WORLD CLIMATE PROGRAMME

APPLICATIONS and SERVICES

STEERING COMMITTEE

ON

WORLD CLIMATE PROGRAMME - WATER

(WALLINGFORD, UNITED KINGDOM, 21-23 October 2002)

THIRD MEETING

REPORT

WCASP - 57

WMO/TD-No. 1145

(Geneva, March 2003)

UNITED NATIONS EDUCATIONAL SCIENTIFIC AND CULTURAL ORGANIZATION

WORLD METEOROLOGICAL ORGANIZATION

TABLE OF CONTENTS

WCP-Water Steering Committee, October 23, 2002, Wallingford, UK

(from left: Wolfgang Grabs, Pierre Hubert, Mike Bonell, Ann Calver, Harry Lins, Jean-Marie Fritsch)

1. INTRODUCTION

1.1 The Third Meeting of the Steering Committee for the World Climate Programme - Water (WCP-Water) was convened at the Centre for Ecology and Hydrology (CEH) in Wallingford, U.K. from October 21-23, 2002. The meeting focused on several issues of priority concern to the Programme, both in terms of achieving its broad goal as well as fulfilling current workplan tasks and objectives. These included collaboration with the Intergovernmental Panel on Climate Change; collaboration with the Dialogue on Water and Climate; expansion of the WCP-Water Steering Committee membership; set the science agenda.

1.2 The meeting began with an Executive Session devoted to a discussion of research and administrative issues. There was also a review of activities and accomplishments since the second Steering Committee meeting in January, 2002, as well as a brief check of the continuing efficacy of the Programme's scope and priorities.

1.3 The Executive Session was attended by Wolfgang Grabs (WMO), Mike Bonell (UNESCO), Jean-Marie Fritsch (WMO), Ann Calver (IHP Expert), and Harry Lins (Executive Secretary, WCP-Water). The meeting proper was also attended by Cecilia Swenson (CEH), Pierre Hubert (Secretary-General IAHS), Martin Parry (Co-chair, IPCC WG-II), Paul van der Linden (U.K. Met. Office), Mike Harrison (IPCC WG-II Technical Support Unit), Alan Gustard (CEH), and Max Beran (OB Research Services). Pavel Kabat (Dialogue on Water and Climate) was scheduled to attend, but was unable to travel.

2. REVIEW OF POTENTIAL CLIENT AND COLLABORATOR ACTIVITIES

2.1 International Association of Hydrological Sciences (IAHS)

Pierre Hubert, Secretary-General of the IAHS, presented an overview of Association activities of relevance to WCP-Water. He made particular note of the developing Prediction in Ungauged Basins (PUB) activity. PUB is an IAHS initiative devoted to produce more hydrological information in combining field measurement and remote sensing together with hydrological knowledge and modeling. He also observed that all IAHS Commissions have an interest in climate and hydrology, but most especially the International Commission on Surface Water (ICSW) and the International Water Resources Commission (IWRC). There was general agreement that an important aspect of establishing closer working relations with the Association is the opportunity for broader participation in future WCP-Water expert workshops. In addition, it was suggested that WCP-Water should begin planning a climate and water session for inclusion in the 2005 IAHS Assembly. A recommendation was made to create an IAHS/WCP-Water Working Group as a means of formalizing the relationship between the two groups.

2.2 Intergovernmental Panel on Climate Change (IPCC)

Martin Parry, Co-chair of the IPCC's Impacts Working Group (WG-II), gave a general overview of the emerging plans for the Fourth Assessment, to be completed in early 2007. The current timetable calls for national governments to nominate participants sometime around November 2003. Preliminary thinking indicates that the Fourth Impact Assessment may not follow the same format as the Third IPCC Assessment; for example, it may not have sectoral chapters. The meeting was informed that the format of the report needed to be discussed during a scoping meeting planned in November (see below) and the IPCC Bureau meeting scheduled for early December 2002. Some areas of potential emphasis in the Fourth Impact Assessment include: 1) assessing indications of climatic change in non-climatic observational records, e.g., hydrological, cryospheric, ecological, etc.; 2) articulating optimal strategies for adapting to and managing resources in conjunction with climatic change; and 3) evaluating the costs of adaptation versus the costs of mitigation (i.e., the cost of reducing greenhouse gases).

Mr Parry then described, in more detail, an incipient activity related to the issue of climate and water. This activity came about in response to a proposal jointly submitted to the IPCC Bureau by WCP-Water and the Dialogue on Water and Climate in the spring of 2002 calling on the Panel to undertake a special report on climate and water. This proposal emanated from a belief within the hydrology and water resources community that previous IPCC Assessments had not adequately addressed the complexities associated with water, particularly in terms of the highly engineering-based field of water resources management. The IPCC Bureau has asked Working Group II to developing a scoping paper on climate and water, the purpose of which is to assess the need for a special report on the subject. In particular, the scoping paper will address the question of what wasn't accomplished in the 3rd Assessment that is critical to a fuller and more useful understanding of the potential impacts of climatic change on water resources. The scoping paper will be developed at a meeting in Geneva, November 11-13, 2002. Four members of the WCP-Water Steering Committee have been invited and will attend.

After the exchange with the Working Group II representatives was completed, the Steering Committee discussed a number of concepts and issues it believed should be raised at the scoping paper meeting. These points will be articulated in a brief WCP-Water concept document to be submitted to the IPCC prior to the scoping paper meeting.

2.3 International Hydrological Programme (IHP-VI)

2.3.1 Theme Advisory Board Meeting

Mike Bonell reported on the IHP Theme Advisory Board meeting convened at UNESCO in Paris, 23-25 September 2002. The IHP Board recommended that, within IHP-VI, highest priority should be given firstly to extreme events (floods, droughts) and secondly to groundwater.

2.3.2 Ecohydrology Workshop

Separately, the IHP-IAEA held an expert meeting, hosted by the Polish Academy of Sciences, 3-7 July 2002, to formulate new strategies for taking an integrated science approach to enhance better understanding of hydrological and ecological processes across scales for application in HELP basins. Representatives from the disciplines of surface water (i.e., FRIEND), groundwater, ecohydrology, hillslope hydrology, as well as the contaminant transport and isotope hydrology communities were present. This meeting recommended that priority should be given to (1) water quality process research, and (2) hydrological and ecological process investigations associated with extremes (floods, low flows). The impacts of climatic variability on water quality were also recognized.

Regarding floods, the expert group highlighted the need for new methodologies to address the question at which scale meteorological factors may override land use change impacts. The role of groundwater recharge, storage and contaminant transport during flood events was also recognized as a research need. Germany has offered an instrumented basin (258 km^2) that is linked with rain radar as a first step toward addressing this issue.

The Committee welcomed these two developments as a contribution to WCP-Water. The latter priority has direct relations with WCP-Water goals. In particular, under the "extremes" priority, an activity was proposed that focuses on the sensitivity of hydrological processes associated with the generation of floods and low flows (droughts) to global change, and the implications for ecological processes. The Steering Committee views potential developments in this activity as important complements to WCP-Water, and will seek opportunities to interact with those contributing to it.

Ann Calver was proposed for nomination to the Steering group for the future implementation of the above integrated science strategy linked with extremes.

2.3.3 FRIEND

Alan Gustard updated the Steering Committee on the current status and plans for the FRIEND project, noting that the next six to eight months is a period of reflection and priority setting for IHP-VI. He also stated that many investigators, both in and outside the FRIEND community, are increasingly concerned over the rapidly growing number of international climate and water programs that appear to have overlapping goals. He suggested that the water research community would benefit from some form of index or clearinghouse capability that clarifies the distinctions among the various programs, their modes of operation, and the means whereby researchers (particularly those early in their careers) can become involved. This could take the form of a website. The Steering Committee agreed that it should consider an effort to something like this, at least with respect to those activities related to WCP-Water.

Mr Gustard also noted the importance of demonstrating the "added value" of international programs, particularly given the increasing significance of multinational funding sources such as the European Union. In the context of WCP-Water, he suggested that a series of "one pagers" describing Programme projects and activities, the requirements for accomplishing objectives, and including the types of researchers needed, would be a major contribution.

2.4 Dialogue on Water and Climate (DWC)

The Steering Committee had planned to have a substantive discussion with Pavel Kabat regarding the future of the Dialogue on Water and Climate, which is scheduled to complete its originally funded activities at the end of December 2002. Due to the unavailability of Mr Kabat, no update of current DWC plans was available at the meeting. The Committee was relegated, therefore, to a general discussion of options for offering the Dialogue a "home" for its future stakeholder-oriented activities within WCP-Water. There was a consensus among Committee members that the links developed by the DWC with local and regional water resources stakeholders was a very important complement to WCP-Water science activities, including within the HELP basins, and that it would be beneficial to both organizations to have a closer administrative linkage. The Committee tasked Wolfgang Grabs with communicating its interest in providing the DWC with a "home" in the future, subject to the Dialogue's operational continuation and programmatic direction.

2.5 Joint Water Project (JWP)

Harry Lins provided a brief overview of recent activities related to the incipient Joint Water Project (JWP), one of three international research projects sponsored by the four international global change programmes (i.e., the World Climate Research Programme, the International Geosphere-Biosphere Programme, the International Human Dimensions Programme, and DIVERSITAS). He reported that through a series of teleconferences, the JWP had developed a work plan that will lead to a published JWP Scientific Framework. Element of the work plan include:

- Release of a public web page (completed mid-September 2002), located at *http://www.jointwaterproject.net* , and containing the JWP Scoping Document.
- Preparation of a JWP brochure/flyer, to be distributed by mid-November 2002.
- Completion of an initial draft of the Scientific Framework by 15 January 2003.
- Printing of the final Scoping Document by 1 February 2003.

- Convening three regional meetings (of 10-15 participants each) between January and May 2003 to facilitate a dialogue on the Scientific Framework. Tentative plan is to have one meeting in the Americas, one in Europe/Africa, and one in Asia.

- Production of an advanced draft of the Scientific Framework by September 2003.

- Holding an Open Science Conference in October 2003 in Durham, New Hampshire to review the draft Scientific Framework.

- Completion and publication of the JWP Scientific Framework by the end of 2003.

Mike Bonell added that the German government has indicated its willingness to fund the JWP Secretariat, although the location of the Secretariat has yet to be determined.

3 TECHNICAL PRESENTATION

3.1 At the request of the Executive Secretary, Max Beran presented his recent research into the evaluation of climate change impacts on design flood estimation. A summary of his presentation appears in Annex 3 of this report.

4 REVIEW OF ADMINISTRATIVE ISSUES

4.1 Composition of the WCP-Water Steering Committee

4.1.1 The Steering Committee discussed the desirability of expanding its membership. The rapidly increasing number of international activities associated with climate and water make it nearly impossible to engage all groups currently conducting research related to WCP-Water goals. Accordingly, the Committee decided to broaden its membership in order to enfranchise groups that can expand the scope of WCP-Water capabilities. It proposed adding three new members immediately: the Secretary General of the International Association of Hydrological Sciences; a representative of the Dialogue on Water and Climate; and a climate modeler, preferably with a background in land surface hydrology. Professor Roger Pielke of Colorado State University was discussed as a desirable candidate. In addition, it was agreed that potential invitees to the Steering Committee would include representative from CLIVAR, the Joint Water Project, the water resources planning and management community, and the insurance community.

4.2 Representation of WCP-Water in Upcoming Meetings

1. IPCC Consultative Meeting on Climate Change and Water (Geneva; 11-13 November 2002) – Messrs. Lins, Grabs, and Fritsch will attend.

2. DWC Synthesis Meeting (Dhaka; 18-19 December 2002) – Mr Guiseppe Arduino (UNESCO Jakarta Field Office) will attend for UNESCO and Mr Fritsch plans to attend for WMO.

3. IPCC Bureau Meeting (Geneva; December 2002) – WMO will attend; person to be determined.

4. Steering Committee of Warsaw Group (early Spring 2003) – Ms Calver will attend.

5. World Water Forum (Kyoto; 16-23 March 2003) – Attendance to be determined.

6. EGS-AGU-EGU Joint Assembly (Nice; 7-11 April 2003) – Mr Lins and Ms Calver are co-chairing a special session and will be there.

4.3 Tasks and Activities for 2002-2003

1. Plan an Expert Meeting on the state of knowledge of hydrologic sensitivity to climate conditions by February 2003. The target date for the meeting is late autumn 2003. (All)0

2. Assemble a table of WCP-Water contacts, including names, institutions, expertise, and functions. (All)

3. Prepare a set of "one-pagers" of possible WCP-Water projects; e.g., identification of data rich versus data poor regions). (Ann Calver, with help from all)

4. Recast the proposal for a global analysis of streamflow trends, prepared by the Centre for Ecology and Hydrology (CEH) and submitted to (but not funded by) the Dialogue on Water and Climate. The recast proposal should be done in consultation with Zbyszek Kundzewicz, co-editor of the WCP-Water technical report entitled *Detecting Trend and Other Changes in Hydrological Data*, and a new funding source for the proposal should be sought. (C. Svenson and Z. Kundzewicz)

5. The trend analysis CD-ROM that the Steering Committee commissioned to be produced at its Second Meeting, but has yet to be prepared, should be completed and available for distribution by April 2003, in time for the EGS-AGU-EGU Joint Assembly in Nice. (H. Lins)

6. The WCP-Water webpage needs updating and editing, including replacement of the word "Projects" with "Activities" in the page header. (H. Lins)

7. Prepare a foldable WCP-Water brochure. (W. Grabs or J.M. Fritsch, with help from all)

8. Revise the draft WCP-Water scoping paper to the IPCC for use at its November 11-13 consultative meeting on climate change and water in Geneva. The paper must be revised by Monday, 4 November 2002 for submission to Paul van der Linden by Wednesday, 6 November. (J.M. Fritsch, with help from all)

4.4 Other Business

The SC noted that the EC had distributed material regarding the Informal Draft Work Programme from Framework VI (2002-2006) for Global Change and Ecosystems, containing a call for international participation at the global scale. This offers opportunities to formulate WCP-Water research projects consistent with EC requirements and also a potentially for direct collaboration with this EC programme. A draft dated 18 October 2002
Thematic Sub-Priority
1.6.3 Global Change and Ecosystems
WORKPROGRAMME
2002-2006

is available on the Internet at:

http://www.kowi.de/rp6/dokumente/download/WP_6_1.6.3_18102002.pdf

Relevant material from this draft is compiled in Annex 6 to this report.

4.5 Date and Venue of Next Meeting

The Steering Committee agreed that its Fourth Meeting should take place immediately following the Expert Meeting on the State of Knowledge Regarding Hydrologic Sensitivity to Precipitation, in Autumn 2003. The exact dates and location for the meetings will be decided by February 2003.

4.6 Closure

The meeting was adjourned on Wednesday, 23 October at 12:30 hours.

ANNEX 1

Third Meeting of the Steering Committee for WCP-Water

Wallingford, 21-23 October 2002

LIST OF PARTICIPANTS

Members of the Steering Committee

Mr Michael Bonell
Chief, Hydrological Processes & Climate
Division of Water Sciences
UNESCO and IHP Secretariat
1 Rue Miollis
75700 PARIS Cedex 15
France
Tel: (33 1) 45 68 39 96
Fax: (33 1) 45 68 58 11
e-mail: m.bonell@unesco.org

Ms Ann Calver
Head, Hydrological Risks Division
CEH Wallingford
Crowmarsh Gifford
WALLINGFORD
Oxfordshire OX10 8BB
United Kingdom
Tel: (44) 1491 69 22 61
Fax: (44) 1491 69 24 24
e-mail: anc@ceh.ac.uk

Mr Jean-Marie Fritsch
Senior Scientific Officer
Hydrology and Water Resources Dept.
Case postale 2300
7 bis, avenue de la Paix
CH-1211 GENEVA 2
Switzerland
Tel: (41 22) 730 80 08
Fax: (41 22) 730 80 43
e-mail: Fritsch_J@gateway.wmo.ch

Mr Wolfgang Grabs
Chief, Water Resources Division
Hydrology and Water Resources Dept.
Case postale 2300
7 bis, avenue de la Paix
CH-1211 GENEVA 2
Switzerland
Tel: (41 22) 730 83 58
Fax: (41 22) 730 80 43
e-mail: grabs_w@gateway.wmo.ch

Mr Harry Lins
Drought Science Coordinator
US Geological Survey
415 National Center
RESTON
Virginia 20192
USA
Tel: (1 703) 648 57 12
Fax: (1 703) 648 57 22
e-mail: hlins@usgs.gov

Invited Participants

Mr Max Beran
OB Research Services
1 The Croft, East Hagbourne
Didcot, Oxon
OX11 9LS
United Kingdom
Tel: (44) 1235 81 24 93
e-mail: maxberan@oldboot.demon.co.uk

Mr Alan Gustard
Deputy Director
CEH Wallingford
Crowmarsh Gifford
WALLINGFORD
Oxfordshire OX10 8BB
United Kingdom
Tel: (44) 1491 69 23 41
Fax: (44) 1491 69 24 24
e-mail: agu@ceh.ac.uk

Mr Mike Harrison
IPCC WGII Technical Support Unit
UK Met Office
London Road
Bracknell Berkshire RG12 2SY
United Kingdom
Tel: (44) 1344 85 62 12
Fax: (44) 1344 85 48 98
e-mail: mike.Harrison@metoffice.com

Mr Pierre Hubert
Secretary General, IAHS
Ecole des Mines de Paris
35 rue St Honoré
77305 Fontainebleau
France
Tel: (33 1) 64 69 47 40
Fax: (33 1) 64 69 47 03
e-mail: phubert@noos.fr

Mr Martin Parry
Co-chair IPCC WG2
University of East Anglia
Jackson Environmental Institute
School of Environmental Sciences
Norwich NR4 7TJ
United Kingdom
Tel: (44) 1603 59 38 95
Fax: (44) 1603 59 38 96
e-mail: martin.parry@uea.ac.uk

Ms Cecilia Svenson
CEH Wallingford
Crowmarsh Gifford
WALLINGFORD
Oxfordshire OX10 8BB
United Kingdom
Tel: (44) 1491 69 23 63
Fax: (44) 1491 69 24 24
e-mail: csve@ceh.ac.uk

Mr Paul van der Linden
IPCC WGII Technical Support Unit
UK Met Office
London Road
Bracknell Berkshire RG12 2SY
United Kingdom
Tel: (44) 1344 85 46 65
Fax: (44) 1344 85 69 12
e-mail: paul.vanderlinden@metoffice.com

ANNEX 2

Third Meeting of the Steering Committee for WCP-Water
Wallingford, 21-23 October 2002

AGENDA

Tuesday, October 22

08:30 Overview of the status of WCP-Water

09:30 IAHS/WCP-Water common research interests

10:30 Break

10:50 Review of IHP-VI Board Meeting and HELP-FRIEND-Ecohydrology workshop

12:00 Lunch

13:30 IPCC – WCP-Water links

15:00 Break

15:20 Joint Water Project activities and links with WCP-Water

16:00 Dialogue on Water and Climate activities

17:00 Adjourn for day

Wednesday, October 23

08:30 Technical Presentation on Climate Change and Flood Risk

09:30 Composition of the WCP-Water Steering Committee

09:45 Representation of WCP-Water in upcoming meetings

10:00 Development of task list for WCP-Water 2002-2003

10:30 Break

10:50 Action plan for WCP-Water in 2002-2003

11:30 Other business

11:50 Date and venue of the next meeting

12:00 Meeting adjourns

13:30 Rapporteurs meet to produce the draft report

ANNEX 3

Third Meeting of the Steering Committee for WCP-Water

Wallingford, 21-23 October 2002

TECHNICAL PRESENTATION BY MAX BERAN

Max Beran presented his recent research into the evaluation of climate change impacts on design flood estimation. He emphasized the key distinction between the current approach, based on the impact on the flood frequency curve, and his own approach that made allowance for the additional step to arrive at a design decision. Crucially, this step recognizes the uncertainty in flood frequency estimation by the addition of a safety margin and allows for climate change by representing it as an additional source of uncertainty. From a statistical standpoint this shifts the focus from the fundamental flood frequency distribution to its sampling variance; this latter embodying information about uncertainties such as those due to short or uncertain data as well as climate change.

The practical steps involved in this new approach comprised an initial selection of an index of climate, such as the winter half-year rainfall; then to calibrate a statistical model of the annual flood maxima conditional on the climate index of each year. This model can then be applied to the future climate index distribution as obtainable from scenarios and, as a final step, to calculate the sampling distribution of say the 100-year return period flood.

It was found that the design decision based, for example, on the 90-percentile, was very much closer to the current design than that implied by the method advocated in WG2 of the IPCC Third Assessment Report (TAR). However, this was not intrinsic to the scheme as, in a case where the scenarios indicated no future change to the flood frequency distribution, the design flood would nevertheless increase in response to the addition of the new source of uncertainty. This is in contrast to the TAR/WG2 approach that would leave the design decision unchanged because the flood frequency distribution would be unchanged (fig. 1).

It was found that the sensitivity of the flood frequency distribution to the annual variability of rainfall was much lower than that commonly assumed in other studies based on general circulation model (GCM) output. Data were presented to illustrate that this might well be a model artifact as these displayed a high degree of correlation between warming and precipitation even in control runs, whereas observed precipitation and temperature exhibited no such correlation (fig. 2). A theoretical argument could be advanced for this model behavior stemming from the way humidity was handled.

Discussion among the committee focused on this aspect and also on the possible role of choice of statistical model. Future developments would include obtaining broader experience with the scheme, extending the range of statistical models from Lognormal and Gumbel to others, and substituting a more realistic representation of the decision procedure for arriving at the design flood from the basic distribution and its sampling properties.

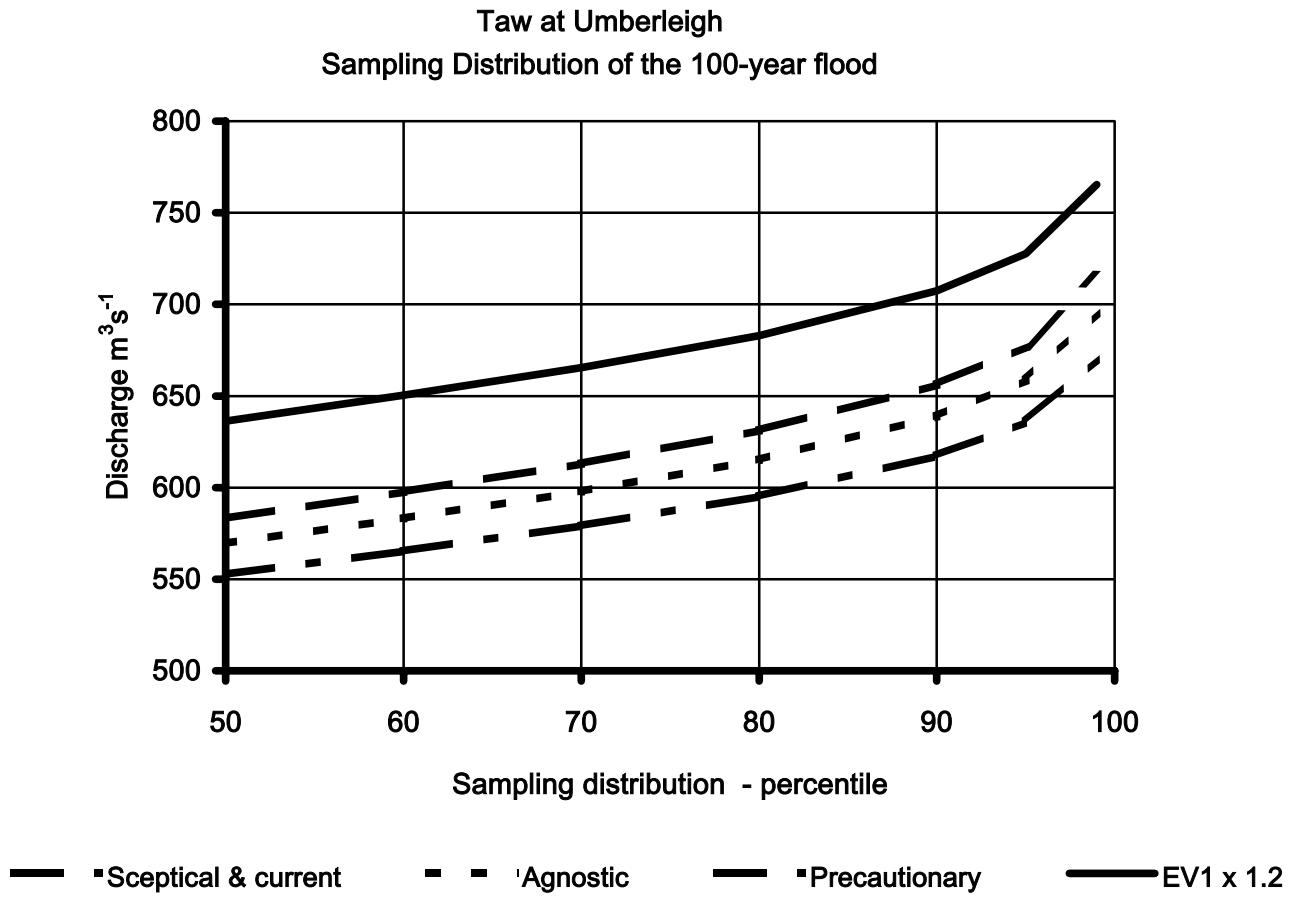


Figure 1. Sampling distribution of the 100-year flood for 2080 for the Taw at Umberleigh gauging station. The design flood is obtained as the 90th percentile point on the sampling distribution of the 100-year flood (equivalent to a decision rule that says that underestimation of the 100-year flood is nine times more serious than overestimation). For example, 90 percent of estimates of the 100-year flood exceed 620 m^3s^{-1} under a skeptical interpretation of the 2080 climate.

The best estimate of the 100-year flood under the current climate is 550 m^3s^{-1} (50th percentile on EV1 line, which happens almost to coincide with the skeptical view of the future). Even under the current climate, a risk-averse engineer would not design to this level, but would use a criterion such as the 90th percentile point on the distribution of the 100-year flood, i.e., 620 m^3s^{-1} or a factor of safety of 70 m^3s^{-1}. By chance, this coincides with the results of taking a skeptical view of the 2080 climate. However, a precautionary view of the future would lead to a design flood of 660 m^2s^{-1}, a factor of safety of 110 m^3s^{-1}. The rule implied by the IPCC Working Group 2 report leads to a design flood of 710 m^3s^{-1}, a factor of safety of 160 m^3s^{-1}. The return period on the current flood frequency curve implied by these design flood estimates are: 350 years for the current and 2080 skeptical assumptions, 600 years for 2080 precautionary, and 1250 years for the IPCC Working Group 2 rule.

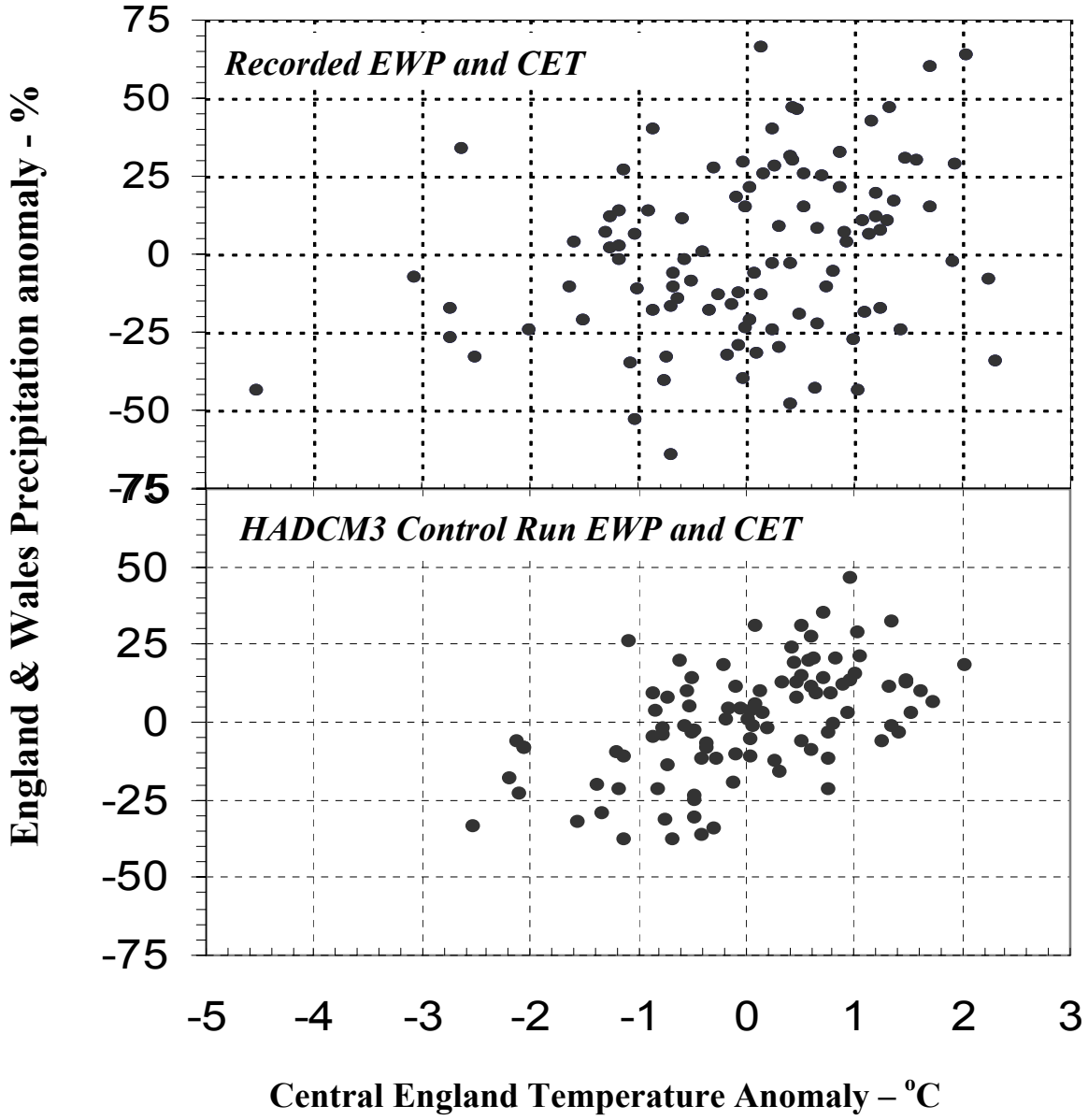


Figure 2. Illustrating the model enhancement of sensitivity of winter precipitation to warming. The upper graph shows the broad scatter of winter season rainfall from the EWP and CET datasets (acknowledgement to Hadley Centre) indicating a low level of climate sensitivity. The lower graph shows equivalent data from the HADCM3 GCM from a 100-year control run (acknowledgements to IPCC Data Centre, Deutsche Wetterdienst) using appropriate grid square weightings for the E&W and CE areas and indicates a much higher level of sensitivity. The equivalent graph for the HADCM3 transient run, eg for the 2020s, indicates even higher levels of sensitivity.

ANNEX 4

Third Meeting of the Steering Committee for WCP-Water

Wallingford, 21-23 October 2002

CD-ROM OF GRIDDED GLOBAL RUNOFF DATA

As a collaborative effort of GRDC and the University of New Hampshire, USA, a project has been completed in 1999 to demonstrate the potential of combining observed river discharge information with a climate-driven Water Balance Model in order to develop composite runoff fields which are consistent with observed discharges. Such combined runoff fields preserve the accuracy of the discharge measurements as well as the spatial and temporal distribution of simulated runoff, thereby providing the "best estimate" of terrestrial runoff over large domains. The presentation also demonstrated the potential "look" of a global product which can be developed using hydrological and climatological data sets.

The method applied in the preparation of this data set utilizes a gridded river network at 30-minute spatial resolution to represent the riverine flow pathways and to link the continental land mass to oceans through river channels. Selected gauging stations from the Global Runoff Data Centre data archive were co-registered to a simulated topological network (STN-30p) developed at the University of New Hampshire. Inter-station regions between gauging stations along the STN-30p network were identified. Inter-station discharge and runoff were calculated to compare observed runoff with outputs from the water balance model (WBM) simulation. Correction coefficients based on the ratio of observed and simulated runoff for inter-station areas were calculated and
applied against simulated runoff to create composite runoff fields.

The present CD contains not only "UNH-GRDC Composite Runoff Fields V1.0" but also intermediate data sets, such as station attributes and long-term monthly regimes of the selected gauging stations. Also included on the CD are the simulated topological network (STN-30p), STN-30p derived attributes for the selected stations and gridded fields of the inter-station regions along STN-30p.

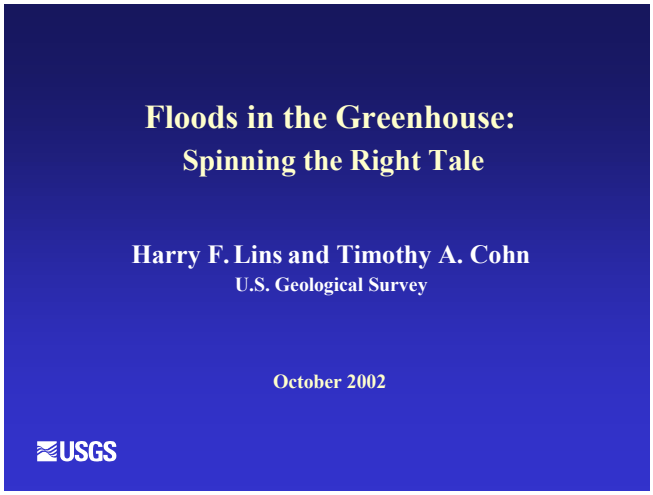
An HTML based data explorer was developed to help users of the CD-ROM view the data. With a standard web browser and the CD it is possible to navigate from a global view of the data, down to a subbasin or station level.

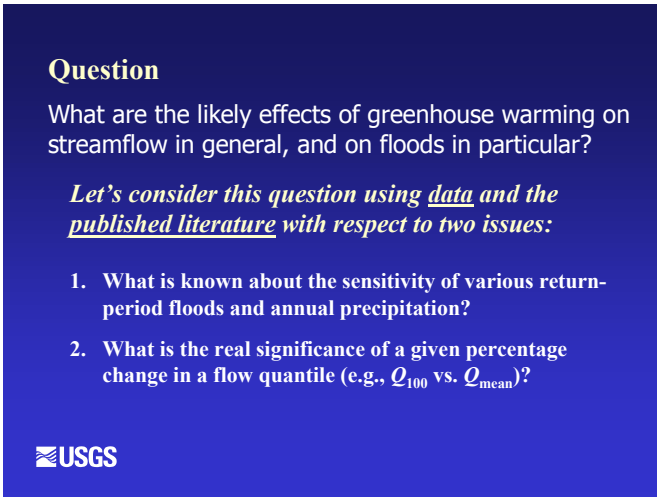
The printed version of the report or the CD can be ordered free of charge from GRDC (grdc@bafg.de) or WMO (dhwr@gateway.wmo.ch). An updated version of the composite runoff fields is currently under preparation by UNH in collaboration with GRDC.

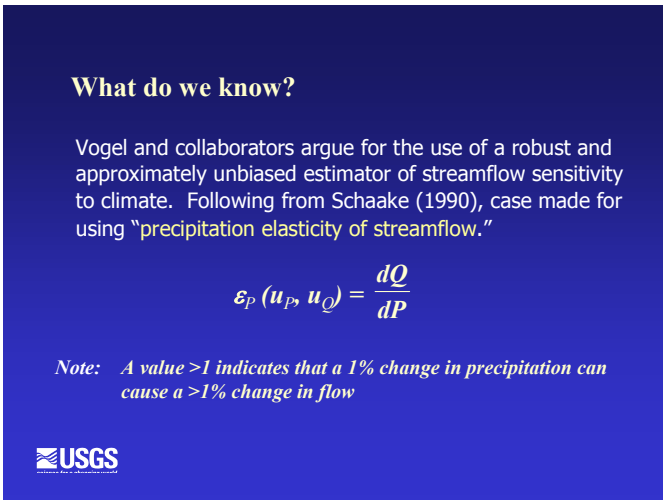
Third Meeting of the Steering Committee for WCP-Water
Wallingford, 21-23 October 2002

PRECIPITATION ELASTICITY OF STREAMFLOW

Excerpts from a presentation made by Harry Lins at the Workshop on Paleofloods, Historical Data and Climatic Variability, 16-19 October 2002, in Barcelona, Spain



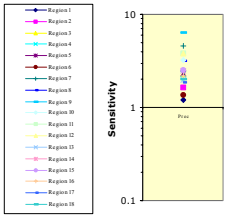




What do we know?

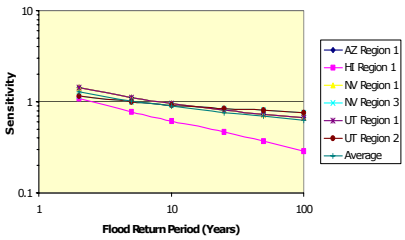
Observed elasticity (sensitivity) of streamflow to changes in precipitation

Mean Annual Flow



Source: Vogel et al., 1999

Flood Flows

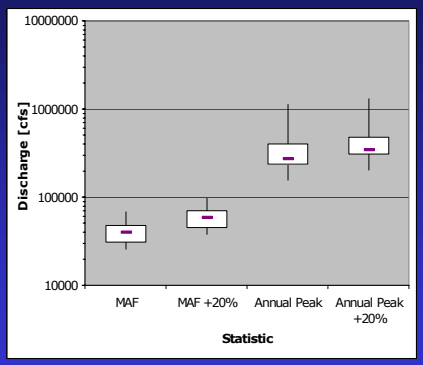


Source: USGS National Flood Frequency Equations

USGS

What's the significance?

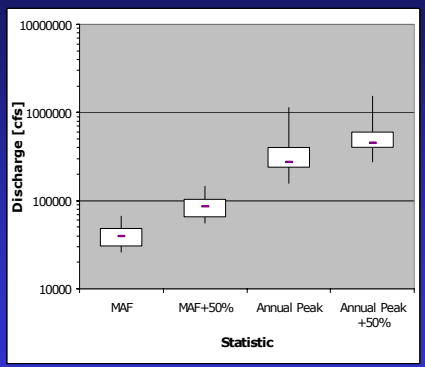
Susquehanna R. Flow Distribution 1968-2000 and Projected With 20% Precipitation Increase



USGS

What's the significance?

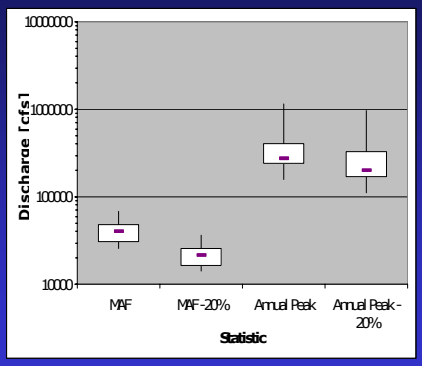
Susquehanna R. Flow Distribution 1968-2000 and Projected With 50% Precipitation Increase



USGS

What's the significance?

Susquehanna R. Flow Distribution 1968-2000 and Projected With 20% Precipitation Decrease



USGS

Conclusion/Opinion

1. *The precipitation sensitivity of mean streamflow is much greater than that of peak streamflow . . .and the greater the return period of the flood, the lower the precipitation sensitivity.*

2. *The continued emphasis on greenhouse-induced increases in extremes, such as floods, is misguided, unsubstantiated by credible evidence, and detracts from a more fruitful discussion of how to take advantage of opportunities posed by increases in mean flow, as well as how to appropriately prepare for the threats posed by decreases in mean flow.*

USGS

Third Meeting of the Steering Committee for WCP-Water
Wallingford, 21-23 October 2002

EUROPEAN COMMISSION
RESEARCH DIRECTORATE-GENERAL
Directorate I - Environment
PCT-FP6-P6-GCE-2002-0008-Draft 18.10.02

DRAFT
Thematic Sub-Priority
1.6.3 Global Change and Ecosystems
WORK PROGRAMME
2002-2006

Excerpts from the document

Research priorities

I.3. Climate dynamics and variability
Climate dynamics, climate variability, the hydrological cycle, feedback processes and rapid climate changes. Quantification and modelling of significant physical, chemical and biological processes and their interactions with the oceans, cryosphere, land and biosphere. Investigation of past climate variations, events and forcing factors. Reconstruction of climate and environmental conditions over periods relevant for understanding climate change and climate system dynamics. Improved understanding of fundamental modes in the coupled climate system, in particular the ocean-atmosphere system (e.g. ENSO, NAO).

*Topic for Network of Excellence or Integrated Project to implement in the **second call***

I.3.a) **Past climates and its dynamics.** Reconstruction and modelling of past climatic conditions and climatic events. Their analysis in a framework of climate variability and dynamics to significantly contribute to better climate change prediction.

*Topics for STREP and Co-ordination Actions to implement in the **second call***

I.3.b) **Coupled climate system.** Improving the understanding of the coupled climate system, in particular the coupled ocean-atmosphere system and dynamics of El Nino Southern Oscillation (ENSO) and North Atlantic Oscillation (NAO).

I.3.c) **Novel palaeo-reconstruction methods.** Development of novel palaeo-reconstruction methodologies and multidisciplinary approaches for past climate conditions and climate dynamics.

*Indicative topic to implement in the **third call***

I.3.d) **Hot spots in the climate system.**
International co-operation
International co-operation in support of international research programmes (e.g. IGBP/WCRP is envisaged. Coordinated Calls for Proposals are foreseen with the US National Science Foundation (NSF). Also it is envisaged that research will be performed in co-operation with non EU countries (e.g. US), also for access to research platforms (e.g. research vessels).

I.4. Prediction of climatic change and its impacts

Prediction of global to regional climatic change and its physical impacts, including sea-level change, changes in storminess and precipitation, drought severity and frequency.
Development of models for and the prediction of climatic change and impacts over seasons, decades to centuries including quantification of uncertainties in particular those linked to earth system processes, feed backs and limits of predictability.

*Topic for Network of Excellence or Integrated Project to implement in the **first call***

I.4.a) **Earth system modelling.**
Earth system modelling and integrated climate change studies involving prediction and regional impacts and scenarios. Ensemble based probabilistic methods should be used and models should be developed to explicitly include the important earth system processes and as far as possible also the human dimension aspects and other processes of relevance for impacts assessment.

*Indicative topics to implement in the **third call***

I.4.b) **Seasonal climate prediction.**

I.4.c) **Climate predictability.**
International co-operation
International co-operation in support of international research programmes (e.g. WCRP-CLIVAR) is envisaged. Also it is envisaged that research will be performed in co-operation with non EU countries (e.g. China, Japan, US).

II. Water cycle, including soil-related aspects (Excerpts)

The objective is to understand the mechanisms and assess the impact of global change and in particular climate change on the water cycle, water quality and availability, as well as soil functions and quality to provide the bases for management and technological tools for water systems to mitigate the impacts.

Research priorities

II.1. Climate and hydrological processes

Climate change has a profound impact on the components of the water cycle; very relevant research challenges still exist with regard to climate change modeling to make them compatible for river basin or catchment management. There is a need to develop downscaling methods and improved modelling approaches to translate the results of global and regional climate change modeling studies to hydrological studies at spatial and temporal scales relevant for water management, and to develop up-scaling methods for water cycle parameters and related data assimilation techniques. Forecasting of climate change impacts on hydrology should give special attention to possible changes in frequency and severity of droughts and floods.

II.1.1) Climate modelling at catchment-regional scale

*Topic for Network of Excellence or Integrated Project to implement in the **first call***

II.1.1.a) **Improved modelling of climate-water interactions at catchment-regional scal**e.

Development of advanced modelling approaches at scales relevant for assessing the potential effects of climate changes on water resources management, their validation and application for major impact and mitigation studies.

*Indicative topic to implement in the **third call***

II.1.1.b) **Integration of instrumented catchments for improving the understanding of hydrological processe**s.

II.1.2) Climate variability, floods and droughts

*Topic for Network of Excellence or Integrated Project to implement in the **first call***

II.1.2.a) **Development of a European (Virtual) Centre for Flood and Drought Studie**s, through the development of long-term integrated research activities on the main drivers, with emphasis on data collection and exchange, information management, comparison of forecasting methods, evaluation of flood and drought warning systems, linking different disciplines and providing interaction with major stakeholders.

*Indicative topic to implement in the **third call***

II.1.2.b) **Technologies and systems for flood prediction under changing climatic conditions**.

II.2. Ecological impact of global change, soil functioning and water quality

Global change can exert severe impacts on the ecology of aquatic and wetland ecosystems, on the filter and transport functions of soils and on water quality. Assessments of these changes require to better understand the consequences of major hydrological changes, to identify and quantify the key biogeochemical processes and to predict the consequences of global change at different scales. The integrated management of soil-water systems requires a detailed understanding of the properties and the functional role of soil, and the behavior and fate of pollutants.

II.2.1) Ecological impact of global change on surface water bodies

*Topic for Network of Excellence or Integrated Project to implement in the **first call***

II.2.1.a) **Assessment of ecological impacts of global change on freshwater bodies, development of ecological indicators of ecosystem health and related remediation strategies**. In a phased approach this action should integrate the wide range of expertise needed to assess the combined impacts of medium to long-term global climate and environmental changes on the quality of water, the structure and ecological functioning of surface water and marginal wetland ecosystems, in order to develop a set of ecological indicators of the health of those ecosystems, and to identify best practices for re-naturalisation.

*Topic for Specific Support Actions to implement in the **first call***

II.2.1.b) **Consolidating knowledge on the role of wetlands in the water cycle**. In view of the implementation of the Water Framework Directive, there is a need to synthesize the results of concluded and on-going research activities, both at European and national level, for giving guidance on the hydrological, ecological and socio-economic role of wetlands.

II.3.3) Management of scarce water resources and mitigation technologies

*Topic for STREP and Co-ordination Actions to implement in the **first call***

II.3.3.a) **Technologies for monitoring and mitigating the impact of water scarcity**. Specific development of innovative and cost-effective mitigation technologies or improvement of existing methods (e.g. artificial recharge, water reuse, water conservation, desalination, etc.) and of technologies adapted to specific conditions of developing countries. The participation of SMEs in these activities is encouraged.

*Topic for Network of Excellence or Integrated Project to implement in the **second call***

II.3.3.b) **New approaches to water stress**. Water stress can be the consequence of water deficit, water scarcity, of temporary drought conditions or any combination of these, and puts challenges to optimal water allocation. This requires the development of management strategies, technologies and monitoring systems for water reclamation and re-use, aquifer recharge, combating saline intrusion and water pollution, reducing water losses, water savings and use of alternative water sources. Moreover better understanding of the relationships between surface water, soil and groundwater as well as between soils, plants and the atmosphere are needed. The participation of Mediterranean countries suffering from problems of water scarcity should be foreseen.

*Indicative topic to implement in the **third call***

II.3.3.c) **Technologies for monitoring and mitigating the impact of water scarcity**.

II.4. Scenarios of water demand and availability

With the aim of defining a sustainable development framework and to provide to policy-makers instruments in support of policy choices, more advanced analytical tools have to be worked out in order to define more realistic medium- and long-term scenarios of water demand and availability at a wide regional level.

*Topic for Network of Excellence or Integrated Project to implement in the **second call***

II.4.1.a) **Water scenarios for Europe and for neighboring countries.** Development of medium-long term (25-50 y) scenarios, based on advanced policy, socio-economic and technological option design strategies, that should become a reference for large scale regional planning. The initiative will contribute to international activities on global water assessment. The participation of third countries should cover in particular the areas surrounding the European borders.

International co-operation - Water cycle and soil related aspects

The targets agreed upon in Johannesburg at the World Summit on Sustainable Development and confirmed by the EU Water Initiative, namely to halve by 2015 the number of people not having access to drinking water and sanitation, are very ambitious and require a joint international effort in this direction. This part of the programme aims at contributing to the research component of the EU Initiative. The participation of International Organizations involved in development co-operation is welcome, especially with regard to the establishment of the necessary interfaces to other bilateral and multilateral co-operation actions.

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WORLD CLIMATE APPLICATIONS PROGRAMME (WCAP)/
WORLD CLIMATE APPLICATIONS AND SERVICES PROGRAMME (WCASP)
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WCAP - 2	CLIMATE AND HUMAN HEALTH. Proceedings of the Symposium in Leningrad, 22-26 September 1986, Volume II
WCAP - 3	ANALYZING LONG TIME SERIES OF HYDROLOGICAL DATA WITH RESPECT TO CLIMATE VARIABILITY - Project Description. WMO/TD-No. 224 *(out of print)*
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Note: ***Following the change of the name of the World Climate Applications Programme (WCAP) to World Climate Applications and Services Programme (WCASP) by the Eleventh WMO Congress (May 1991), the subsequent reports in this series will be published as WCASP reports, the numbering being continued from No. 16 (the last "WCAP" report).***

WCASP - 17 A NONPARAMETRIC FRAMEWORK FOR LONG-RANGE STREAMFLOW FORECASTING by J.A. Smith, G.N. Day and M.D. Kane, Hydrologic Research Laboratory, National Weather Service, U.S.A. WMO/TD-No. 428

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WCASP - 32 REPORT FROM THE MEETING OF EXPERTS ON CLIMATE INFORMATION & PREDICTION SERVICES, CLIPS (Melbourne, Australia, 28 to 31 March 1995). WMO/TD-No. 680 *(out of print)*

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WCASP - 41 REGULATORY APPLICATIONS OF THE RELATIONSHIPS BETWEEN NATURAL GAS USAGE AND WEATHER, prepared by J.A. Gray, D.L. Patterson, M.S. Proctor and H.E. Warren (USA) and
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