommendations and decisions of the various governing bodies of the organizations concerned in the planning of the World Climate Programme.

2.2 WMO Congress (1979) had adopted the World Climate Programme (WCP) as a major WMO programme encompassing a variety of activities directed to:

- -- aid countries in the application of climate knowledge to the planning and management of many aspects of man's activities, and
- -- foresee and warn of possible future variations and changes in climate, either natural or man-made, which may significantly affect the

2.3 The meeting noted that the World Climate Programme is one of very wide scope, and the planning and implementation of the wide-ranging activities involved depended on co-operation with many other agencies and governmental and non-governmental organizations. In particular, UNEP, ICSU and Unesco were closely associated with various aspects of the programme.

2.4. The meeting recalled that the WCP has four components which are the responsibility of the organizations listed:

World Climate Data Programme (WMO);
World Climate Applications Programme (WMO);
World Climate Research Programme (WMO and ICSU);
World Climate Impact Studies Programme (UNEP).

WMO had been entrusted to co-ordinate the activities of these four components with the aim of achieving the objectives of the WCP.

2.5 It was explained that the purpose of the World Climate Data Programme (WCDP) was to provide timely access to reliable climate data in exchangeable formats. The major objectives of the WCDP are:

(a) To determine requirements for climate data and improve climate data exchange;

(b) To develop a climate data referral system (INFOCLIMA) which will tell users what data now exist, where, the format, and how to obtain them;

(c) To assist countries to improve their climate data management systems through a transfer of technology, stressing the use of microcomputer systems (CLICOM);

(d) To assist countries and regions to build climate data banks for applications, impact studies and research;

(e) To develop a procedure to monitor, diagnose and disseminate information on significant climatic events which may affect mankind's activities, using existing facilities (Climate System Monitoring).

2.6 The meeting noted that the WCDP comprised several major elements which address specific needs expressed by the Member countries of WMO and the needs of other international organizations involved in the WCP. Overall climate data management transcends WMO programme boundaries as composed of the atmosphere, oceans, cryosphere and the surface/biosphere. Some aspects were contained within other international organizations. The implementation objectives of the WCDP involved co-ordination with all Technical Commissions and other relevant international

2.7 It was noted that the purpose of the World Climate Applications Programme (WCAP) was to apply existing climate information with priorities in food, water and energy, and in other areas as resources permit, the major objectives of the WCAP being:

(a) To help countries to strengthen their national institutional capabilities to apply climate knowledge;

(b) To make available existing basic knowledge about the climate of each region, presented in a way to permit ready application, in a user-tailored form;

(c) To provide ready access to practical techniques for application of climate knowledge;

(d) To promote the development, transfer of knowledge and use of climate application techniques through:

- Increasing the awareness of users of the potential benefits to be gained through the application of climate knowledge;

- Defining requirements for climate information by specific users;

- Provision of guidance material and training.

2.8 The meeting was informed that the Ninth WMO Congress (1983) adopted a World Climate Application Plan to be implemented with contributions from the WMO Technical Commissions. Other organizations involved in climate applications were Unesco, FAO, World Energy Council, the United Nations Centre for Human Settlements (HABITAT), WHO and the Consultative Group for International Agricultural Research (CGIAR). The WCAP is organized into the following sub-programmes: WCAP-Food; WCAP-Water; WCAP-Energy; WCAP-Other Applications. Activities in WCAP-Food were closely coordinated with those in the Agricultural Meteorology Programme and those in WCAP-Water with activities in the Hydrology and Water Resources Programme. The WCAP was also organized in a matrix structure with similar activities being implemented in each sub-programme. An example mentioned was the Climate Applications Referral System (CARS) which is implemented under WCAP - Food and WCAP-Energy, but is not implemented in the water field as its aims are fully met in that respect by the Hydrological Operational Multipurpose Subprogramme (HOMS) of WMO.

2.9 The World Climate Research Programme (WCRP) was introduced as being aimed at determining the predictability of climate and the extent of man's influence on climate. The major objectives of the WCRP had been grouped into three streams:

(a) To determine the physical basis for long-range weather (or short-term climate) prediction on time scales of one month to a season;

(b) To determine the predictability of interannual climate variations on time scales up to about four or five years;

(c) To determine the predictability of decadal climate changes up to about 100 years, including the effects of mankind in producing C02 and other radiatively active gases.

2.10 It was explained that the activities were conducted under the overall guidance of the Joint Scientific Committee for the World Climate Research Programme (JSC) established jointly by WMO and ICSU. The JSC reports to the executive bodies of these two organizations. Several other international organizations a Iso participate in the implementation of the WCRP, notably the Unesco Inter-governmental Oceanographic Commission (IOC) as well as many organizations in the ICSU family such as the International Association of Meteorology and Atmospheric Sciences (IAMAP), the Committee on Space Research (COSPAR) and the Scientific Committee on Oceanic Research (SCOR). The co-ordination with IOC and SCOR was arranged through their joint Committee on Climatic Change and the Ocean (CCCO).

2.11 The World Climate Impact Studies Programme (WCIP) had been defined so as to offer warnings to governments of the potential economic, social and political impacts of significant climatic variations or changes, both natural and man made. The major current activities of the WCIP were stated as being:

(a) To improve the methodology of undertaking assessments of climate impact, a new science essentially spawned by the WCP;

(b) To determine the potential economic, social and political impacts of man-induced climatic changes, with a strong emphasis on the effects of increasing C02 and other radiatively active gases;

(c) To determine the impacts on national food systems of climate variations and changes, with special emphasis on the effects of droughts.

Other activities foreseen for the WCIP include climate impacts on human health, water management and energy.

2.12 The meeting noted that the United Nations Environment Programme (UNEP) had accepted the responsibility to implement this component of the World Climate Programme.

2.13 The meeting recognized that the WMO Congress, meeting every four years, provided the overall co-ordination of the World Climate Programme. The mechanism used for co-ordination of the WCP activities between sessions of Congress included:

(a) Annual,review and guidance-by the WMO Executive Council;

(b) Meetings of the executive heads of international organizations involved in the WCP;

(c) Meetings of the chairmen of;

- the WMO Advisory Committee on the World Climate Applications and Data Programme (ACCAD);

- the ICSU/WMO Joint Scientific Committee (JSC);

- the UNEP Scientific Advisory Committee (SAC).

(d) As regards water-related activities, the meeting noted that co-ordination was also ensured, as appropriate, by meetings of the ACC Intersecretariat Group for Water; by bilateral meetings such as the joint WMO/Unesco Liaison Committee for Hydrological Activities; and by meetings such as the Third Planning Meeting on WCP-Water.

3. GENERAL REVIEW OF CURRENT AND PLANNED AGENCY ACTIVITIES

3.1 The representatives of organizations provided information on those activities being undertaken or planned by their organizations which were relevant to the subject of the meeting. They emphasized the link between these activities and the WCP and the support they provided to the WCP-Water projects.

3.2 As regards WMO, the meeting noted that the seventh session of the WMO Commission for Hydrology which had been held in August/September 1985 had considered in some detail the contribution it could make to the WCP.

3.3 The Commission had recognized that a large part of its past and future work was very relevant to the basic aims of the WCP and could therefore be seen as a contribution to the programme. The Commission had identified which of its working groups and rapporteurs were likely to be most concerned with each of the projects currently being implemented under WCP-Water. In addition, the Commission had appointed a Rapporteur on WCP-Water whose task was to advise and assist, as appropriate, in the implementation of all WCP-Water projects related to the Commission's interest. This rapporteur had also been asked to prepare a report on the use of climatological data and climate information in water-resource projects.

3.4 The meeting was informed that the most important single activity being implemented under the auspices of CHy was the development and operation of the Hydrological Operational Multipurpose Subprogramme (HOMS). Since the start of the WCP, close attention had been paid to the link between HOMS and the WCP and a recent meeting of representatives of HOMS National Reference Centres (Geneva, September/October 1985) had considered this link in some detail. The specific proposals of the meeting are summarized in Annex 3 to this report.

3.5 The meeting took note of the action taken by each of the six regional associations of WMO in establishing working groups on hydrology which had, amongst other responsibilities, the tasks of advising their respective associations on regional aspects of the WCP. Three of these working groups have specific terms of reference in this regard. Furthermore, each of the regional association working groups on hydrology was currently collecting material on the application of climatological information to water-related activities for inclusion in six regional reports each of which would constitute a contribution to WCP-Water.

3.6 The International Hydrological Programme (IHP) of Unesco is one of the main international scientific co-operation programmes of the Organization. It concerns the improvement of knowledge concerning water resources and the development of the scientific basis for understanding interrelationships between human activities and the hydrological system and for developing the rational management of water resources aimed at the solution of the problems arising in connexion with the multipurpose uses of water resources and with the protection of these resources, bearing in mind ecological, economic and social factors.

3.7 The main objectives of the third phase of the IHP (1984-1989) were defined and adopted by the Unesco/WMO International Conference on Hydrology and the Scientific Bases for the Rational Management of Water Resources (Paris, 18-27 August 1981). The detailed Programme and Plan of IHP-III (1984-1989) - Hydrology and the Scientific Bases for the Rational Management of Water Resources for Economic and Social Development - was approved during the Sixth Session of the Intergovernmental Council for the IHP (March 1984). The Bureau of the Intergovernmental Council for the IHP at its twelfth sessic (October 1984) took the necessary steps for the execution of the Programme an Plan of IHP-III by constituting working groups and appointing rapporteurs for the approved activities on the basis of nominations from National Committees for the IHP and taking into account the existence of national and regional activities as well as the need for an appropriate geographical distribution.

4. IMPLEMENTATION OF WCP-WATER PROJECTS UNDER THE SIX ACTIVITY AREAS

4.1 It was recognized that the role of planning meetings was to formulate proposals for projects, while responsibility for their adoption and implementation lay elsewhere. The meeting was informed of the ways and means of implementing different projects under WCP in general and WCP-Water in particular. It noted that the funds allocated under the budget of WMO or Unesco can only provide seed money to those projects, mainly to ensure co-ordination of national activities and planning of co-operative ventures of national institutions in international projects. It was also noted that no funding from the WMO or Unesco budgets is available to execute research or to collect data and establish date bases for such research. It was finally noted that, except for their planning and international co-ordination, all field projects have been in the past and will continue in the future to be funded as co-operative ventures of national institutions.

4.2 The meeting reviewed the current status of implementation of the 12 priority projects proposed by the Second Planning Meeting on WCP-Water on the basis of information provided by the organizations responsible and by the individual experts concerned.

4.3 Each project had its own time schedule and mechanism for implementation and they could not be expected to proceed all at the same pace. It was very evident that the most important factor was the availability of funds and the planning cycles and policies of the organizations responsible.

4.4 The value of linking projects with existing field activities was stressed, while recognizing the difficulties this posed in many instances as regards the finances and logistics. In this regard, particular reference was made to Activity Area C and the use of pilot projects. One solution was seen as being to include under WCP-Water a number of major national projects which met the aims of the programme and were of wide international interest. One such was Project C.4. It was proposed that the international organizations involved in WCP-Water seek a small number of additional projects of this nature for inclusion under whichever activity area was considered appropriate. In this spirit, a project on the re-analysis of hydrological observations to be undertaken by the Hydrometeorological Institute in Prague was proposed for inclusion under Activity Area C.

4.5 Progress with certain projects led the meeting to propose major revisions in their future plans, for others only minor amendments were suggested. There was a strong feeling that some work should be undertaken with regard to Activity Areas E and F. The inclusion by Unesco of activities under Activity Area E would be welcomed in particular in the framework of its projects concerning environmental assessment of the impact of large scale water pro]ects and the hope was expressed that UNEP would soon be in a position to develop specific activities under both Activity Areas E and F, in particular under the auspices of the WCIP. A number of ideas for projects under Activity Area F arose during the discussions. A specific project proposal was formulated with the hope that an appropriate agency would adopt and seek funding for it as a contribution to WCP-Water.

5. TERMINATION OF PROJECTS AND DEVELOPMENT OF NEW PROJECTS

5.1 The meeting reviewed the various proposals made under agenda item 4 for the revision, up-dating and addition of projects under WCP-Water. As for the Second Planning Meeting, these proposals were compiled into a standard format as a set of project descriptions each setting out what had already been accomplished and what was proposed for the future. These descriptions are contained in Annex 4 to this report which commences with a summary listing of the projects concerned.

5.2 Many of the proposed projects are inter-related and their implementation will need to be coordinated. Even when projects are undertaken quite independently, it may be that certain anticipated outputs from one project cannot be achieved unless contributions from other projects are available. This highlights the need for continuous co-ordination at the working level and, on occasion, setting priorities in execution. The meeting expressed its views on the inter-relationships between certain of the projects. The chart included in Annex 5 to this report illustrates these inter-relationships.

5.3 The project proposals contained in Annex 4 are presented under.six activity areas, as were the proposals developed at the second Planning Meeting on WCP-Water. However, although very similar, the titles and descriptions of some of the areas differ from those used previously and so Annex 4 employs a new numbering system for both activity areas and projects.

6. FUTURE DEVELOPMENTS AND MEDIUM TO LONG-TERM PLANS

6.1 The meeting was informed of the planning procedures and cycles of WMO and Unesco and how the proposals for WCP-Water projects prepared by the meeting would be considered.

6.2 WMO was currently in the middle of its ninth four-year financial period. WCP-Water activities were incorporated into the Organization's World Climate Programme and its Hydrology and Water Resources Programme. Both of these programmes contained sufficient flexibility to accept immediately certain of the proposals of the meeting. However, major proposals would need to be submitted to Tenth WMO Congress in 1987.

6.3 A few months prior to Tenth Congress would be convened the Third WMO/Unesco International Conference on Hydrology and the Scientific Bases of Water Resources Management. It would be held in Geneva in March 1987 and would review and comment on the proposals being put to Tenth Congress for WMO's water-related activities for the tenth financial period: 1988-1991. The joint conference would also review a draft of WMO's Second Long-Term Plan for the Hydrology and Water Resources Programme which would be submitted to Congress and will cover the period 1988-1997.

6.4 The proposals of the current planning meeting would be taken into account in preparing the final submissions to Congress for the periods 1988-1991 and 1988-1997.

6.5 The IHP programme of Unesco is implemented through successive phases each normally of six years duration. The present third phase - IPH III – runs from 1984 to 1989 and is an integral part of Unesco's Second Medium-Term Plan which also runs from 1984 to 1989. The basic objectives and main subjects of the next phase of the IHP - IHP IV (1990-1995) - will be defined by the International Conference on Hydrology and the Scientific Bases for the Rational Use of Water Resources to be convened jointly by Unesco and WMO in March 1987 in Geneva. One of the main subjects proposed to the conference will be related to the WCP-Water.

6.6 The general Conference of Unesco will approve and/or amend the proposals of the Unesco/WMO Conference at its 24th session in October/November 1987 after which it will become a part of Unesco's third Medium-Term Plan for 1990 to 1995.

6.7 The detailed programming and planning for IHP IV will be done by the Inter-governmental Council of the IHP in 1988.

6.8 It was noted that 1987 and 1988 would be important years in the planning of activities under WCP-Water. The XIX General Assembly of IUGG in Vancouver in August 1987 was expected to attract a large number of hydrologists and climatologists, in particular in conjunction with the IAHS Symposium on the Influence of Climate Changes and Climate Variability on Hydrological Regime and Water Resources. This would offer an excellent opportunity to consider and co-ordinate activities under a number of WCP-Water projects, possibly through the convening of a planning meeting. It was seen as being likely that a further planning meeting on WCP-Water would be convened in 1988 or 1989.

7. CLOSURE

7.1 The meeting reviewed a draft of its report and requested the secretariats to finalize and edit it so as to present it in the same form as the report of the Second Planning Meeting on WCP-Water.

7.2 The participants expressed their appreciation to the Chairman for the excellent manner in which he had conducted the meeting and the representatives of the WMO and Unesco Secretariats thanked all the participants for their valuable contributions to the planning of activities under WCP-Water.

ANNEX 1

LIST OF PARTICIPANTS

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ANNEX 2

AGENDA

1. OPENING OF THE MEETING

2. REVIEW OF RECOMMENDATIONS AND DECISIONS OF GOVERNING AND ADVISORY BODIES

3. GENERAL REVIEW OF CURRENT AND PLANNED AGENCY ACITIVITIES

4. IMPLEMENTATION OF WCP-WATER PROJECTS UNDER THE SIX ACTIVITY AREAS:

   4.1 Studies of hydrological data in the context of climate variability and change
   4.2 Modelling of the hydrological cycle for climate study purposes
   4.3 Application of climate information to hydrological forecasts in the operation of water-resource systems
   4.4 Studies of the influence of climate variations on water resources
   4.5 Impact of climate on society through water resources
   4.6 Influence of man's activities on climate through the hydrological regime

5. TERMINATION OF PROJECTS AND DEVELOPMENT OF NEW PROJECTS

6. FUTURE DEVELOPMENTS AND MEDIUM- TO LONG-TERM PLANS

7. CLOSURE

ANNEX 3

EXCERPT FROM THE REPORT OF THE MEETING OF REPRESENTATIVES OF HOMS NATIONAL REFERENCE CENTRES ON THE HOMS REFERENCE MANUAL AND THE WORLD CLIMATE PROGRAMME
(Geneva, 20 September - 4 October, 1985)

WORLD CLIMATE PROGRAMME AND HOMS

1. The meeting was informed of the overall aims and structure of the World Climate Programme and of the current status in the implementation of those WCP activities which are of greatest relevance to HOMS. Attention focused in particular on CARS, CLICOM, HAPEX and the series of WCP-Water projects currently being undertaken.

WCP-Water and its contribution to HOMS

2. The meeting considered the WCP-Water projects as described in the Report of the Second Planning Meeting on WCP-Water (WCP Report No. 36) and on the basis of up-to-date information provided by the Secretariat.

3. In general it was felt that any proven operational methodologies which would be produced from WCP-Water projects could and should be considered for HOMS. It was recognized that in most instances this would be in the long term. However, the meeting felt that a number of recommendations or observations should be made with regard to the WCP-Water projects, as follows:

(i) Any methodologies developed under project I.2* would be most useful as HOMS components. The meeting felt that project I.2 could be a mechanism whereby not only one but a number of different techniques could be brought together, and possibly included in HOMS.

(ii) It was noted that the initial purpose of project I.4**, that of providing hydrological information to grid point or average grid area values was not currently being pursued. However, it was considered that the two related problems, converting hydrological data to grid values and the using climate data from grid points in hydrological studies which need point/or catchment data, still need to be faced. There was seen to be a need for an interaction between hydrologists and climatologists to discuss how one can interchange hydrological and climatological data from grid point values to station or catchment (areal) values.

(iii) Climatologists are using many new methods by which to predict or forecast future climate. For example, as of late good correlation has been found between the southern oscillation, El-Nino and climate events. The meeting felt that hydrologists should be kept informed on what new predictive techniques were being developed so that they might incorporate the products of these techniques into their hydrological forecasts, if feasible. A dialogue between climatologists and hydrologists needs to be established in this regard.

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* described herein as Project A.2
** described herein as Project A.4

(iv) Although valuable work had been done in the area of the sensitivity of water-resource systems to climate variations (viz: WCP Report No. 98) work on project IV.l*** should be continued. In addition, any validation of models undertaken under the auspices of WCP-Water would be of considerable interest to HOMS.

Contribution by HOMS to WCP-Water

4. The meeting reviewed the current edition of the HRM and identified the sections and components which it felt would be of interest to each of the WCP-Water projects.

5. Relevant components were identified in all sections except A, G and Y. It should be noted that the meeting agreed with the proposals of the CHy Working Group on Hydrological Models and Forecasting as regards components in sections J and K.

CARS

6. It was noted that the mechanism for submitting and accepting CARS components was different from that used for HOMS components and that the two systems were being developed, in many details, along different lines. Nevertheless, the meeting felt that HOMS and CARS complemented one another in most respects. It was therefore considered that any CARS component which was relevant to HOMS and which met HOMS criteria could reside in both HOMS and CARS. Similarly, it was hoped that any HOMS component considered relevant to CARS would be incorporated in CARS.

7. In addition, it was recommended that HOMS and CARS reference one another in their manuals, publications and brochures, and that HNRCs be sent copies of CARS publications so that they might be aware of the system and have up-to-date information concerning it.

CLICOM

8. The meeting was informed of the work being undertaken on CLICOM and, in particular, the development of application software in the area of hydrology. It was recommended that any application software being developed in the area of operational hydrology for CLICOM should be a component of HOMS.

*** described herein as Project D.1

ANNEX 4

WORLD CLIMATE PROGRAMME - WATER (WCP-Water)

ACTIVITY AREAS

And

PRIORITY PROJECTS

As proposed by the Third Planning Meeting on WCP-Water
(Geneva, November 1985)

Summary Listing of Activity Areas and Priority Projects for WCP-Water
as prepared by the Third Planning Meeting on WCP-Water
(Geneva, November 1985)

A. STUDIES OF HYDROLOGICAL DATA IN THE CONTEXT OF CLIMATE VARIABILITY AND CHANGE

A.1 Analyzing historical hydrological and related information with respect to climate change

- IAHS with co-operation of Unesco, WMO, ICSU, other interested international bodies and national institutions
- 1983-90.

A.2 Analyzing long time series of hydrological data and indices with respect to climate variability

- WMO in co-operation with Unesco, IAHS and interested national bodies
- 1983-91.

A.3 Distinguishing between the influence of man's activities and that of climate variability on the hydrological cycle

- Unesco and interested Member States
- 1984-88.

A.4 Monitoring of glacier fluctuations

- ICSI (IAHS) with the support of Unesco and UNEP
- 1983-86 and continuing.

A.5 Collection of global runoff data sets

- WMO in collaboration with national institutions in the Federal Republic of Germany
- 1983-87 and continuing.

A.6 Transfer of hydrological information to grid point or average grid area values

- WMO in collaboration with national institutions in the Federal Republic of Germany
- 1982-88.

B. MODELLING OF HYDROLOGICAL CYCLE

B.1 Coupling of physically based climate and hydrological models

- WMO and ICSU
- 1986-89.

B.2 Development and application **of** second generation grid orientated hydrological modelling techniques

- WMO in co-operation with Unesco, IAHS and national institutions
- 1986-87 and continuing.

B.3 Development of grid-related estimates of hydrological variables

- WMO in collaboration with national institutions
- 1986-90.

B.4 Hydrological modelling in conjunction with HAPEX

- WMO and ICSU
- 1983-87 and continuing.

C. APPLICATION OF CLIMATE INFORMATION IN THE PLANNING, DESIGN AND OPERATION OF WATER-RESOURCE SYSTEMS

C.1 Application of climatological data and methods to water-resource projects

- WMO
- 1985-87.

C.2 Application of climate information for water projects in the Sahel

- WMO, with participation of countries of the Sahel and in collaboration with UNSO, CIEH, AGRHYMET Centre
- 1984-86 and continuing.

C.3 Application of climate information to irrigation water supply assessments in Africa using a digital geographic information system data base

- FAO in co-operation with interested member countries, WMO and Unesco
- 1985-86 and continuing.

C.4 Application of positional climatological information to water supply forecasting in the U.S.A.

- National agencies
- 1982-90.

C.5 Re-analysis of hydrological observations in Czechoslovakia

- Czech Hydrometeorological Institute
- 1986-94.

D. STUDIES OF THE INFLUENCE OF CLIMATE CHANGE AND VARIATION ON WATER RESOURCES

D.1 Sensitivity of water-resource systems to climate variations

- National institutions and WMO with contributions from Unesco, IIASA and IAHS
- 1983-90.

D.2 Use of climate data for the study, planning and management of water resources

- Unesco with co-operation of WMO, IIASA, IAHS and UATI
- 1984-89.

D.3 Study of the impact of climate variability and change on the occurrence of droughts

- Unesco in co-operation with WMO and IAHS
- 1984-88.

D.4 Study of the impact of climate variability and change on the occurrence of floods in urban areas

- Unesco in co-operation with WMO, IAHS and UATI
- 1984-89.

D.5 Testing the transferabililty of hydrological simulation models

- National institutions with international co-ordination by WMO
- Continuous.

E. IMPACT OF CLIMATE ON SOCIETY THROUGH WATER RESOURCES

- no projects proposed at this stage -

F. INFLUENCE OF MAN'S ACTIVITIES ON CLIMATE

F.1 Influence of water-resource projects on climate

- Unesco and UNEP in co-operation with national organizations
- 1986.

ACTIVITY AREA A

STUDIES OF HYDROLOGICAL DATA IN THE CONTEXT OF CLIMATE VARIABILITY AND CHANGE

An analysis of historical hydrological data and information and in particular of long hydrological time series is being undertaken in order to gain fuller knowledge of climate variability and a better understanding of the processes related to climate change, including the influence of man on climate.

Due to the close relationship between climate and hydrology, hydrological variables and water resources are very strongly influenced by variations in climate. In this respect, hydrological variables, such as surface runoff, can be considered as "climate variables" representing on a large scale in time and space the residual of precipitation and evaporation.

In addition, a continuing inventory of water resources, their supply, demands and their dynamics, is needed to provide hydrological data (precipitation, runoff, glacier fluctuations, etc.):

(a) to climate modellers for the validation of predictions;

(b) to researchers studying climate change and variability;

(c) to hydrologic modellers for validation of their models and methods and for use in sensitivity studies; and

(d) for the application to food, energy, economic and health problems.

In relation to (a) above, new methodologies should be developed to relate hydrological and physiographic data to grid points or areas so that they might be used in conjunction with atmospheric general circulation models (AGCMs).

Project A-1 Analyzing Historical Hydrological and related Information with respect to Climate Change

1. Background

Historical hydrological and related information concerning for example floods, low flow periods or river ice periods, is available in many countries in the form of direct information stored in archives or in the form of indirect information such as proxy-data (i.e. ice core data, dendrochronological data, sediment probes, historical records tied to climatological or hydrological parameters, etc.). This material has been used for specific studies but could be more broadly used for increasing our knowledge of variations in hydrological regimes during past centuries. Such information would be useful for analyzing climate change.

Several organizations, including some working within the framework of the WCP, have undertaken research in these fields. However, there is a need for more co-ordination between the individual research studies.

Research groups need information on existing inventories of historical hydrological data sources including proxy-data. Therefore, it would be necessary to compile information on existing data. Furthermore, a unified methodology is needed in the form of guidance material so that results of individual research groups can be compared. Hence it is necessary:

(a) to develop guidance material on the analysis of historical hydrological and proxy-data;

(b) to compile inventories of sources of historical data, including proxy-data.

2. Output

(a) Improvement of methodologies and as far as possible unification of them;

(b) Comparison of results using various approaches for specific climatological or hydrological variables and for specific periods;

(c) Support for the work of and provision of guidance to research groups.

3. Mechanism for implementation

(a) Preliminary planning;

(b) IAHS Symposium on the Influence of Climate Changes and Climatic Variability on the Hydrological Regime and Water Resources, Vancouver, August 1987;

(c) Round-table discussion at General Assembly of IUGG in Vancouver (August, 1987) on topics l(a) and l(b);

(d) Establishment of an ad hoc and temporary working group for liaison and to some extent co-ordination.

4. Organizations/bodies involved

IAHS responsible with co-operation from Unesco, WMO, ICSU and other interested international bodies and national institutions.

5. Tentative time schedule

Based on (a) to (c) of 3 above:

(a) 1983-86
(b) 1987
(c) 1987
(d) 1988-90.

6. Comments

This project involves the co-operation of many scientists from very different fields of research. This project started in 1983 and will become operational only after several years, at which time the project will encompass most of the related action.

Liaison necessary with Projects A.2 and A.3.

Project A.2 Analyzing Long Time Series of Hydrological Data and Indices with respect to Climate Variability

1. Background

In many countries long hydrological time series are available (e.g. for precipitation, discharge, water levels of rivers, estuaries, lakes). From these hydrological variables and relevant meteorological variables (e.g. air temperature) sets of hydrological statistics (annual mean, monthly mean, minimum values, exceedence for different time periods based on daily values, etc.) and indices (drought-index, etc.) can be obtained. This material should be used for improving knowledge of climate variability by being analyzed in that respect. In some countries relevant investigations are currently being undertaken.

Research groups need information on existing long time series. Therefore, it will be necessary to compile information on such time series and their availability. Furthermore, a unified methodology is needed in the form of guidance material so that the results of individual research groups can be compared.

Long hydrological time series are often influenced by man's activities. These effects have to be identified and eliminated in the time series so as to isolate the influence of climate change. A methodology for eliminating these effects will be developed under Project A.3.

It is necessary:

(a) to compile information on existing time series starting before 1900;

(b) to develop guidance material on analyzing long time series with respect to climatic variability.

2. Output

Round-table discussions were held in Hamburg in 1983. A preliminary proposal for the project was developed in 1984. A detailed draft methodology for the analysis of long-time series, including a computer program, was prepared in 1985.

Results of analyzing such long time series may give more detailed information on the variability of climate in time and space. The results will contribute to a better understanding of the physical processes behind climate variability.

3. Mechanism for implementation

(a) To make the results of such studies in different countries comparable with each other, a unified method is being developed and guidelines will be prepared for the use of existing statistical methods. As the problem is very complex, the appropriate methodology can be found only by trial and error (i.e. by application to concrete cases and critical analysis of the results). Consequently, it has been decided that the present set of instructions, formulae and the computer program are sufficient as a first stage. A number of institutions will undertake to apply the existing program to some basins with long records in their country and report on the results in a workshop to be convened during the IUGG Assembly in Vancouver;

(b) IAHS Symposium on the Influence of Climate Changes and Climatic Variability on the Hydrological Regime and Water Resources, Vancouver, August 1987;

(c) The round-table discussion in Vancouver referred to under 3(b) of Project A.1 could also aid in reviewing the interim progress of this project;

(d) As a result of the deliberations of the workshop referred to in (a) above, a revised form of the instructions and the programme will be prepared, to be distributed to a wider circle of research organizations;

(e) After this methodology is tested by these organizations and found satisfactory, WMO will send the final form of the instructions and the program to various countries that possess long hydrological data series;

(f) Member countries will be asked to analyze their long time series on the basis of the recommended statistical method;

(g) Results of these studies should be sent to WMO for a compilation of the results obtained in different countries.

4. Organizations/bodies involved

The project will be executed by WMO in co-operation with Unesco, IAHS and with the participation of those Members which have available long hydrological time series.

5. Tentative time schedule

Based on (a) to (g) under 3 above:

(a) 1983-87, draft of methodology completed 1985;
(b)-(d) 1987;
(e) 1988-1989;
(f) 1989-1990;
(g) 1991.

6. Comments

An expert to review all material which is published describing existing long time series of hydrological data. Countries to be asked for a compilation of this information by a questionnaire on their existing long hydrological time series. Data for the studies mentioned should be on a daily or at least monthly basis. Minimum length of records should be about 80 years. Furthermore, additional information on the stations and the catchments will be requested.

Liaison with Projects A.1 and A.3.

Project A.3 Distinguishing between the Influence of Man's Activity and Climate Variability on the Hydrological Cycle

1. Background

The assessment of the influence of man's management activities on the hydrological cycle is central to the problem of modern hydrology, especially considering the increasing scale of river runoff regulation, groundwater utilization and general changes in the environment. However, there are difficulties in differentiating between the influence of climate variations and man's actions, in particular as regards long series of stream flows. Therefore a methodology for use in differentiating between these two influences has to be identified using long time series of hydrological and climatic data, statistical methods, models and experimental data.

2. Output

A methodology for distinguishing between the effects of man's influence and climate variability on the different elements of the hydrological cycle.

3. Mechanism for implementation

(a) Compilation of relevant methodologies by the group of rapporteurs for Unesco/IHP-III Project 6.3 "Establishment of a methodology for distinguishing between man's influence and climate variability on the hydrological cycle, in particular streamflow and ground water";

(b) Preparation of a state-of-the-art report on methodologies for distinguishing between man's influence and climate variability on the hydrological cycle;

(c) Support to the IAHS Symposium on Influence of Climate Changes and Climatic Variability on the Hydrological Regime and Water Resources, Vancouver, August 1987.

4. Organizations/bodies involved

The project will be executed by Unesco with the participation of those Member States which have long hydrological series and other pertinent data.

5. Tentative time schedule

(a) 1984 - appointment of rapporteur and agreement on his plan of work;

(b) 1986 - first draft of the report;

(c) 1987 - report for the symposium in Vancouver;

(d) 1988 - publication of the report by Unesco.

6. Comments

Liaison with Projects A.1 and A.2.

Project A.4 Monitoring of Glacier Fluctuations

1. Background

In some alpine countries glacier fluctuations have been observed for many decades. Since 1960 glacier observations have been standardized on an international level and published on a five-year basis by the Permanent Service on the Fluctuations of Glaciers (PSFG). Four volumes of "Fluctuations of Glaciers" have been published.

Since 1976, the Temporary Technical Secretariat (TTS) for World Glacier Inventory has assembled national or regional glacier inventories using a computerized data system. This project was mainly complete by mid-1985, by which time a joint programme had been developed. This new programme combines the TTS and the PSFG. Reference glaciers are being chosen on the basis of the World Glacier Inventory and national inventories. These glaciers will be monitored in detail (annual mass balance).

2. Output

(a) Record of long time series of glacier variations;

(b) Monitoring climate variations in all glaciated regions on the basis of mass-balance studies of reference glaciers.

3. Mechanism for implementation

National correspondents (institutions) have been invited to participate and these contacts are already well established. A central secretariat is responsible for collection, assembling and publication.

4. Organizations/bodies involved

(a) ICSI of IAHS with the support of Unesco and UNEP;

(b) Some institutions to furnish the infrastructure of the secretariat (e.g. free use of computer);

(c) National institutions as correspondents.

5. Tentative time schedule

prior to 1985	Completion of the World Glacier Inventory
1983-1986	TTS to select reference glaciers in collaboration with national correspondents
1985	Publication of Vol. IV of "Fluctuations of Glaciers" (1975-1980)
1986	Start of compilation of Vol. V (1980-1985,)

6. Comments

Liaison with Project A.l.

Project A.5 Collection of Global Runoff Data Sets

1. Background

An international data base of hydrological data is considered as necessary for estimating land surface related hydrological inputs/outputs of atmospheric general circulation models (AGCMs), for testing grid orientated estimation techniques for such inputs/outputs, for validation of AGCMs and other purposes, the initialization of the hydrological components in AGCMs and for the validation of such models. AGCMs use large scale grids of 2 1/20 or 50 km x 250 km and larger) which are too large to be represented by more (2 single hydrological time series. Therefore, it is necessary to select hydrological data sets such as runoff values of small river basins (100-5000 kmz) each representative of a hydrologically homogeneous region within the grid meshes. It is necessary to complete the data sets by data from large river basins. These data sets, once assembled, will also be of great value for a number of purposes other than the study and development of AGCMS.

2. Output

(a) Global data base for surface water runoff from about 1500 selected stations; daily and/or monthly values;

(b) Support for the development of AGCMS;

(c) Service to other activities requiring such data.

3. Mechanism for implementation

(a) Collection of runoff data for years 1978-80 and related catchment maps;

(b) Assembling of global data base and establishment of global data c6ntre;

(c) Collection of runoff data for subsequent years;

(d) Maintenance of data centre and up-dating of data set.

4. Organizations/bodies involved

Based on (a) to (d) of 3 above:

(a) and (c):	WMO Secretariat	
(b) and (d):	1983-87	- Institute for Bioclimatology and Applied Meteorology, MUnich, Federal Republic of Germany
	after 1987	- Federal Institute of Hydrology, Koblenz, Federal Republic of Germany

5. Tentative time schedule

Based on (a) to (d) of 3 above:

(a) and (b) - completed by end of 1985;

(c) and (d) - continuing activity 1985 and thereafter.

6. Comments

Liaison necessary with Project A.6

Project A.6 Transfer of Hydrological Information to Grid Point or Average Grid Area Values

1. Background

Atmospheric general circulation models (AGCMS) are based on grid values for their parameter inputs. Station networks and basins are not uniformly distributed in space and are not always representative of the various types of physiographic characteristics (topography, soil, vegetation, etc.). This makes it difficult to transform the observed hydrological data to grid points. Physiographic and other characteristics have also to be transformed to grid points. The relevant methodology has to be developed.

2. Output

(a) Methodology for the transfer of hydrological information as well as physiographic and other characteristics to grid point or grid area values;

(b) Availability of methodology for modellers of AGCM'S.

3. Mechanism for implementation

(a) Compilation of relevant methodologies by a consultant;

(b) Review of the compilation by a meeting of experts.

(c) Development of a selected methodology by a national institute;

4. Organizations/bodies involved

WMO in collaboration with Institute of Bioclimatology and Applied Meteorology in Miinich, Federal Republic of Germany.

5. Tentative time schedule

Development of preliminary methodology 1984 Further implementation 1986-1988

6. Comments

Liaison with Projects A.5, B.2 and B.3.

ACTIVITY AREA B

MODELLING OF THE HYDROLOGICAL CYCLE WITH SPECIAL REGARD TO PROVIDING INPUTS FOR CLIMATE MODELS

The quantitative coupling of climate, hydrologic and water-resource systems can best be achieved within the framework of mathematical models of the hydrological cycle. However, nearly all existing hydrological models are river basin orientated and so are their atmospheric inputs and outputs (precipitation and evapotranspiration). This is one reason for the recent difficulties in coupling hydrological models with atmospheric general circulation models (AGCMs), the latter being generally grid oriented with standard grid scales of 5 or 2.5 degrees. Even when the hydrologic and climate models are not directly coupled but run in parallel, enormous difficulties exist in providing the required input data from one model to the other. For the same reason, it is impossible to make direct use of observed river discharges for climate studies over an area.

The most practical way of overcoming this difficulty would appear to be by developing and applying a second generation of grid-orientated hydrological modelling techniques which can take account of all land surface related moisture and heat fluxes. Outputs of these models are related primarily to grid areas. However, if one wishes to use the outputs for flow components (overland flow, percolation, interflow, base flow, streamflow) in any river basin studies then these outputs must first be related to basin divides. For this reason they must be routed and superimposed with special regard to the storage and delay processes within the different hydrological subsystems of the river basin. This should be taken into account when using discharge records for such studies and, in particular, for validating AGCMS.

Thus, intensified research activities are required in the field of hydrological modelling in the framework of the projects listed below. It is quite obvious that for these projects causal physically-based models are preferred. The explanatory power of causal models makes them especially attractive to WCP-Water because they have the potential of making inferences about events and their impacts which are beyond the range of past observations, as well as about the consequences of man's influence on the natural processes involved.

While recognizing the legitimacy of many categories of models, special emphasis should be put on those which are based on the dynamics of the physical processes involved, including the feedbacks between the processes traditionally treated independently of each other. The inclusion of such feedbacks will call for innovative approaches and a re-examination of the traditional dividing lines.

Project B.1 Coupling of Physically Based Climate and Hydrological Models

1. Background

It is considered that the further development and improvement of physically-based mathematical models of the atmosphere would gain greatly from a better understanding of the effect on climate of hydrological processes and an upgrading of the manner in which such processes are incorporated into atmospheric general circulation models (AGCMs).

2. Output

(a) Presentation of practical ways for bringing together results of physical climate and hydrological modelling in order to accommodate the physically based relationships (feedbacks) which are mostly being neglected in the current practice of modelling;

(b) Specifications of input data requirements to be considered by:

-- climate modellers
-- hydrologic and water-resource system modellers.

3. Mechanism for implementation

(a) A workshop, of about one week's duration, with attendance limited to scientists and professionals actively working in physically based climate and hydrological modelling;

The primary objective would be to propose specific research projects and approaches that seem promising for coupling physically based climate and hydrological models;

A second objective would be to agree on guidelines as to how appropriate scenarios of climate change and variation should be established which can then be taken as inputs into hydrological and water-resource system models for investigating the influence of climate change and variation on these systems and for sensitivity analyses;

(b) Follow-up action on basis of workshop proposals.

4. Organizations/bodies involved

International organizations with WMO as lead agency in co-operation with ICSU.

5. Tentative time schedule

Informal discussion mid-1986; Workshop late 1986;
Workshop late 1986;
Follow-up action, possibly under WCRP and in conjunction with Projects B.2 and B.3, 1987-89.

Project B.2 Development and application of second generation grid orientated hydrological modelling techniques

1. Background

In order to permit the coupling of climate and hydrological models, it will be necessary to develop grid orientated hydrological models which can take account of land surface related moisture and heat fluxes.

2. Output

Improved methods (hydrological models) and computerized technologies for estimating water transfer at the land surface, in particular areal evapotranspiration, dependent upon climatic, physiographic and other characteristics (e.g. soil, land use, vegetation, geology).

3. Mechanism for implementation

(a) Compilation and review of existing grid orientated hydrological modelling techniques;

(b) Preparation of a report and development of specific conclusions and proposals for research activities;

(c) Follow-up activities according to the conclusions of the report under (b), in particular the development of advanced technologies for grid orientated hydrological modelling.

4. Organizations/bodies involved

WMO in co-operation with Unesco, IAHS and national institutions.

5. Tentative time schedule

Based on (a) to (c) of 3 above:

(a) and (b) by WMO/CHy Rapporteur on Hydrological Models in conjunction with Cliy Rapporteur on Areal Assessment of Hydrological Elements and other co-authors July 1987;

(c) after 1987.

6. Comments

Liaison with Projects B.1 and B.3.

Project B.3 Development of grid-related estimates of hydrological variables

1. Background

No widely accepted methodology exists for transferring information from river gauging stations. to grid points or areas. Such a methodology is required, however, for making use of information on observed streamflow in the development and use of atmospheric general circulation models (AGCMs).

2. Output

(a) A methodology and generalized procedures for using grid-related estimates of hydrological variables for the generation of time series of river discharges;

(b) Application and verification of the procedures in selected test river basins;

(c) Procedures or at least recommendations for "transferring" hydrological information from river gauging stations to grid point or grid area values.

3. Mechanism for impleaentation

(a) Compilation and review of existing procedures;

(b) Development of a specific project proposal;

(c) Meeting of experts to elaborate the project proposal and plan co-ordination of national activities for the development and application of existing procedures;

(d) Case studies by national institutions;

(e) Coordinated review of case study results and development of conclusions.

4. Organizations/bodies involved

WMO in collaboration with national institutions.

5. Tentative time schedule

1986-90.

6. Comments

Liaison with Projects A.6, B.11 B.2 and B.4.

Project B.4 Hydrologqical modelling in conjunction with HAPEX

1. Background

There is ample evidence of the sensitivity of climate to changes in heat and moisture fluxes at the land surface. The purpose of the WCRP project for Hydrological-Atmospheric Pilot Experiments (HAPEX) is to improve our understanding of the processes involved and to provide a basis for developing and testing improved parametric formulations of these processes for use in atmospheric circulation models. HAPEX field studies will collect comprehensive sets of hydrological, atmospheric and related data for a number of specific sites. The interpretation and use of these data will require the application of hydrological models designed or amended specifically for the purpose.

2. Output

(a) Data processing and hydrological modelling techniques for use in HAPEX;

(b) Sets of original and processed data from HAPEX field studies stored at a central repository or repositories.

3. Mechanism for implementation

(a) Development and/or revision of techniques by seconded experts and by national experts involved in HAPEX field studies;

(b) Collation and storage of HAPEX data sets.

4. Organizations/bodies involved

WMO/ICSU under WCRP.

5. Tentative time schedule

1983-85	Review of existing techniques and HAPEX requirements
1986	Selection and application of specific techniques
after 1987	Establishment of HAPEX data banks.

6. Comments

Liaison with Projects B.1, B.2 and B.3.

ACTIVITY AREA C

APPLICATION OF CLIMATE INFORMATION IN THE PLANNING, DESIGN AND OPERATION OF WATER-RESOURCE SYSTEMS

Water-resource projects can sometimes be planned, designed and operated purely on the basis of hydrological data. When such data are not sufficient, use must be made of other data, particularly climatological data. Even when a reasonable to good set of hydrological data is available, the use of climatological data can greatly improve the planning and design. In many cases the only local data are climatological and these must be used to derive estimates of hydrological and water-resource parameters for the localities concerned.

Long-range weather outlooks for periods of one to three months hold great potential for the improved management of water resources through their use in deriving predictions of future water supply and demand. The current uncertainty in these predictions means that a probabilistic approach needs to be taken.

There is a need for studies and guidance as to what climate information can be used and how in the planning, design and operation of water-resource systems. Future improvements in long-range climate predictions should be followed with a view to their being used to enhance water-resource management practice.

Project C.1 Application of climatological data and methods to water-resource projects

1. Background

The planning, design and operation of many water-resource projects is based in large part on the analysis of climatological data. Current practice already demonstrates the value of this approach and can provide the basis for the development of guidance on the subject.

2. Output

Guidance on the application of climatological data and methods to water-resource projects.

3. Mechanism for implementation

Preparation of a technical report.

4. Organizations/bodies involved

WMO through CHy Rapporteur on WCP-Water.

5. Tentative time schedule

1985 draft outline of report 1986-87 preparation of report

6. Comments

Liaison with Project D.2.

Project C.2 Application of Climate Information for water projects in the Sahel

1. Background

Nowhere has the impact of climate variability been more evident in recent years than in the Sahel. The central factor in all considerations of the droughts and desertif ication in the region is the shortage and unreliability of water supplies. Of all regions, therefore, the Sahel is one where all available information should be used to ensure the best designed and most efficiently operated water projects. This includes the use of climate information in the planning, design and operation of such projects.

2. Output

(a) Guidance on the use of climate information in conjunction with hydrological data for the design and operation of water projects, in particular where such information and data are scarce;

(b) Contributions to studies of the impact on water systems of climate variability in the Sahel;

(c) Assistance in the practical application of climate information for water projects in the Sahel.

3. Mechanism for implementation

The above outputs will be achieved through a series of activities undertaken as the opportunity arises and as funds permit, principally in collaboration with other international and region bodies.

The AGRHYMET Programme (including the AGRHYMET Centre in Niamey) provides an infrastructure, including a data base and computer facilities, and iL pursues a programme of activities closely related to the subject of this project.

The United Nations Sahelian Office (UNSO) and the Comit4 Inter-africain d'Etudes Hydrauliques (CIEH) are both involved in related activities.

Certain activities of a technical assistance nature will be undertaken with the financial support of UNDP or WMO's Voluntary Corporation Programme (VCP).

4. Orqanizations/bodies involved

WMO, with the participation of the countries of the Sahelian region and in collaboration of UNSO, CIEH and the AGRHYMET Centre and with the financial support of UNDP and other donors.

5. Tentative time schedule

1984	Preparation of a report on derivation of design floods for small basins in the Sahel (WMO/UNSO);
1985	Preparation of a report on application of climate information and hydrological forecasts for the Sahel (WMO);
1986	Technical meeting on hydrological design criteria for use in the Sahel (Dakar) (WMO/CIEH/UNSO);
after 1986	Continuing activities similar to the above.

Project C.3 Application of climate information to irrigation water supply assessments in Africa using a digital geographic information system data base

1. Background

A digital geographic information system (GIS) data base for Africa has been prepared by FAO with UNEP funding in connexion with a desertification study. Twenty-three maps have been digitized and processed at a scale of 1 to 5 million including political boundaries, soils (FAO soil map), geology (Unesco map), watersheds, annual rainfall, river systems and physiography. Because of FAO's emphasis on Africa and the need for consistent information on water and irrigation potential, the Africa GIS is being used as a basis for developing a methodology for water supply assessment on a regional and continent-wide basis.

2. Output

Broad scale climate information (annual precipitation, temperature, evapotranspiration) will be combined with elementary water balance principles to develop a preliminary assessment of water supply for irrigation systems in selected watersheds in Africa.

3. Mechanism for implementation

The work is being undertaken by the Land and Water Division of FAO as part of agency wide studies of strategies for increasing food production in Africa.

4. Organizations/bodies involved

FAO will coordinate the work closely with interested member countries, WMO and Unesco.

5. Tentative time schedule

The project is initiated (February 1985) and preliminary results are expected in April 1986. The work will be continuing.

6. Comments

Liaison to Projects A.5 and B.2.

Project C.4 Applications of Positional Climatological Information to Water Supply Forecasting in the United States of America

1. Backqround

Monthly weather outlooks are made by the US National Weather Service'S Climate Analysis Centre. These can lead to a positional* or conditional climatology appropriate to the present state of the climate system. This climatology, together with current and historical time series of hydrometeorological data, can then be used as input to hydrological models to produce an ensemble of possible future streamflow hydrographs which can then be analyzed in a statistical sense to produce probabilistic Extended Streamflow Predictions (ESP's) for specified time periods in the future. The NWS's Office of Hydrology and related components will produce such forecasts for selected basins and these will be evaluated from the standpoint of their usefulness for water managers who must make decisions on possible operational alternative for various water-resource systems.

2. Output

(a) Prototype for the potential application of climate information in water-resource management;

(b) Evaluation of improved skill achieved in Extended Streamflow Predictions for monthly and seasonal time periods through the incorporation of positional climatological information;

(c) Formulation of objective procedures for incorporating positional climatological information into hydrologic forecasting methodology to produce probabilistic Extended Streamflow Predictions;

(d) Report describing results of project, including procedural recommendations and recommendations for future development and research.

3. Mechanism for implementation

The procedures will be implemented in the USA for selected basins through co-operation between the US National Weather Service and water authorities who potentially will apply the Extended Streamflow Predictions as inputs to their water-resource planning, management and operations.

4. Organizations/bodies involved

The principal organization involved in this project will be the US National Weather Service in co-operation with other water and climatological organizations in the USA.

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* Positional climatology in this context is that climatological information and forecasts which allows one to position or weight historical time series of hydrometeorological data in relation to current weather patterns so that they may be used in hydrologic simulations leading to probabilistic Extended Streamflow Predictions.

5. Tentative time schedule

(a) Development of Data Base of Positional Climatological Information ongoing;

(b) Development of initial hydrological prediction;

(c) Implementation of procedures for selected basins - 1985-1987;

(d) Evaluation of improved skill achieved in probabilistic ESP with incorporation of positional climatological information - 1987-1988;

(e) Refinement and revision of techniques, and final testing;

(f) Prepare final report - 1990.

6. Comments

This project will be conducted in close co-operation with other projects under Activity Area C, which are being coordinated internationally by the WMO.

Project C.5 Re-analysis of hydrological observations in Czechoslovakia

1. Background

Hydrological and related climatological data have been collected and stored in Czechoslovakia for many decades. They have been analyzed as a basis for evaluating the country's water resources and for other purposes. From time to time such evaluations are revised to take account of new data that have become available and/or amendments to national water policy. Recent developments in our understanding of climate, its variability and its impact on available water resources may lead to new approaches in the assessment of water resources and call for a re-analysis of the existing hydrological records.

2. Output

(a) Review of existing national methodologies for the analysis of hydrological data and the assessment of available water resources;

(b) Review of international guidance in this field, in particular in association with Projects A.2 and D.1, and their pilot application in Czechoslovakia;

(c) Re-analysis of certain hydrological and climatological observations in Czechoslovakia;

(d) Proposals for further development and future application of methodologies at national and international levels.

3. Mechanism for implementation

The work will be undertaken by national experts, with assistance from international experts as and when appropriate.

4. Organizations/bodies involved

The Czech Hydrometeoro.logical Institute, Prague.

5. Tentative time schedule

Based on (a) to (d) of 2 above

(a) 1986-1988
(b) 1988-1994
(c) starting 1986
(d) 1954

6. Comments

This project will be closely coordinated with Projects A.2, D.1 and D.5.

ACTIVITY AREA D

STUDIES OF THE INFLUENCE OF CLIMATE CHANGE AND VARIATION ON WATER RESOURCES

The projects under this activity field are divided into groups each prompted by a major observation about climate's impact on water resources.

Perhaps the most important outcome of any study in this area is a statement of the effect on water-resource decision variables of changes in climate inputs, whether actual, predicted or presented only as possible future scenarios. This activity therefore includes all sensitivity analyses, whether on hydrological variables or on water-resource decision variables (Project D.1).

The second class of projects is inspired by the recent altered perspective on climate, i.e. that it is in continual motion. Movements which occur over a time scale of, say, 30 to 80 years are of particular importance as these are the planning horizons for current human activity in water-resource projects. Movements which occur over a 10-30 year time scale are important in that this is often the order of duration of our data base on which the scheme is designed. Within this time scale we conventionally ignore the possibility that part of the variation is due to movement and we tend to assign the total variability to the single causes of local fluctuation about a locally stable average value.

The final premise on which the projects in this activity field are founded is the idea that there is a distinction between hydrological variables (e.g. aquifer level, runoff volume, flood frequency distribution), and water-resource decision variables (e.g. reservoir volume, hundred year flood, crop water use). In some cases the difference is slight, but in general it can be stated that hydrological variables are directly measured or derived from measurements with little intervention. Water-resource decision variables tend to be derived quantities somewhat remote from the basic measurements. Thus it is often the case that the relationship is sufficiently obscured so that one cannot directly and simply estimate the effect of an alteration in .the governing hydrological variables on the derived water-resource variable.

The question of establishing appropriate scenarios for climate changes and variations to be expected within the planning period of important water-resource projects is covered under Activity Area B.

Project D.1 Sensitivity of Water-Resource Systems to Climate Variations

1. Background

Hydrologists, water-resource planners and managers are increasingly alerted to the differences in the properties of climate and hydrological quantities as measured over different time periods. This realization, and the need to take action, exist independently of whether the differences are the product of sampling variability or intrinsic non-stationarity due to climate change. The problem is especially acute in arid and semi-arid regions where variability, for example in annual runoff, is already high so that stable estimates of design quantities are difficult to achieve but where the need for water-resource schemes to compensate for the uncertainty and shortages of supplies is most vital.

2. Output

(a) The enhancement of our understanding of the origin of interannual and seasonal variability and the persistence properties of salient hydrological variables;

(b) An increase in our application of the performance of different hydrological modelling techniques in replicating the response to climate inputs;

(c) Estimates of the sensitivity of hydrological outputs due to possible changes in climate inputs;

(d) Estimates of the sensitivity of water-resource outputs (e.g. the reliability of a reservoir or the value of the 100-year return period flood) to changes in the hydrological input series.

3. Mechanism for implementation

A report on the subject has been prepared under the auspices of WMO. This project now calls for further applied research, which should be based on studies of a range of river basins and water-resource systems.

It is felt that the larger part of the effort should be devoted to the roblem of change in hydrological output expressed as a function of a given change in climate input (mainly precipitation). Large basins which illustrate different rainfall and temperature regimes should be selected. All forms of modelling and approaches should be encouraged ranging from simple water and energy balance formualtions to conceptual models. However, more emphasis should be given to those models which successfully passed the tests suggested under Project D.5.

4. Organizations/bodies involved

Research at national level.

WMO at international level, with contributions from Unesco, IIASA and IAHS.

5. Tentative time schedule

1983-85	National research and development
1985	Issuing by WMO of a report
1986-90	Further research and development at national level
1987	Report to IAHS Symposium on the Influence of Climate Changes and Climatic Variability on the Hydrological Regime and Water Resources, Vancouver.

6. Comments

Closely linked with Project B.1, and the outcome of the workshop foreseen for that project, and with Projects D.2 and D. 5.

Project D.2 Use of Climate Data for the Study, Planning and Management of Water Resources

1. Background

The relationship between climate and the water-resource system on the earth is unique in the sense that parts of the hydrological cycle, namely precipitation and evapotranspiration, are also important characteristics of climate. The hydrological cycle is in turn the very basis of availability of water resources. It is possible to consider hydrological processes as a transfer function from the climate system to the water resource system and vice versa, the function being under different circumstances part of both systems. With the increasing use of water resources the vulnerability of society with regard to fluctuations in water supply due to climatic variability is likely to increase. It is, therefore, important to promote the understanding and better use of climate information by hydrologists in order to improve the design of water projects, the use of existing knowledge on climate variability and its impact on water availability and on water-resource systems and society in general.

2. Outputs

(a) Promotion of national studies that involve climatologists, hydrologists, water-resource systems specialists and decision makers;

(b) Compilation and review of existing information on the relative vulnerability of different water-resource systems to climate variability and change. (This review is primarily for the information of hydrologists, water-resource systems specialists and decision-makers.);

(c) Promotion of the introduction of climatology into curricula for the training of water-scientists through the preparation of a source book on climatology for hydrologists and water-resource engineers.

3. Mechanism for implementation

(a) The National Committees for IHP are requested to provide national reports by 1988 in the framework of IHP III project 3.1 (a);

(b) The IHP Council has appointed rapporteurs in the framework of IHP project 3.2 (d) to prepare a technical report describing the relative vulnerability of different water management systems and related socioeconomic aspects to climate variability and change. A draft of this technical report will be discussed at the IAHS Symposium on the Influence of Climate Changes and Climatic Variability on the Hydrological Regime and Water Resources in Vancouver in 1987. The publication of the technical report is planned for 1988 (this report is also related to Activity Area E);

(c) The IHP Council has appointed rapporteurs in the framework of IHP III project 3.1 (b) to prepare a source book on climatology for hydrologists and water-resource engineers. A draft version of the source book will be discussed at the Vancouver Symposium in 1987 and publication is planned for 1988-89.

4. Organizations/bodies involved

Unesco with co-operation of WMO, UNEP, IIASA, IAHS and UATII

5. Tentative time schedule

1984-85 Appointment of rapporteurs and agreement on their work plans;

1986-89 Preparation and publication of report and source book.

6. Comments

Liaison with Projects C.1, D.1, D.3 and D.4.

Project D.3 Study of the Impact of Climatic Variability and Change in the Occurrence of Drouqhts

1. Background

There is a need to provide hydrologists with advice on how to make better use of climatological information in order to enable them to better understand the occurrence of hydrological droughts, including associated climate events. The aim is to improve related risk assessment, planning and management for the prevention and mitigation of the consequences of the natural hazards concerned.

2. Antic

(a) Promotion of national studies;

(b) Publication of a technical report.

3. Mechanism for implementation

(a) The technical report will be prepared by the rapporteur for the Unesco/IHP-III project 3.4;

(b) Convening of a symposium under Unesco/IHP-III in co-operation with IAHS.

4. Orgaiizations/bodies involved

Unesco in co-operation with WMO and IAHS.

5. Tentative time schedule

(a) Appointment of rapporteur and agreement on his work plan - 1984-85;

(b) First draft of the report will be presented and discussed during the IAHS Symposium on the Influence of Climate Changes and Climatic Variability on the Hydrological Regime and Water Resources, Vancouver, August 1987;

(c) Publication of the report by Unesco in 1988.

6. Comments

Liaison with Projects D.2 and D.4.

Project D.4 Study of the Impact of Climate Variability and Change on the Occurrence of Floods in Urban Areas

1. Background

Current design practice for urban drainage systems takes no account of possible climate change due to the effects on climate of the urban area. There is evidence of changes in rainfall rates and the incidence of heavy rainstorms which can cause more severe flood problems than hitherto.

2. Anticipated output

Improved awareness amongst urban designers of possible greater vulnerability of current drainage systems to floods and the development of design modifications to overcome the hazard.

3. Mechanisms for implementation

Through Unesco under IHP-III project 8.3.

4. Organizations/bodies involved

Unesco in co-operation with WMO, IAHS and UATI.

5. Tentative time schedule

1984-1989.

6. Comments

Liaison with Projects D.2, D.3 and with the WMO programme of activities in urban climatology.

Project D.5 Testing the transferability of hydrological simulation models

1. Backqround

Remarkable progress has been achieved during the past period in the better understanding of problems related to the use of mathematical models of river basins for investigating changes in the hydrological regime due to climate variations (or changes) and/or other causes, such as land-use changes. Following this, consideration has turned to the usefulness, indeed the necessity, of testing more carefully the transferability of catchment models from gauged to ungauged basins or from given to changed conditions (climate or land-use changes, etc.), which is a prerequisite for the application of these models in studies of the effects of various changes in the physical conditions in a basin on its hydrological regime.

Moreover, it was felt that intensified activities in the development of hydrological models which meet the demands of physical soundness, geographic, climate and land-use transferability are most desirable and could contribute greatly to better solutions of the problems being considered within this activity area.

Long-term activities involving the testing of hydrological simulation models should continue. It is recognized that the testing of model transferability will require considerable research efforts and that, even if specific activities would be initiated immediately, it would take some time before results could be obtained which would contribute directly to the objectives of the WCP and the Operational Hydrology Programme of WMO. Because of this, the recommendation for the above project should not be construed as a recommendation to terminate studies of climate-impact assessment along the lines already pursued.

2. Output

Guidance and practical experience on the transferability of hydrological simulation models.

3. Mechanism for implementation

Studies and testing of various hydrological models.

4. Organizations/bodies involved

National studies with international co-ordination by WMO.

5. Tentative time schedule

Continuous.

6. Comments

Liaison with Project D.l.

ACTIVITY AREA E

IMPACT OF CLIMATE ON SOCIETY THROUGH WATER RESOURCES

The impact of climate on society through water resources can be considered on several levels. One is a simple statement of the type of impact that a climate change or variation has on the population of a given region either directly, through significant changes in hydrological characteristics, or indirectly through the projection of these water-regime changes into other areas of vital societal importance such as food, energy and health. It should be noted that the final impact might be positive or negative, not only as a function of the climate change or variation itself but also as a consequence of the effect of the change in hydrological characteristics on societal interests. For example, flooding in moderation can be beneficial to some societies and reduced variability in streamflow could be detrimental.

A higher level involves the study of the adaptability of the given population to such impacts. For example with regard to the impact of droughts and floods, two major hypotheses have been posed (Warrick, 1980; Sugawara, 1978). The first states that persistent and adaptive societies, through their technological and social organization, lessen the impacts upon the resident population of frequent climate fluctuations or climate related events. The second hypothesis states that success in insulating a society from relatively frequent events of climate origin, where the society is becoming increasingly complex both socially and technically, will inc ease the vulnerability of such a society to natural (climate-related) as well as to social perturbations that occur much less frequently.

ACTIVITY AREA F

INFLUENCE OF MAN'S ACTIVITIES ON CLIMATE

There is much interest in both scientific and more general circles as to whether man's activities are influencing or will influence the climate. It is proposed that such an influence might be exerted through changes in the hydrological regime. If such a proposition is to be seriously studied, there is need for an improvement of the representation of the climate forcing functions in the modelling of the hydrological cycle under man's intervention. Results of such studies would help to separate man-made changes in the hydrological cycle from natural variability and would also help to reconstruct non-influenced conditions.

Project F.1 Influence of Water-Resource Projects on Climate

1. Background

Water projects (e.g. reservoirs, diversions, irrigation and drainage works) may influence the micro-climate or possibly the meso-climate in their vicinity. In several countries an environmental impact assessment, including an assessment of climate change which may result from the water project prior to the implementation of such projects, is compulsory. There are in existence several projects where some information is available which may prove useful for the estimation of the effect of future water projects on climate.

2. Output

(a) To detect the presence and scale of climate change resulting from existing projects under different climatic conditions;

(b) To develop methods for the prediction of effects of water projects on climate, in particular for the purposes of environmental impact assessment;

(c) To compile case studies on specific proposed water projects (e.g. reservoirs, diversions, irrigation and drainage works) on the climate;

(d) Proceedings of International Symposium on the Impact of Large Water Projects on the Environment, Paris, October 1986.

3. Mechanism of implementation

(a) A survey by national organizations and/or consultants of available information on the influence of water projects of different types and sizes;

(b) An analysis of such existing projects from the point of view of their impact on climate;

(c) A case study, or case studies, involving environmental impact assessments, of proposed diversions, inter-basin transfers to estimate their influence on climate.

(d) International symposium in 1986.

4. Organizations/bodies involved

Unesco, UNEP in co-operation with national organizations.

5. Tentative time schedule

1986 - International symposium.

ANNEX 5

INTER-RELATIONSHIPS BETWEEN WCP-WATER PROJECTS