WORLD CLIMATE PROGRAMME

APPLICATIONS and SERVICES


# STEERING COMMITTEE

# ON

# WORLD CLIMATE PROGRAMME - WATER

## (GENEVA, SWITZERLAND, 23-25 October 2000)

## FIRST MEETING

## FINAL REPORT

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## 1. EXECUTIVE SUMMARY

1.1 The World Climate Programme-Water (WCP-Water) was established in 1981 as a joint World Meteorological Organization (WMO) - United Nations Educational, Scientific and Cultural Organization (UNESCO) activity *to meet more effectively the socio-economic needs which depend on water-resource systems, through the improved application of climate data and information*. In the ensuing years, WCP-Water activities were organized under four broad topical areas and involved more than three-dozen priority projects. Some of these, such as project A.5 (Collection of Global Runoff Data Sets; which lead directly to the establishment of the Global Runoff Data Centre [GRDC]) have been enormously successful and enduring. Overall, the most important contribution of WCP-Water has been in linking climate and water (hydrology and water resources), in terms of both process science and empirical studies of impacts through the initiation and promotion of projects implemented by Members. Its most significant shortcomings, though, have been in sustaining projects long enough to obtain publishable results, and insuccessfully monitoring a large number of projects with respect to its goals and expected deliverables. As a consequence of these shortcomings, few WCP-Water projects had an impact on such important international programmes as the World Climate Programme (WCP) and the Intergovernmental Panel on Climate Change (IPCC).

1.2 To improve the visibility and effectiveness of WCP-Water, WMO and UNESCO decided to re-organize the programme. The aim being to make the programme a more effective vehicle for addressing priority societal issues that could benefit from a better understanding of how hydrology and water resources respond to climate events, variations, and changes. This report presents the elements of this reorganization. It establishes a revised goal for WCP-Water, i.e., ***to promote hydrological activities in the World Climate Programme and related conventions, and to provide the water community with current data and information on hydrological and water resources conditions and variations, in a climatic context, over a wide range of time and space scales.*** It also explicitly proposes that initial efforts be concentrated on implementing activities in three priority areas of social concern: climate, water and health; climate, water and food security; and climate-related natural disasters and hydrological extremes in vulnerable basins. Additionally, the report includes a series of distinct projects, to be implemented in a progressive framework during the period 2001-2003, as well as guidelines for implementing and administering the programme and its activities. In so doing, a thoughtful effort has been made to ensure that WCP-Water has a viable and unambiguous framework for achieving its goal.

## 2. INTRODUCTION

2.1 In the process leading to the seventh planning meeting of WCP-Water (May 1997), several programme participants noted that existing programmatic and administrative linkages within WCP-Water were inadequate to facilitate meaningful interaction among the hydrology and climatology programmes of the various agencies. As an example, it was pointed out that WCP-Water was not explicitly involved in the hydrological and water resources activities of the Intergovernmental Panel on Climate Change (IPCC). This was surprising given that WCP-Water had facilitated more studies of the linkages between climate and hydrologic conditions, as well as the impacts of climatic variability and change on water resources, than any other single programme since its inception in 1981.

2.2 At the Seventh Planning Meeting, held in Koblenz 14-16 May 1997, participants therefore considered potential changes to WCP-Water, and recommended the establishment of a Panel to review the programme's aims and structure. The Review Panel met in Espoo, Finland on 21-22 August 1998, immediately following the Second International Conference on Climate and Water (CAW2). Many of the Conference's conclusions and recommendations provided a basis for the work of the Review Panel. The Review Panel's report is included, in its entirety, as Annex 3 to this report.

2.3 The most significant elements of the report included a revised perspective and goal for WCP-Water (*To promote hydrological activities in the World Climate Programme and related conventions, to provide the water community with current data and information on climate variability and change over a wide range of time and space scales*); the establishment of a Steering Committee to oversee the activities of the programme; and recommendations with regard to focal areas of future activities of a re-structured programme together with concrete activities leading to renewed activities of the programme. This included the proposal to hold a workshop to detect trends and changes in hydrological data which was held in Wallingford (December 1998) and to convene a Steering Committee to prepare a conceptual plan as a follow-up to the recommendations of the workshop, and to identify partnerships for undertaking various aspects on these recommendations.

2.4 In a joint effort, WMO and UNESCO organized and convened the first meeting of the re-structured WCP-Water programme at the WMO Headquarters in Geneva on 23-25 October 2000. The members of the core Steering Committee were Harry Lins (serving as a CHy Expert), Ann Calver (serving as an IHP Expert), Mike Bonell (representing the UNESCO Secretariat), and Wolfgang Grabs (representing the WMO Secretariat) in concurrence with the recommendations of the review panel with regard to the composition of the WCP-Water Steering Committee. W. Grabs agreed to chair the meeting.

2.5 This report is the record of the Steering Committee's proceedings. It formally sets forth the goals, guidelines, functions, approach, activities, and administrative organization of WCP-Water. It also defines the programme's collaborative framework, as well as its organizational and programmatic partners.

## 3. CORE ISSUES

3.1 Fresh water, as a finite and highly variable resource, is the fundamental concern for all impact-related issues associated with global environmental change. This includes agriculture, forestry, human health, energy, and domestic and industrial water supply. Indeed, the potential environmental change (particularly climatic) effects on agriculture, forestry, and urban infrastructure are largely derivative problems stemming from antecedent climatic effects on water availability. Clearly, a reliable water supply is an essential base for social, economic, and political stability internationally.

3.2 The Steering Committee recognized the necessity of reaching beyond the available data and information related to climate and water resources to derive value-added products appropriate for applications. Such products can only be developed through continuous programmatic interactions involving both the climatology and the hydrology and water resources communities.

3.3 In this regard, effective and efficient actions to utilize existing knowledge and skills related to climate and water, in the context of the various impact sectors (agriculture, health, energy etc.), requires meaningful linkages between and among the

various agencies and programmes charged with climate and water responsibilities. Currently, such meaningful linkages are not well developed or are ineffective. With the intention of strengthening such interactions, the Steering Committee was briefed on a number of programmes and agency activities that are closely related to the objective of WCP-Water. A summary of the information presented in these briefings follows.

## 4. PROGRAMMES AND PROJECTS RELATED TO WCP-WATER

### 4.1 World Meteorological Organization

**Hydrology and Water Resources programme (HWRP)**

4.1.1 The Hydrology and Water Resources Programme (HWRP) fulfils one of the major purposes of WMO, namely "to promote activities in operational hydrology and to further close cooperation between Meteorological and Hydrological Services". The overall objective of the Hydrology and Water Resources Programme is to apply hydrologic knowledge to meet sustainable development needs and the efficient use of water and related resources; to mitigate water-related disasters; and to facilitate effective environmental management at national and international levels.

4.1.2 Hydrological elements are embedded in several other WMO Programmes. Of interest for WCP-Water is the linkage with the World Climate Programme. There are strong links between hydrology and meteorology through the study of the hydrological cycle where WMO has a particular interest and responsibility in promoting the close co-ordination of the methods and activities of those involved in the two disciplines. In this context, the Global Energy and Water Cycle Experiment (GEWEX) is noteworthy.

4.1.3 Within HWRP, the World Climate Programme – Water is primarily implemented in the context of the sub-programme: “Hydrology in the context of global environmental issues”. Of particular interest to WCP-Water are activities in the sub-programme with the aim to develop and test techniques to analyse global and regional hydrological data sets to yield products of value to studies of global processes and to understand the long-term trends and variability of hydrological processes. This includes studies of the potential impact of climate change on water resources.

4.1.4 Of particular interest for WCP-Water is the planned establishment of a Global Hydrological Observation Network for Climate. This network was proposed during a meeting convened by HWRP and GCOS on the initiative of the Terrestrial Observation Panel for Climate (TOPC). The meeting was hosted by the German Weather Service (Geisenheim, June 2000). The purpose of the proposed network is to:

a) provide users with timely access to hydrological data and related metadata;
b) ensure that mechanisms exist to satisfy user requirements of timeliness and quality;
c) promote standardization in observations and the use of best practices;
d) guarantee that access to data and products is done in accordance with existing rules, such as WMO Resolutions 40 (Cg-XII) and 25 (Cg-XIII); and
e) be responsive to user feedback and to changing data and metadata needs.

If implemented, GTN-H will be built on existing networks and participating agencies, to the extent possible.

**World Climate Programme (WCP)**

4.1.5 Mr M. Coughlan, Director of the World Climate Programme (WCP), provided the Steering Committee with an overview of the programme. The goals of WCP are to improve understanding of the climate system and to apply that understanding for the benefit of societies coping with climatic variability and change. It is currently looking to develop and enhance proactive approaches to improving resilience and reducing vulnerability to climatic variability and change. In this context, applications-oriented research and service products are needed to develop adaptation strategies and options for increasing societal resilience to extreme events and disasters. Water science, data, and information are central to these efforts. Accordingly, Mr Coughlan strongly supported a closer and more active interaction with WCP-Water.

**Climate and Health**

4.1.6 Mr P. Llanso, Chief of the World Climate Applications Division (WCAD), described WCP activities associated with water quality and human health to the Steering Committee. WCAD is using information on water in a real-time warning system for urban health, which is being developed as part of a disaster prevention capability. He pointed out that, through an integrated view of seasonal or persistent changes in climate and water, a clearer understanding of the role played by hydrologic conditions in water-borne diseases and other impacts on health will be obtained.

In this regard, the group recognized four working groups of particular importance to the development of WCP-Water: These include three ISDR Working Groups;

a) the Working Group on El Nino, La Nina, Climate Change and Variability under the umbrella of the ISDR Secretariat,
b) the Working Group on Early Warning Systems,
c) the Working Group on Vulnerability and Risk Assessment;

and the ICSU Special Committee for Natural Hazard Reduction.

**Agricultural Meteorology**

4.1.7 Mr M.V.K Sivakumar, Chief of the Agricultural Meteorology Division, informed the group about activities in agrometeorology, which are governed mainly by two basic principles, i.e., environmental sustainability and economic viability. The Programme assists Members in the provision of meteorological and related services to the agricultural community for the purpose of developing sustainable and economically viable agricultural systems; improving production and quality; reducing losses and risks; decreasing costs; increasing efficiency in the use of water, labour and energy; conserving natural resources; and decreasing pollution by agricultural chemicals or other agents that contribute to the degradation of the environment. The programme focuses on assisting farmers in making risk-averse decisions to safeguard investments and existence. The four thematic areas of activities of particular interest to WCP-Water include the following:

**Agrometeorological applications**

4.1.8 Emphasis in this area is placed on further development and application of basic knowledge on relationships between meteorological factors and sustainable management of farming systems, fisheries, forestry and livestock. With respect to water, the activities are geared to improving the efficiency of water use for farmers to maximize benefits during good years with a long growing period as a result of an early onset of the

rainy season, and to minimize losses during bad years when a late onset rains could result in a short growing season.

**Agrometeorological adaptation strategies to climate variability and climate change**

4.1.9 In response to current concerns regarding climate variability and climate change, this project is developing agrometeorological adaptation strategies to cope with these phenomena, especially in marginal regions where silviculture, ecosystems, food and fibre production are most sensitive and vulnerable to climatic fluctuations. Model-generated scenarios are used to obtain an estimate of the magnitude of expected change and the possible adaptation of agricultural systems to climate change.

**Combating desertification and drought**

4.1.10 Emphasis in this project is placed on studies and applications of agrometeorological information needed to cope better with droughts and desertification. This activity area is implemented through the development of strategies for drought preparedness and drought management that are based on an understanding of the nature of droughts in a particular region including their frequencies and probabilities, possible impacts on crop growth and development and identification of longer-term drought preparedness strategies for communities at risk.

**Floods**

4.1.11 With respect to floods, historical information on flood timing and magnitude can be used to determine cropping approaches. These four themes are being implemented through the activities of three working groups of the Commission for Agricultural Meteorology (CAgM); namely those on:

- Impacts of Agrometeorological Applications for Sustainable Management of Farming Systems, Forestry and Livestock;
- Impacts of Desertification, Drought and other Extreme Meteorological Events; and
- Impact of Management Strategies in Agriculture and Forestry to Mitigate Greenhouse Gas Emissions and to Adapt to Climate Variability and Climate Change.

**World Climate Research Programme (WCRP)**

4.1.12 Mrs. V. Detemmerman and Mr W. Grabs provided the group with an overview of CLIVAR and GEWEX, respectively.

**Climate Variability and Predictability (CLIVAR )**

4.1.13 CLIVAR is the main focus in WCRP for studies of climate variability, extending effective predictions of climate variation, and refining the estimates of anthropogenic climate change. In particular, CLIVAR is attempting to exploit the "memory" in the slowly changing oceans and to develop understanding of the coupled behaviour of the rapidly changing atmosphere and the slowly varying land surface, oceans and ice masses as they respond to natural processes, human influences and changes in the Earth's chemistry and biota.

4.1.14 CLIVAR covers climate variability and predictability on time scales from seasons to decades. The Initial Implementation Plan (WCRP no 103, WMO/TD no. 869) identifies 11 Principal Research Areas (PRAs) and several unifying cross-cutting themes. The PRAs that are likely to have the most direct impact on hydrology and water resources are: ENSO: Extending and Improving Predictions; Variability of the Asian-

Australian Monsoon System; Variability of the American Monsoon Systems (VAMOS); and African Climate Variability. Each of these projects involves observations, data set development, modeling and process studies. Within CLIVAR, special emphasis has been placed on downscaling issues; an area of convergence for basin-scale studies and research in hydrology and water resources.

4.1.15 Although CLIVAR is distinctly oriented toward basic research, there is an increasing recognition that the interface with the applications and user communities must be enhanced to ensure product utility and relevance. The hydrological communities would stand to benefit directly from advances in the knowledge of climate variability and improvements in the prediction thereof. Outreach to this community might be initiated through the GEWEX project.

4.1.16 The WCRP modeling groups are investigating various aspects of regional modeling and downscaling techniques. A review of the state of the art and outstanding problems will be prepared in a year or so. Regional models are also being developed in the context of the individual PRAs, for instance as part of the VAMOS study which focuses on the Rio de la Plata basin in South America.

4.1.17 A project has recently been launched, under the auspices of the CLIVAR/CCl Working Group on Climate Change Detection (WGCCD), to develop standard indices of climate parameters using daily climate records from stations around the world. Regional workshops to analyze climate records and calculate indices have taken place in the Southwest Pacific (Melbourne, Australia) and are scheduled for the Caribbean (January 2001, Kingston, Jamaica) and for Africa (February 2001, Casablanca, Morocco).

**Global Energy and Water Cycle Experiment (GEWEX)**

4.1.18 GEWEX is the scientific focus in WCRP for studies of atmospheric and thermodynamic processes that determine the global hydrological cycle and water budget, and their adjustment to such global changes as increasing greenhouse gases. One of the main thrusts of GEWEX is the implementation of a series of atmospheric/hydrological - regional process studies such as the GEWEX Continental-scale International Project (GCIP) embracing the whole Mississippi river basin, the GEWEX Asian Monsoon Experiment (GAME), and the Baltic Sea Experiment (BALTEX). The following objectives of GEWEX are of particular interest to WCP-Water:

a) Develop the ability to predict variations in global and regional hydrological processes and water resources, and their response to environmental change;
b) Advance the development of observing techniques, data management, and assimilation systems for operational application to long-range weather forecasts, hydrology, and climate predictions.

4.1.19 With an aim of promoting a dialogue with the water resources community regarding existing and potential contributions of GEWEX to water management, the GEWEX Hydrometeorological Panel established the GEWEX Water Resources Application Project (WRAP). Links between WCP-Water and WRAP have the potential of being useful in the further development of WCP-Water. Between 2001 and 2003, GEWEX/WRAP will organize the following meetings:

4.1.20 "Applications of GEWEX products for water resource management", and a special IUUG Workshop on "The role of GEWEX hydrology and hydrometeorology science in improved water resources management". WRAP will also facilitate regional workshops on water resources that are coordinated or organized by the CSEs.

## 4.2 UNESCO

### Hydrology for Life Environment and Policy (HELP)

4.2.1 Mr M. Bonell of UNESCO informed the group about the HELP programme. HELP is a newly developed joint UNESCO/WMO programme designed to establish a global network of catchments to improve linkages between hydrology and societal needs. The vital importance of water in sustaining human and environmental health is the key driving force behind HELP. However, no international hydrological programme has addressed key water resource issues in the field and integrated them with policy and management needs. HELP aims to change this by creating a new approach to integrated catchment management. The new approach is to use actual catchments, with real water-related problems, as the environment within which hydro-scientists, water resources managers, and water law and policy experts can be brought together.

4.2.2 HELP is, therefore, a problem-driven and demand-responsive initiative focused on the following eight issues:

- Water and food security
- Water quality and human health
- Water and the environment (environmental health)
- Water and potential conflicts
- Impact of climate variability on water resources
- Improved communications between hydrologists and society
- Water-related disaster prevention and mitigation (flood control, drought management)
- Water for socio-economic development

4.2.3 The outputs of HELP will be new data and models that are better adapted to revising current water policy and water resources management practices in these eight issues. As HELP specifically includes climatic variability and change impacts as a focal issue, HELP could provide, through a carefully selected basin(s), new scientific data sets which also support water policy and management needs in the context of climate variability, water quality, and extreme events (floods and droughts).

### Flow Regimes from International and Experimental Network Data (FRIEND)

4.2.4 FRIEND is now well established in several regional groups following its inauguration in 1985, initially for the northern European region (FRIEND NE). The most recent addition is FRIEND AMIGO in the Caribbean and Mexico. FRIEND has benefited from WCP-Water through the use of the Second International Conference on Climate and Water, Espoo, Finland, Aug 1998, as a forum for presenting the results principally from the FRIEND NE and AMHY groups. FRIEND will also benefit from the use of outputs from the WCP-WATER workshop on Detection of Trends in Hydrology, Wallingford, Dec 1998; and the subsequent development of a software package. FRIEND could also contribute to the development of indicators of sustainability.

## 4.3 Joint UN activity: World Water Development Report (WWDR)

The production of the World Water Development Report, to be published every two years with a different global assessment theme, is envisaged as a joint effort of the UN system and its member states worldwide. With regard to WCP-Water, the following activities undertaken for the WWDR are of principal interest:

a) To identify and diagnose the state of global freshwater – its quantity, quality and use, and the organizational, socio-economic and environmental context of its management;
b) To monitor trends at river basin, regional and global levels, thereby improving information for decision-making.

These activities, amongst others have to be seen in the climate context and its influence on the sustainable use of water under conditions of change and variability.

## 5. CONCEPTUAL FRAMEWORK FOR WCP-WATER

5.1 The Steering Committee reviewed the goal proposed by the Review Panel and recommended that the goal of WCP-Water should reflect programmatic developments of the last two years since the Review Panel has made its recommendations. The Committee therefore recommended to revising the goal of WCP-Water as follows:

***To promote hydrological activities in the World Climate Programme and related conventions, and to provide the water community with current data and information on hydrological and water resources conditions and variations, in a climatic context, over a wide range of time and space scales.***

5.2 With this goal in mind, six technical objectives for WCP-Water were established:

a) to provide guidance on the use of basic analytical procedures and statistical methods;
b) differentiate climatic from human-induced impacts;
c) expand the use of modelling frameworks as tools for organizing integrated solutions to water problems;
d) enhance understanding of measures of uncertainty and how to use them effectively;
e) facilitate assessments of hydrologic extremes and water-related natural disasters;
f) assure the scale compatibility of model linkages, particularly in the linking of atmospheric and hydrologic models.

5.3 As an initial step from an applications perspective, the Steering Committee proposed concentrating on implementing activities in three priority areas of social concern:

a) Climate, water and health;
b) Climate, water, and food security;
c) Climate-related natural disasters and hydrologic extremes in vulnerable basins.

5.4 These “topical areas” represent the foci of the programmes and projects depicted in figure 1. The group also recommended that demonstration or pilot projects were the most practical approach to addressing such priority topics.

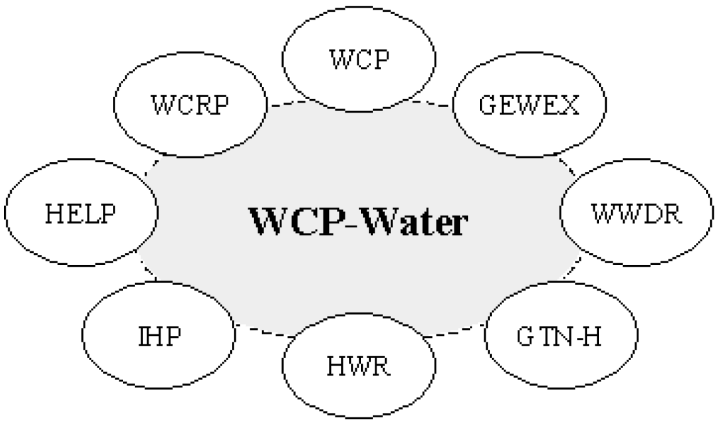



**Fig. 1.** UNESCO and WMO programmes and projects that would benefit directly from climate and water activities of WCP-Water related to such societal issues as health, food security, and natural disasters.

5.5 The Steering Committee fully recognized that these initial priority areas should not be construed as encompassing the full scope of WCP-Water activities in the course of its future development. The immediate concern was to establish an approach ensuring that WCP-Water was anchored in the framework of related programmes and projects implemented by UNESCO and WMO, as well as the joint activities of other specialized agencies within the UN system. WCP-Water is, therefore, explicitly understood to be a complementary endeavour to the programmes and projects depicted in Figure 1.

5.6 In addition to these specific aims and initial priority topics, the group re-affirmed that these aims and activities are embedded within the broader perspective of WCP-Water established by the Review Panel:

(a) enhance understanding of the relationship between climatic and hydrologic processes;
(b) improve availability of data required to achieve success in all WCP-Water activities;
(c) enhance understanding of climatic variability and change within hydrologic systems and evaluate the impact of such variations and changes on water resources systems;
(d) promote more effective use of hydrologic information, visibly associated with climatic variability and change, in water resources management;
(e) promote more effective use of hydrologic information in climate research, analysis, and interpretation;
(f) encourage closer collaboration between the hydrological and climatological communities;
(g) encourage interaction among decision-makers and the producers and users of hydroclimatological information in the provision of policy guidance.

## 6. OPERATIONAL FUNCTIONS OF THE WCP-WATER PROGRAMME

6.1 The Steering Committee, recognizing the transitional nature of WCP-Water, felt that the programme's success was, in part, predicated on operational functions that would maximize its visibility with various organizations. A focused effort at promoting the programme and its activities was considered to be essential.

Accordingly, it was proposed that four promotional, or operational functions be established: a **bridging function**, initially linking climate and water-related activities in the areas of disaster mitigation, human health, food security, and water quality; a **coordinating function**, to avoid or minimize redundancy in the climate and water-related activities of UNESCO and WMO; an **outreach function**, to liase with other relevant activities of UN agencies, such as WWDR; and the maintenance of an **enabling environment**, in which researchers and organizations are invited to contribute to the topical areas and activities of WCP-Water

6.2 In the context of these functions, the Committee reviewed the information currently available on the establishment of a global hydrological network for climate which has been proposed to be termed the "Global Terrestrial Network – Hydrology (GTN-H)." Based on this information, the group recommended that, in order to ensure that the hydrological data and systems described as being important in GTN-H are consistent with the requirements for fulfilling the goals and objectives of WCP-Water constituent activities, WCP-Water should be represented on the proposed Hydrological Observation Panel (HOP). Such representation would guarantee that the joint interests of the constituent bodies of WMO and UNESCO, vis-a-vis climate and water-related activities and networks, are adequately represented in the operation of this important network.

## 7. APPROACH

7.1 The Committee considered approaches to facilitating the new conceptual framework of WCP-Water. It recognized that with the emphasis shift toward water-related issues such as health, food security, and natural disasters (floods and droughts), the notion of risk and uncertainty represented a logical model for organizing activities under the new framework. The elements of a risk and uncertainty model appear graphically in Figure 2.

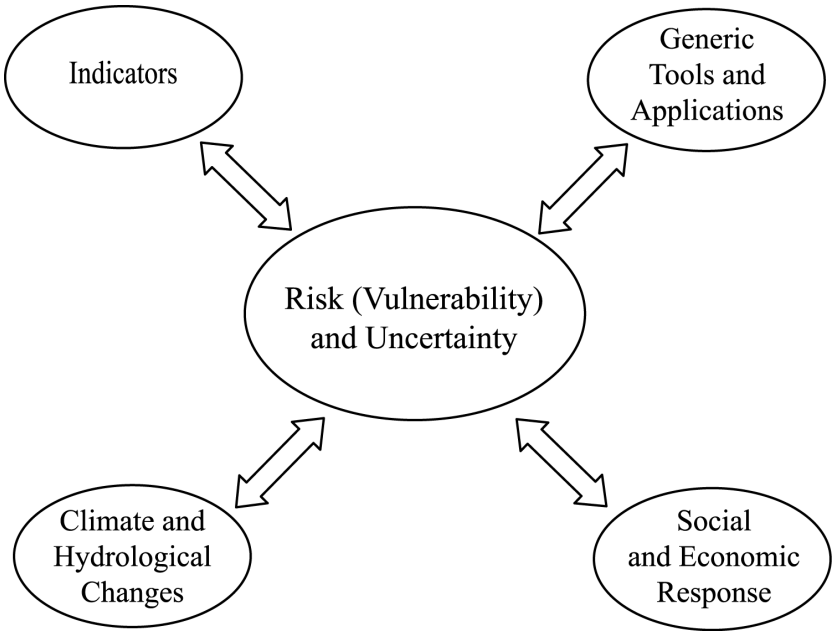



**Fig. 2.** The central nature of risk (vulnerability) and uncertainty in relation to the indicators and tools for assessing it, the hydroclimatic changes that affect it, and the socio-economic responses to it.

7.2 The reason that this is a desirable approach for a water resources and climate-oriented research activity is its analytical functionality. For example, risk and uncertainty can be assessed using a variety of indicators (i.e. vulnerability, reliability, resilience, etc.) and a broad array of basic (generic) statistical and numerical tools. It can also incorporate critical information on variations and changes of physical and environmental conditions, revealing the vulnerability of populations and systems to such variations, and the uncertainty associated with these changes or variability. Finally, this approach has the potential to produce information that can be used to initialize societal or resource-system adaptation to the indicated risks. The Steering Committee strongly encouraged the use of this approach in organizing future WCP-Water efforts.

## 8. IMPLEMENTATION GUIDELINES

### 8.1 Administrative organization of WCP-Water

8.1.1 The Committee recommended three levels of administration and oversight of WCP-Water:

(a) Overall governance of all actions and activities associated with WCP-Water is provided by UNESCO and WMO;

(b) Technical guidance of activities conducted under WCP-Water should be provided by this Steering Committee. Following the recommendation of the Review Panel, the Steering Committee will be composed of a CHy-Expert, an IHP expert and one representative each of the WMO and UNESCO Secretariats. The group agreed that it would be useful that ex-officio representatives may be invited to participate in its work on an ad-hoc basis as well as selected experts in an advisory role as and when needed.

(c) The Committee decided that the day-to-day technical oversight of WCP-Water will best be handled by an executive secretary in collaboration with the Secretariats of WMO and UNESCO. The executive secretary is selected by the Steering Committee from within its members on a rotational basis. Mr Harry Lins was nominated to serve as executive secretary until the next meeting of the Steering Committee planned for late 2001.

### 8.2 Scope of activities

The scope of WCP-Water activities was discussed at length by the Steering Committee. The result was a recommendation as to the range of *potential* initiatives, from pure and applied research to the demonstration of practical applications and principles. These initiatives do not necessarily constitute an exclusive list of what WCP-Water could or should pursue but, rather, the scope of activities appropriate for it to investigate. In all instances, the initiatives could be implemented over a three- to four-year time frame. The entire package of initiatives over a time scale of 3-5 years is displayed in Figure 3.

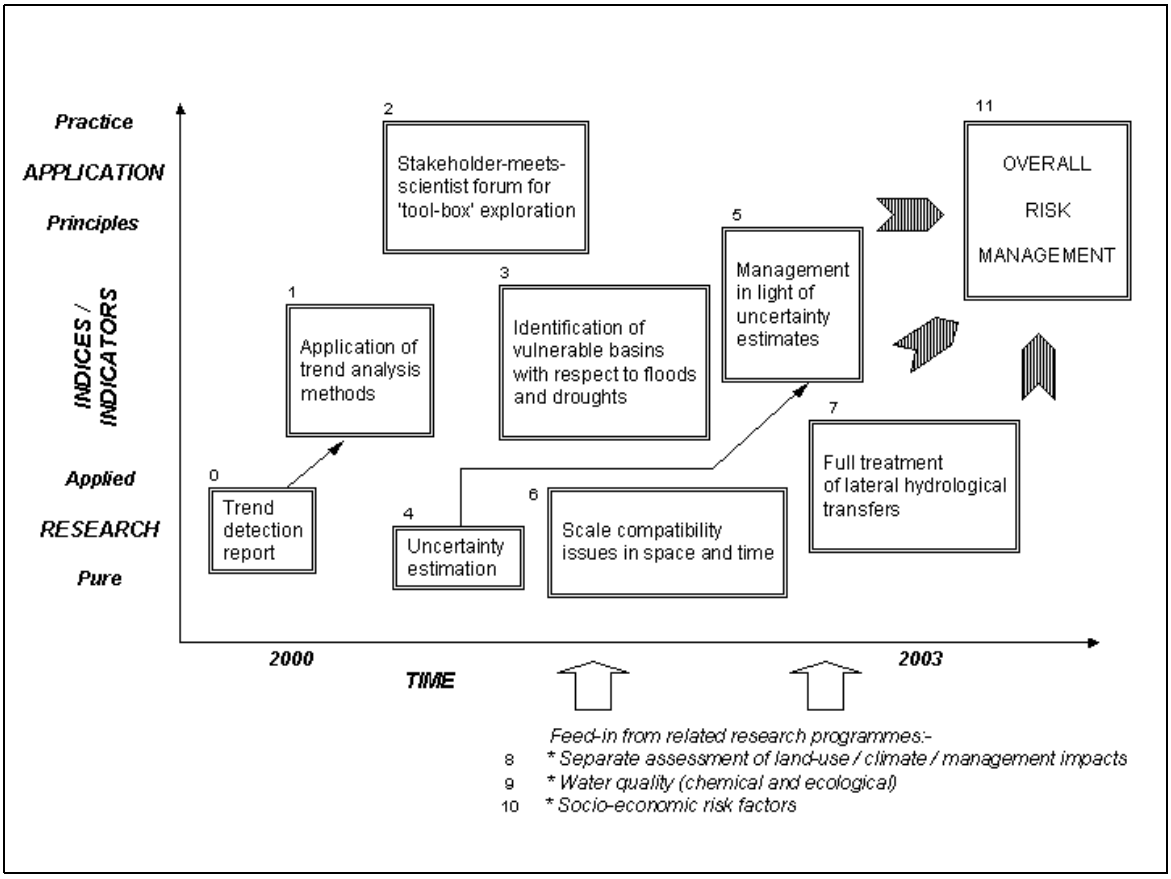



**Fig. 3**. Scope and dimensions of WCP-Water programme implementation.

The numbers in the following text are keyed to items appearing in the figure.

0 This item is the June 2000 WCP-Water report Detecting Trend and other Changes in Hydrological Data. It is included on the diagram to demonstrate a logical continuity between past and future activities of the programme.

1 This initiative applies the trend analysis methods of item 0 above to an examination of hydrological extremes. These analyses should focus initially on basins where climatic influences are distinguishable from human influences.

2 Experimental workshops and study group initiatives are envisaged where users interact with scientists. Such meetings provide stakeholders with opportunities to explore and understand the current contents of scientific 'tool-boxes' and contribute to the direction of provision of further tools. HELP programme basins provide a logical sample for initial user-scientist workshops.

3 Item 3 is the identification of basins having high vulnerability to floods or droughts. Indices of vulnerability and risk can be tested in terms of their quality and performance as indicators, particularly with respect to the dynamic nature of indicators. Demonstration catchments are envisaged

but with generic methodologies and approaches wherever possible, in order to transfer experience more widely.

4 This initiative reviews available techniques on uncertainty estimation, with particular emphasis on extreme events. This covers uncertainty associated with data, the structure of models and procedures, and with parameter estimation.

5 Risk management should be evaluated in the light of uncertainty estimates. Here one is addressing the question of how catchment managers can adapt their decision-making strategies given probabilistic statements on distributions of outcomes. Emphasis is again expected to be placed on flood and drought risk management.

6 Scale compatibility in space and time is an important issue in relating climate parameters and models to hydrological responses. Upscaling (/downscaling) and aggregation (/disaggregation) techniques are at the core of basin analysis and modelling. This is especially important with respect to data discretisation, conversion of point process information to spatially-continuous fields at catchment and regional scales, and in the sophisticated use of general circulation model (GCM) outputs.

7 Item 7 seeks to evaluate the efficacy of lateral hydrological transfer schemes as they are currently handled within integrated climate and hydrological modelling systems. There is a need to ensure that lateral transfers account for not only surface runoff and river discharge but also the substantial flux of groundwater components.

8 Hydrological systems respond not only to climatic variability and change, but also to land use and land use change (including urbanisation) in combination with catchment and river management practices. There is a clear need to elucidate the separate components of the complex responses to assist in the potential for predicting risk. This initiative would benefit from input from agrometeorology programmes.

9 Value is added to WCP-Water initiatives by the addition of a water quality dimension to trend, vulnerability and risk assessment initiatives. Both chemical and ecological aspects of water quality need to be considered. Input from health programmes is essential.

10 The assessment of methods for incorporating risk factors from the social sciences and economics also enhances WCP-Water initiatives. Output from such work needs to be expressed in appropriate form and with appropriate parameterisation in integrated hydrological modelling. The advantage of fully integrated analysis lies in the compatibility of outcomes with respect to the suite of catchment management risks.

11 Overall risk assessment is seen as a medium-term goal of WCP-Water activities. Developmental routes converge on this from the essentially research aspects of the programme (items 0, 4, 6 and 7), from feed-in from other programmes (8, 9 and 10), as well as from the enhancement of indicator performance via programme initiatives 1, 2, 3 and 5.

## 9. RECOMMENDED ACTIVITIES AND TIMEFRAME OF IMPLEMENTATION

9.1 The Steering Committee recommended that the activities proposed and documented below be focused primarily in river basins previously identified as being vulnerable to climatic and hydrologic variability and change. Figure 4 provides an overview of the timeframe of the proposed activities.

9.2 As a follow-up to the WCDMP-45 Report "Detecting Trend and other Changes in Hydrological Data" (WMO/TD-No. 1013, Geneva, May 2000), the Committee recommended that the following activities be pursued:

### A) CD-ROM of trend analysis procedures

9.3 To facilitate the expanded use of trend analysis in hydrology, a CD-ROM containing the following items should be prepared and published.

**Code-writing** -- A selection of proposed statistical routines, referred to in the Trend Report. These should be encoded in FORTRAN (preferably) for use in customized individual statistical software packages.

**Documentation** -- Detailed documentation of each coded routine in terms of mathematical formulae, appropriate uses and limitations of each routine, and a sample of demonstrated use to facilitate interpretation of results.

**Sample datasets and outputs** -- A sample data set with outputs resulting from the use of each routine will be provided to enable the analyst to verify that the routine is correctly running on their computers.

**Reference list** -- including commercial software packages that use the algorithms proposed on the CD.

### B) Regional and global analysis of hydrological change and trends, in collaboration with GRDC and FRIEND

9.4 Conduct an analysis of hydrological trends, focused on rivers with minimal human influences. The group suggested that in order to facilitate this analysis, the regional FRIEND coordinators and GRDC be contacted to provide relevant data and information for the selection of appropriate rivers, and to assist in the analysis. Member States of UNESCO and WMO may be requested to supplement the available information where necessary for the purpose of the analysis. This latter activity will be undertaken by the Secretariats of UNESCO and WMO.

### C) Expert meeting on climate-related natural disasters and hydrological extremes in vulnerable basins

9.5 Organize and convene an expert meeting to assess indications of change in the frequency and magnitude of climate-related natural disasters and hydrological extremes, in selected vulnerable basins. The output of this expert meeting could be used in subsequent studies aimed at detecting regional patterns of natural disasters, hydrological extreme events, and possible common generating processes.

**D) Workshop on indices and indicators of climate and related hydrological change and variability**

9.6 Plan and conduct a workshop to assess existing approaches to (indicators of) hydroclimatic variability and change, particularly in the new WCP-Water context; i.e., the vulnerability of river basins and resident populations to climate and related hydrological change and variability. The expected output is a report providing information on existing indices and indicators, along with recommendations as to their use in water resources and related applications.

**E) Conceptual study on climate, water and health**

9.7 Assess the state of knowledge regarding this subject area for the purpose of identifying critical and needs for, and tractable approaches to collaborative research.

**F) Workshop on climate, water and risk management in agricultural practices**

9.8 The Committee proposed to plan and conduct a workshop with a similar approach as outlined in item 9.4 above. The expected outcome of this workshop is an overview of applicable tools for farm-based risk management at both the short-term, weather-related scale, and at the longer-term scale of hydroclimatic variability.

**G) WCP-Water Website**

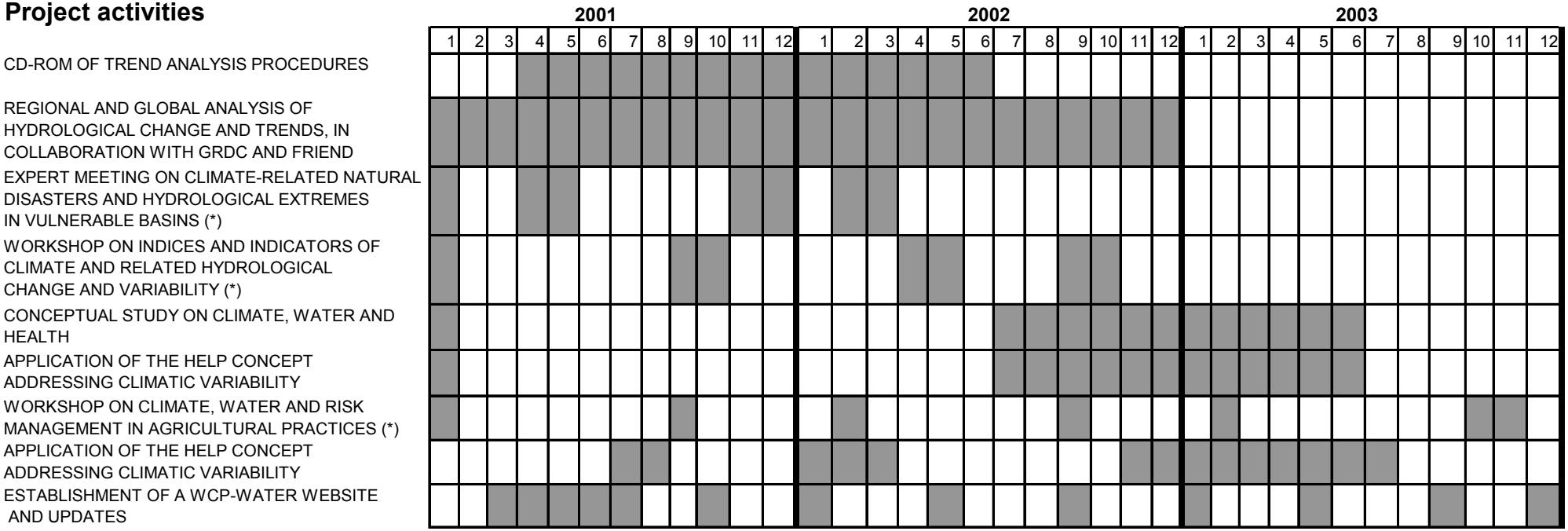
9.9 The Committee recommended establishing a WCP-Water Website to:

a) disseminate general information related to WCP-Water;
b) communicate with researchers and institutions;
c) highlight the linkages that exist with other institutions, programmes, and projects, as well as for disseminating products, results, and information on forthcoming events;
d) provide a platform for the exchange of views, information, and results of research (feedback);
e) provide a roster of voluntary experts interested in contributing to WCP-Water; and
f) provide a forum for questions and answers, and for discussion of selected topics.

A prototype web page will be developed by Harry Lins and, after peer-review, will reside on the WMO web server. The web page will be administrated by the Executive Secretary of WCP-Water, in collaboration with the Secretariats of UNESCO and WMO (see item 10 below).

Duration (months)

**Project activities**




(*) including preparations for these meetings

Fig. 4. Timeframe of WCP-Water activities 2001 – 2003 as of October 2000

## 10. COLLABORATING PARTNERS

10.1 As stated in item 8.1 above, UNESCO and WMO are the governing agencies for WCP-Water. The Committee specifically recognized that the close cooperation between several WMO programmes, namely HWRP, WCP and WCRP, will be vital for the success of the programme. The IHP of UNESCO is the principal programmatic link between UNESCO and WCP-Water. Within the topic areas of WCP-Water, inputs will be sought as and when needed from WHO, FAO, UNEP, ISDR and IAHS. The group identified projects of an overarching nature such as WWDR, HELP to collaborate with WCP-Water. To facilitate the implementation of activities, the collaboration with specialized working groups within identified key programmes and projects of interest will be vital. In this respect, the group pointed towards the working groups mentioned in CLIVAR.

## 11. DATE AND PLACE OF NEXT MEETING

The Committee recommended that the second meeting of the WCP–Water Steering Committee be held at WMO Headquarters in Geneva in the fourth quarter of 2001.

## 12. CLOSURE

The meeting was adjourned on Wednesday, 25 October at 16:00 hours.

**ANNEX 1**

**Meeting of the Steering Committee for WCP-Water**

**Geneva, 23-25 October 2000**

**LIST OF PARTICIPANTS**

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**ANNEX 2**

Meeting of the Steering Committee for WCP-Water

Geneva, 23-25 October 2000

## AGENDA

**Monday, 23 October**

***Morning Session (09:00 – 13:00)***

- Opening of the meeting
- Background briefing about current developments relevant to WCP-Water
- Development a strategic approach to achieve the overall objective of WCP-Water (*).

***Afternoon Session (14:00 – 17:30)***

- Definition of the role of WCP-Water and identification of hydrological studies in the context of climate variability, change and natural disasters.

**Tuesday, 24 October**

***Morning Session (09:00 – 12:30)***

- Applications of climate-related enhanced hydrological information in planning, design and operation of water resources systems including disaster management.

***Afternoon Session (14:00 – 17:30)***

- Review of the general perspective of WCP-Water to reflect improved forecasting, risk assessment, adaptation to change of hydrological regimes due to climate variability and change and disaster reduction.

**Wednesday, 25 October**

***Morning Session (09:00 – 12:30)***

- Collaborating researchers and institutions in WCP-Water.
- Define mechanisms of cooperation with related programmes and projects within and outside WMO and UNESCO.

***Afternoon Session (14:00 – 15:30)***

- Development of an action plan.

(*) Goal of WCP-Water as defined by the WCP-Water Review Panel (Espoo, Finland, 21-22 August 1998): "To promote hydrological activities in the World Climate Programme and related conventions, to provide the water community with current data and information on climate variability and change over a wide range of time and space scales".

**ANNEX 3**

**Report of the WCP-Water Review Panel, Espoo, Finland, 1998**

**World Climate Programme-Water**

**MEETING OF REVIEW PANEL**

**(ESPOO, FINLAND, 21-22 August 1998)**

**FINAL REPORT**

UNITED NATIONS EDUCATIONAL SCIENTIFIC AND CULTURAL ORGANIZATION

WORLD METEOROLOGICAL ORGANIZATION

## 1. INTRODUCTION

1.1 The Seventh Planning Meeting of WCP-Water [Koblenz, Germany, 13-16 May 1997] considered potential changes to WCP-Water, and recommended the establishment of a Panel to review its aims and structure. This Review Panel met in Espoo, Finland on 21-22 August 1998, immediately following the Second International Conference on Climate and Water (CAW2); the conclusions and recommendations of which provided a basis for its work.

1.2 The following individuals participated in the meeting. Review Panel: A. Askew (WMO), M. Bonell (UNESCO), A. Hall (Australia), H. Lins (USA); Rapporteurs: Z. Kundzewicz (Poland), P. Pilon (Canada); Observers: J. Rodda (IAHS), J. Kuylenstierna (Sweden), and O. Varis (Finland). A. Hall agreed to chair the meeting.

## 2. REVISION OF AIMS AND STRUCTURE OF WCP-WATER

### 2.1 Aims of WCP-Water

2.1.1 The Review Panel considered the draft goal and objectives prepared at the Seventh Planning Meeting and proposed the following revised version:

Goal: To promote hydrological activities in the World Climate Programme and related conventions, to provide the water community with current data and information on climate variability and change over a wide range of time and space scales.

Role: To provide the mechanisms to address the following objectives.

Objectives:

(a) to enhance understanding of the relationship between climatic and hydrological processes;
(b) to improve the availability of data required to achieve the objectives of WCP-Water;
(c) to enhance understanding of climate variability and change within hydrological systems and evaluate their impact on water resources systems;
(d) to promote more effective use of hydrological information linked with climate variability and change in water resources management;
(e) to promote more effective use of hydrological information in climate research, analysis and interpretation;
(f) to encourage closer collaboration between the hydrological and climatological communities;
(g) to encourage interaction among decision-makers and producers and users of hydroclimatological information in the provision of policy advice.

### 2.2 Structure of the programme

2.2.1 It was recommended that a Steering Committee be established to oversee the activities of WCP-Water, with the following composition and terms of reference:

(a) Composition

The Committee will be formally composed of a CHy Expert, an IHP Expert, and one representative each of the WMO and UNESCO Secretariats. Additional

experts and representatives of other organizations/programmes may be invited by the Committee to participate in its work. Preferably, the Committee should meet every two years, working via e-mail during intervening periods.

(b) Terms of Reference

(1) To advise WMO and UNESCO on WCP-Water activities and respond to the requests of their constituent bodies.
(2) To promote the use of WCP-Water in achieving the goals and objectives of other international programmes and conventions.
(3) Develop proposals for specific activities to be undertaken by WCP-Water, and to review and advise on their progress.

## 3. PROPOSED ACTIVITIES

3.1 The meeting considered the summary listing of activity areas and priority projects for WCP-Water as compiled by the Seventh Planning Meeting at Koblenz (13 to 16 May 1997). A very large numbers of topics were listed under the six activity areas. Some were addressed by projects that had been completed, for others projects were on-going. An even larger number of projects were either inactive or functioning primarily under the auspices of other programmes. The meeting likened these activities and projects to a set of pigeon hole, some where the pigeons had flown, a few of which were occupied by pigeons, but many more were empty. Participants agreed that this great diversity and range of projects had been the weakness of WCP-Water, and a sharper focus was now needed.

3.2 Discussion focused in detail on the six previous activity areas, A to F, and it was agreed to concentrate future activities of WCP-Water into two areas, namely:

*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 resource systems.*

*The first of these is briefly presented below, the other being reserved for future projects. It was also agreed that for the further development of WCP-Water, the Steering Committee would develop additional areas to encompass other activities.*

3.3 Following the papers and discussions at CAW2, it was agreed that a sharper focus would be achieved best by placing emphasis on a single project directed at the analysis of hydroclimatic variability and change. This project would fall within new Activity Area A

and is considered to be of fundamental importance. The project will focus on methods for detecting trends in a number of hydroclimatic variables, and for determining changes in moments, persistence, and seasonal behavior (e.g. flow regimes). In addition, multisite and multivariate tests will be utilized. It was also envisaged that the project would consider a wide range of other variables (e.g. water quality). Moreover, the preceding strategy could be expanded to include extreme hydrological events and the detection of point and areal trends at all scales.

3.4 Meeting participants decided that the Wallingford Workshop, scheduled for 2 to 4 December 1998, which will bring together about a dozen experts in trend detection, could be a vital element in streamlining WCP-Water. It is envisaged that, as a result of this workshop, a Steering Committee will be formed to initiate a concept plan and identify partnerships that could undertake various aspects of the plan. It was considered that one outcome of these efforts would be a workshop at the Sixth IAHS Scientific Assembly at Maastricht in July 2001. It was also proposed that this Steering Committee consider submitting applications for funding, such as to the European Union Fifth Framework Programme in the Environment and Climate Area. This or similar initiatives could bring together a number of partners for a three- to four-year programme of research centered on the detection of trends and change within hydrological time series. It could bring in partners and players from outside the European Union with relevant data and interest in the project.

3.5 It was also recognized during CAW2 that a critical challenge in hydrology is separating anthropogenic impacts, such as land-use change, from those attributable to natural climate variability. While such anthropogenic impacts are not the primary focus of WCP-Water, the Review Panel recommended that such complementary activities within the existing programmes of the UNESCO IHP and WMO should be strengthened and linked more closely with WCP-Water.

## 4. OTHER ISSUES

4.1 The previous structure of WCP-Water included both GRDC and GPCC as WCP-Water Projects. With the advent of a new WCP-Water structure this will no longer be the case. Both will, however, continue to operate under their own auspices and will continue to provide important support WCP-Water activities.

4.2 It was proposed that a WCP-Water homepage be developed as a means of increasing the visibility of the Programme as well as a vehicle for dissemination of information, data and methods related to the Programme's activities. H. Lins offered to prepare a draft version of the homepage for review by the WMO and UNESCO Secretariats prior to the Wallingford Workshop in December 1998.

Review Panel Meeting on World Climate Program-Water

Espoo, Finland, 21-22 August 1998

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