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International Association for Hydro-Environment Engineering and Research

Adaptation to Climate Change in Water Engineering: Recommendations to Policy Makers

IAHR Working Group on Climate Change

Presented by Dr Christopher George, IAHR Executive Director

www.iahr.org

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What is IAHR

- IAHR is a prestigious worldwide association of specialist engineers and researchers working in all areas of hydro-environmental science and engineering
- Founded in Europe in 1935 IAHR is one of the oldest international associations engaged in water science, engineering and research
- IAHR strategy is to engage companies, government agencies and institutes with scientific advance
- IAHR is a partner of UN Water, GWP and wishes to collaborate more closely with other associations

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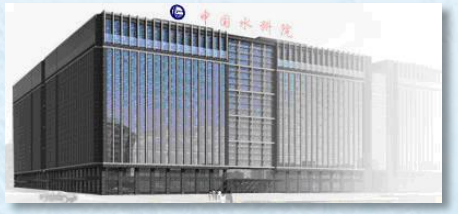
What is IAHR

- IAHR is growing rapidly with over 4000 individuals and more than 100 organisation members in around 100 countries worldwide

- Regional Divisions in
  - Asia Pacific
  - Latin America
  - Europe
  - Africa & Middle East

- Since 2015 IAHR has two headquarters in Beijing and Madrid



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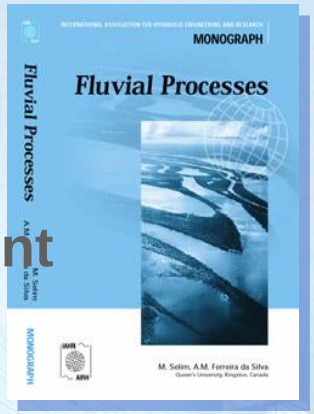
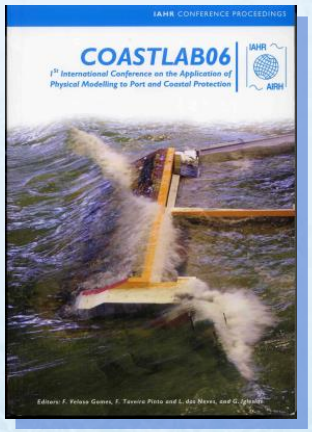
Our activities

- Advocacy for innovation in hydro-environment engineering



- Dissemination of advances:
  - Magazines, books, journals
  - Congresses, and Symposia

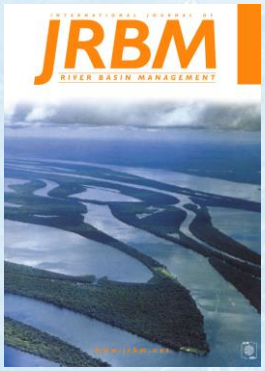
- Many Technical Committees:
  - eg FRM, marine outfalls, ecohydraulics, water resource management, hydraulic machinery, hydraulic structures, hydroinformatics, urban drainage, etc..



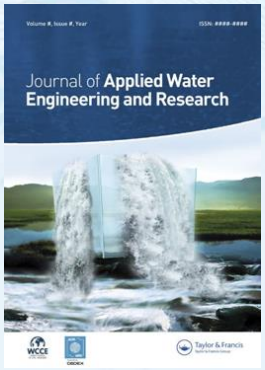
IAHR Publications

Scientific and Peer-reviewed Technical Journals

Journal of Hydraulic Research



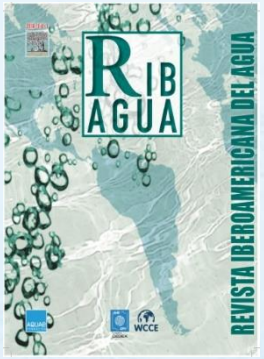
Journal of River & Basin Management



Journal of Applied Water Engineering and Research

Journal of Hydro-environment Research
División Asia/Pacífico

HydroLink



Revista Iberoamericana del Agua

In Spanish and Portuguese

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Background

- This report is a contribution of the IAHR Working Group on Climate Change to the scientific debate on this global challenge to the water sector.
- Experts in different fields from IAHR reviewed and recommended structural and non structural adaptation measures being taken or to be taken in our community to mitigate the effect of CC

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Trend Analyses & Changes Detection in Space-Time Data (1)

Public bodies dealing with the policy and management of water resources should investigate adaptation measures to:

- **Understand and quantify long term trends in hydroclimatic variables especially precipitation and streamflow (amongst others)**
- **Evaluate occurrences, variability and sudden changes of extremes in space and time and develop sustainable and climate-change sensitive hydrologic designs**

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Trend Analyses & Changes Detection in Space-Time Data (2)

- Assess the influences of climate variability on streamflow and precipitation changes at different spatial and temporal scales considering the extent of regional climatology influences
- Understand changes in trends and attribute or separate them based on natural variability or anthropogenic influences

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Competition between food, water and soil in drought-prone areas will become more severe

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Rainfall and Runoff (1)

Climate change is expected to cause a shift to more intense individual storms and fewer weak storms as temperatures increase. Return periods are projected to be reduced by about 10-20% per degree Celsius (˚C) over most of the mid-latitude land masses, with larger reduction over wet tropical regions.

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Rainfall and Runoff (2)

It is recommended that design flood estimation and planning for an asset or activity should consider: service life or planning horizon, design standard, purpose and nature of the asset or activity, screening analysis, climate change projections and their consequences of impact, and statutory requirement.

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Structural measures can help, but also other measures such as improved tools for management, planning and decision-making in reservoir operation can be effective

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Rainfall and Runoff (3)

It is also recommended to take into consideration also a class of worst case extreme events estimated to occur under climate change as survival critical or edge of survivability, partly because projected future changes in design value may have high uncertainty.

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Downscaling and Adaptation to Urban Hydrology Scale (1)

The main challenge in urban hydrology is to predict accurately the future variability of urban hydrologic processes (such as temperature, rainfall, and runoff) at the scale of the urban area in the context of climate change in order to build suitable scenarios for the operation and management of urban water systems.

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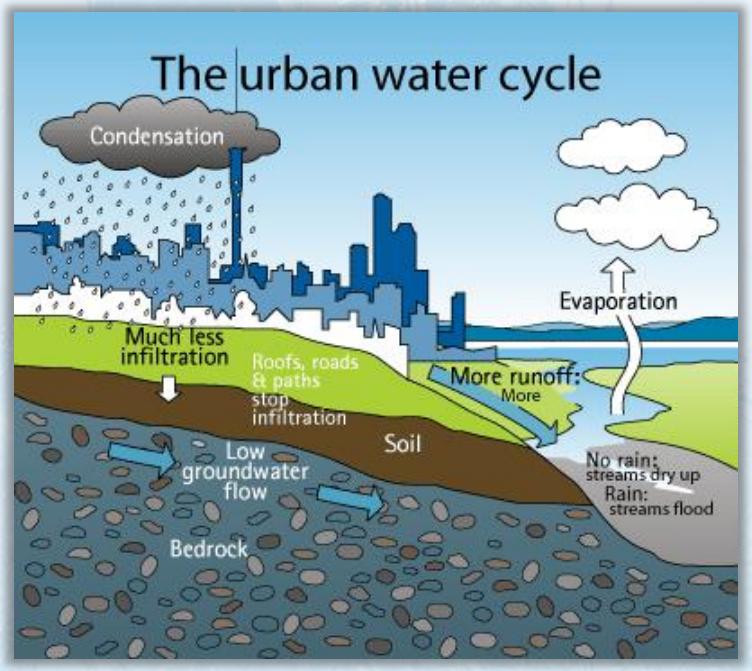
Downscaling and Adaptation to Urban Hydrology Scale (2)

Various impact assessment procedures and adaptation measures should be developed and tested in order to find the most cost-effective method for management and control of the urban water environment.



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Downscaling and Adaptation to Urban Hydrology Scale (3)

Examples of some existing adaptation measures:

- **Storage and infiltration devices together with re-naturalization of urban watercourses are more and more frequently considered and their use should be further enhanced. However, more research is necessary to optimize their application particularly if conditions are changing (drainage flow regime, sediment inputs, vegetation growth linked with temperature, etc.)**

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Downscaling and Adaptation to Urban Hydrology Scale (4)

- Adaptation measures at individual scale (mainly storage or infiltration) should also be favoured but they are only efficient up to some given rainfall volume or intensity; so they should be included in the overall management plan at the municipality scale, which requires complementary tools to integrate water, social and economic issues.

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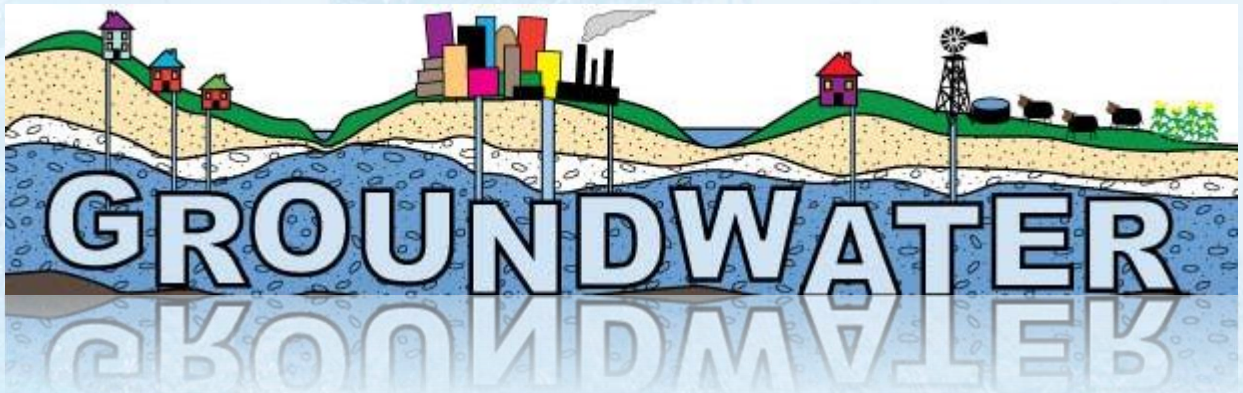
Adaptation in Groundwater and Drought Management (1)

Groundwater will be increasingly critical in sustaining water supplies through periods of climate change as it will help balance the larger fluctuations in precipitation and increased water demands caused by high temperature and drought.



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Droughts are expected to have their patterns of occurrence and magnitude changed in the future

Adaptation in Groundwater and Drought Management (2)

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Policy leadership is required to support efforts toward identifying and funding adaptation measures and related research such as:

- **Groundwater quantity and quality data collection**
- **Conjunctive use of surface and ground water resources**
- **Managed aquifer recharge**
- **Water reuse and brackish groundwater supplies**
- **Rainwater harvesting**
- **Protection of groundwater supplies**
- **Water demand management**
- **Improved tools for management, planning, and decision making**
- **Adaptation of policy, legal and institutional frameworks for water management**

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Impact on Hydropower Generation and Mountain Hydrology (1)

The impact of projected rainfall and evapotranspiration losses changes at the global scale imply highly variable spatial patterns of runoff changes and resulting hydropower generation potential. More clear is the projected impact on mountain hydrology, with a projected shift of the snowmelt season to early spring months, a decrease of summer runoff and an increased variability of runoff regimes, thus enhancing the potential impact of droughts and floods on inflow to reservoirs.

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Impact on Hydropower Generation and Mountain Hydrology (2)

Public bodies dealing with the policy and management of water resource and energy should investigate and implement adaptation measures to face the following topics:

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Impact on Hydropower Generation and Mountain Hydrology (3)

- increasing variation (distribution and quantity) on water incoming to hydropower reservoirs imply the need of an increase of storage volumes, in some cases.
- Increasing damages to the connectivity of water bodies and injures to the river ecosystems imply reservoir regul ation paying more attention to environmental issues as an adaptation measure.
- Increasing demand and competition among different wat er uses imply more accurate planning and management optimization of the water resources and participation of stakeholders in decision making processes.

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Climate Change, Sea level Rise and its Impact on Land and Water

Sea level rise may also be ascerbated by storm surges and wave set up. In addition to causing loss of coastal land, these sea level variations will directly impact the surrounding ground water table. While construction of embankments, dikes, and dams etc., could be implemented in suitable areas to prevent land loss, the preferable approach would be to demarcate areas under threat and use them for recreational purposes, with very minor construction.

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Trans-Boundary Watershed Management

- The management of trans-boundary watersheds requires an integrated regional approach which should consider.
- the increase in future water variability.
- Changing social, economic and climate conditions which may alter current hydro-political balances, in terms of potential inability of states to meet their treaty commitments.
- Water scarcity as effect of climate change will have impact on international conflict and security.
- An effective international legal framework addressing future challenges of climate change is required.

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Decision-Making for Climate Change Adaptations and Water Resources Management (1)

The decision making process under a changing climate should be based on principles that can handle effectively primary attributes of climate change such as deep uncertainty and non-stationarity.

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Decision-Making for Climate Change Adaptations and Water Resources Management (2)

Good decisions under climate change can:

- **perform reasonably well over the entire range of uncertainty**
- **allow various options through the entire decision making process**
- **be iteratively refined as new information including trial errors is available**
- **take into consideration a class of worst case extreme events estimated to occur under climate change as survival critical or edge of survivability**

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Decision-Making for Climate Change Adaptations and Water Resources Management (3)

Key aspects to be considered in the decision making process include:

- **Climate change impact on water resources management**
- **Technical adaptations to Climate Change**
- **Institutional adaptations to Climate Change**
- **Legislation adaptation to Climate Change**
- **Capacity building improvement**
- **Public involvement improvement**

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Trend analyses and changes detection in space-time data

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Rainfall and Runoff

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Downscaling and Adaptation to Urban Hydrology Scale

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Prof. Carlos Galvão, Campina Grande University, Brazil

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Dr. Maximo Aurelio Peviani

Impact on Hydropower Generation and Mountain Hydrology

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Impact on the Coastal environment and adaptation in coastal engineering

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Decision Making for Climate Change Adaptations and Water Resources Management

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Thank you for your attention!

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