The IAHR Project on
Climate Change impact on the Hydrological cycle, water management and Engineering
(CCHE)

QUESTIONNAIRE on
Climate Change IMPACT on the hydrological cycle and ADAPTATION measures
(version 1.0 November 2009)

Dear Sir/Madame,

IAHR, the International Association for Hydro-Environment Engineering and Research (www.iahr.org) launched a research Project called **Climate Change impact on the Hydrological cycle, water management and Engineering** (IAHR CCHE Project) described in the Annex I. The undersigned Chairs of its Scientific Committee (SC) invite you to spend a little of your time to fill in the following Questionnaire. IAHR members who will significantly contribute to the project's activities will become project's partners, after approval by the Scientific Committee. Others, who will participate to some of the project's activities will become participants. The responses will be included in a Web-based **inventory** of studies on **climate change impacts** on the hydrological cycle and the water management and the engineering feedback for the **adaptation to climate change.** The results of the survey will be summarized in a Report to be presented by the Chairs of the SC at the IAHR Congress in Brisbane in July 2011. Our plans are to invite both partners and participants to submit the results in a series of papers to a peer-reviewed international journal just after the 2011 IAHR Congress. If some questions are out of your competence, you can invite other persons to respond them, or leave them without answers. It can happen that you are either expert in *impact* of climate change on hydrology or in water management and engineering measures. In that case you can fill, in addition to part A and D (which are mandatory) just some fields of part B or C. If you believe this can take to you too much time you can start to fill some fields only and send to us. Then you can take your time to provide further information.

Please **send** this filled Questionnaire, together with the annexed Excel **.xls** spreadsheet and, possibly, the **.kmz** or **.shp** files about the investigated area in a single .zip file **to** Roberto Ranzi (ranzi@ing.unibs.it) **and in Cc**: to Toshiharu Kojiri (tkojiri@wrcs.dpri.kyoto-u.ac.jp) and to Arthur Mynett (a.mynett@unesco-ihe.org), and to the person you received it from. **Deadline**: end of December 2009.
Needed information fields are in **bold** and grey-shaded. Other fields and the annexed Excel file and .kmz and .shp files are very welcome, and useful for us, but if there are technical problems to produce them or related information is missing **they are not strictly needed**. If possible you can complete the information later.

Annex I: IAHR CCHE PROJECT DESCRIPTION
Annex II: IAHR_ CCHE_ Questionnaire.xls

6th November 2009
Roberto Ranzi, University of Brescia, Italy
Arthur Mynett, IHE-UNESCO, Delft, The Netherlands
Toshiharu Kojiri, Water Resources Research Center, Kyoto University, Japan

A) Investigated region or river basin

Field	Code	Example
A1	1) Union of Countries 2) Country 3) Administrative region, Country 4) Hydrological basin, Station	1 or 2 or 3 or 4
A2	Name	1) European Union 2) Germany 3) Bavaria, Germany 4) Oglio, Sarnico or Donau, Budapest
A3	For codes 1), 2), 3) area (km²), mean altitude (m asl) For code 4) outlet lat °N (negative °S), lon °E (negative °W), altitude (m asl), basin area (km²), mean, max basin altitude (m asl), annual precipitation (mm), annual runoff (mm)	4) 45.660400, 9.938411,187,1840,1379, 3539,1165, 933
A4	Observed JFMAMJJASOND precipitation (mm)	68.1 38.2 64.0 94.9 126.9 129.0 114.9 117.4 113.5 136.4 85.7 76.3
A5	Observed JFMAMJJASOND runoff (mm)	43.3 33.5 44.7 70.6 129.0 134.0 108.8 74.7 73.2 100.7 69.1 51.5
A6	Observed JFMAMJJASOND mean monthly temperature at mean altitude (°C)	-2.0 -0.7 2.4 4.9 9.6 12.9 15.9 15.8 11.9 7.3 2.1 -1.2
A7	Major water-related problems in the region/basin	Water stored in hydropower reservoirs might be needed to mitigate effects of droughts in the Po Valley. Snow water equivalent decrease
A8	Basin outlet location and watershed divide polygon in .shp or .kmz format	Oglio@Sarnico.kmz Basin@Station.kmz Oglio@Sarnico_Po_Oglio_IT.kmz Basin@Station_Majorbasin_basin_subbasin_IntlCountryCode.kmz
A9	Notes about data sources, period of observation, a short description of the basin, region or country	Period of observation 1979-1999.

Part B) Impacts of climate change on hydrology

It is intended to monitor the current state of knowledge as regards trends in climate characteristics, climate scenarios, and the impacts of projected climate change on the hydrological regime in the region defined at point A. When we indicate 2050 and 2090 it is intended a time window around the mid and the end of the 21st century, as the IPCC Reports often refer to. If you know, or are involved in climate modelling or climate impact assessment for the river basin or region indicated in A, please fill the results of the study(ies) you know in the table. It can happen that you have data just on part B1 ad B2 or B3 and B4. Fill whichever field you have information about. If you are expert on adaptation measures only, skip this part and just fill part C and D.

Trend analysis for the historical period				
B1 method of investigation	B2 Observed change			
Method of trend analysis used (period investigated)	Trend found for precipitation in the period (mm/100 yrs±st.dev)	Trend found for runoff in the period (mm/100 yrs± st.dev)	Trend found for temperature in the period (°C/100 yrs ± st.dev)	Other detected trends (e.g. snow depth, water equivalent, salinity intrusion,....please specify)
e.g. Trend analysis from the slope of the regression line (runoff 1959-2005) or Mann Kendall test, or Spearman's test,... at the point scale or regional scale.	....	217 ± 19 mm/100 years	....	
• Trend analysis • Non stationarity tests of mean, variance,… • Others	....		....	

B3 Projected climate scenarios for the region		
Method: • Global Climate Model, scenarios • Regional Climate Model scenarios • Analogues with the past • Trend analysis • …..	Projected change in mean annual precipitation by 2050 ΔP (mm) +33 mm	Projected change in mean annual precipitation by 2090 ΔP (mm) +10 mm
e.g. PCM scenario A2	Projected change in mean annual temperature by 2050 ΔT (°C) +1.1 °C	Projected change in mean annual temperature by 2090 ΔT (°C) +2.4 °C

B4 Projected Impact on hydrological regime		
Method used for impact assessment • e.g. hydrological modelling with GCM+WATFLOOD • …..	Projected change in mean annual runoff by 2050 ΔQ (mm) -62 mm	Projected change in mean annual runoff by 2090 ΔQ (mm) -117 mm
• e.g. hydrological modelling with GCM+WATFLOOD • ….	Projected monthly runoff regime (site-specific) 43,56.1,64.2,90.8,128.7,112.6,71.9,50.7,44.6,47.6,77.5,77.6	 62,64.3,82,105.1,126.2,86.5,63.8,32.8,22.4,29.7,65,70.6
• e.g. At site direct estimation of T-years return period peak flow • Regional estimation of T-years peak flow • Rational formula • RCM scenarios+ hydrological modelling • ….	Projected impact on T-years return period (T=100 yrs, specify otherwise) peak flow $\pm$ X % change by 2050 (site-specific or regional assessment)	Projected impact on T-years return period (T= 100 yrs, specify otherwise) peak flow $\pm$ X % change by 2090 (site-specific or regional assessment)

Please include references on the trend analysis studies, regional climate scenarios and regional climate impact studies. Include here additional text if necessary, about one page for instance describing theoretical aspects, technical details developed for this case study.

Part C) Adaptation to climate change

It is intended to assess the extent to which these impacts are recognized and taken into account by international and national water authorities, engineering organizations and other regulating bodies in setting their standard practices and procedures for the planning, design and operation of water works, as well as other non-structural measures. This will include both “hard” responses, such as the construction of new or enlargement of engineering structures, and “soft” responses, such as changes in legislation or the operating rules of existing structures. It can happen that you are able to provide information just on structural or non structural measures. Fill whichever field you have information about. If you are expert on impact studies only (part B) , skip this part and complete part D.

1) In your opinion, is expected climate change already influencing design criteria and water management policies in the region/basin (Yes or No)? If No, please explain why.

_____
_____
_____
_____
_____
_____

If Yes (changes are noticeable), please fill in the Table below the status of different structural and non-structural measures, and add new measures if necessary, in the case they were decided because of an observed or projected climate change.

Please include references on the adaptation measures being adopted.

Structural measures						
	Measure is not needed in the basin	Measure is needed in the basin				
		Exist & is fully implemented	Exist, enhancement is planned	Exist, enhancement is not planned	Not exist, but planned	Not exist & is not planned
1. Maintenance and rehabilitation of infrastructure (dams, levees, dykes, river embankments, etc.)						
2. Maintenance and enhancement of water storage reservoirs						
3. Channel construction for water diversion from nearby basins						
4. Increase of natural water retention and water storage in watersheds (extending floodplains, creation of wetlands and polders)						
5. Enhancement of infiltration and retardation of water (reducing impermeable areas, building groundwater cisterns etc.)						
6. Water reuse and water recycling						
7. Expanded use of rainwater harvesting						
8. Sea water desalination						
9.						
10.						

Non-structural measures						
	Measure is not needed in the basin	Measure is needed in the basin				
		Exist & is fully implemented	Exist, enhancement is planned	Exist, enhancement not planned	Not exist, but planned	Not exist & is not planned
11. Early warning system for droughts						
12. Flood mitigation system of forecasting, early warning, evacuation and post-flood recovery						
13. Improved land use in agriculture: crop substitution & diversification, modified vegetation cover to reduce evapotranspiration						
14. Agriculture practices reducing runoff (catch crops, no black fallow)						
15. Adjustment of planting dates and crop varieties						
16. Land use planning accounting on higher frequency of extreme events						
17. Zoning (delineation of floodplain zone with low-value infrastructure)						
18. Ensuring appropriate construction methods in flood-prone areas						
19. Improved water use efficiency in different sectors						
20. Development of water allocation strategies among competing demands, exchange of water rights						
21. System of water pricing, quotas and subsidies, legal measures						
22. Drought contingency planning: restrictions on water use, rationing schemes, special water tariffs, reduction of low-value uses						
23. Development of non-farm livelihoods in drought affected areas						

24. Risk spreading method: climate-related hazards insurance						
25. Information and education on flood protection abd scarce water resources usage						
26. Application of new technologies: efficient cooling systems, improved seeds, desalinization etc.						
27.						
28.						

Please include references about the measures adopted.
Include here additional text if necessary, about one page, describing the type of structure/infrastructure and the measures adopted or planned.

Part D) Author

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