Science for *Water Solutions* Decade on:

HELPING – Hydrology Engaging Local People IN one Global world

Helping = we need to collaborate, share and help each other to overcome the water crisis.

Hydrology = Hydrological sciences should underpin management and governance of water resources; thus, we need better understanding of impact from global drivers at local scales and vice versa.

Engaging = co-creation of knowledge includes shared capacity, common learning and community engagement.

Local = water phenomena and problems are often unique at the local scale and solutions must therefore be solved considering local needs and knowledge.

People = the purpose is to connect people (scientists, practitioners, communicators and the general public) with similar interests to co-design, accumulate and transfer hydrological knowledge worldwide.

IN one = together we can advance science faster than individually to overcome shared or similar challenges.

Global world = the Planet is in an emergency state with complex water-cycle interactions, which needs urgent actions to not leave anybody or any catchment behind.

Motivation (WHY?)

The Earth is facing severe problems due to climate change, globalisation, and population growth. The Anthropocene has put the planet into an emergency state, where impacts on the water cycle are accelerating the crisis; freshwater supply often varies between being too much, too little or too dirty for sustainable development. Hydrological knowledge is needed more than ever to address these problems. However, the impact and management of water issues are spread over many actors and organisations. Likewise, scientific knowledge on resilience and water security is fragmented. There is a substantial lack of synthesis and easily digestible scientific messages among hydrologists, across disciplines and from scientists to practitioners, decision-makers and the general public. Hence, there is a need for concerted actions from the hydrological research community to link local hydrological research with global patterns of the water cycle, and further, to provide science-based water-centric decision support. The next decade must thus identify local water problems in holistic/system analyses (i.e., linking local and global scales, disciplines and needs, and connecting the dots), develop water sciences for solutions, be bold and push boundaries to make an impact, be of global and local relevance, connect people across and within regions (e.g., Global North-Global South, North-North, South-South) and provide synthesis to answer the needs of society for sustainable development, safety and security. Concerted actions by hydrological scientists providing water-related knowledge in engagement with other disciplines and stakeholders are essential for solving environmental and societal issues, which all depend on water.

To sum up, there is an urgency for the new initiative on a *Science for Water Solutions Decade HELPING*.

Scientific focus (WHAT?)

The next scientific decade will underpin solutions for the water crisis, leaving no catchment or hydrologist behind, in search for scientific evidence to:

- Accelerate the understanding of the linkages between **hydrological processes at local and global scales** and their interaction with water resources.
- E**ngage with local scientists and societies** to learn from local experience, differences in hydrological processes and change around the world, and transfer solutions globally.
- Synthesising hydrological understanding across the globe and underpin the management of current crises by **finding holistic solutions** to mitigate future crises.

1. Global and local interactions

The observed diversity in hydrology across the globe is still not understood using current conceptualisation approaches and data sources. Many observed phenomena and discrepancies between scales are not yet explained (e.g., impacts of and feedback to climate or vegetation changes). Therefore, coherent global hydrological data and information are needed at several levels and scales (i.e., global data, national operational databases, experimental catchments). Collecting and sharing data will provide the basis for synthesis through system analysis, connectivity, evolutionary loops, human alterations and complexities such as non-linearity, non-stationarity, tipping points, system memory and trajectory. Solutions to handle the water crisis must be underpinned by knowledge of current water systems behaviour to ensure sustainability by allocating the right measures at the right time. Research could be supported by statistics, machine learning/artificial intelligence (AI) or process-based modelling and utilise all kinds of data including in-situ measurements, remote sensing and citizen-science observations. Comparative studies are encouraged as well as alignment with open science.

2. Holistic solutions for water security

Water scarcity, quality deterioration, floods and hazards should be forecasted and measures should be taken to minimise their impacts. Here we consider all dimensions of water issues, such as undesired quantity and quality, extremes, availability vs. demands/needs, transboundary water bodies, compound events and cascading effects. Similarly, we address all sorts of innovative solutions and make comparative studies of already implemented solutions, and predict impact of planned ones, by e.g., modelling or replacing time with space. Scale effects and side-effects are also important to investigate. Many countries nowadays strive for a green transition of society, with focus on nature-based solutions and fossil free sectors. The water system nexus and its links with various sectors should be considered central to advance sustainable development and to enable resilient societies. For smooth implementation of solutions and long-term maintenance, we need efficient policy processes across sectors with shared frameworks to evaluate impact on governance, economy, justice, fairness and equality. A scientific challenge is to find integrated solutions for multiple purposes.

3. Engaging with people locally

IAHS facilitates engagement with scientists worldwide to learn from the experience of local hydrologists and the specific characteristics of particular catchments. Local specificities may unveil unexpected hydrological processes and interactions that are extremely relevant to

both water management and science. Water issues may arise from global drivers and policy decisions (e.g., climate change, upstream management changes) but need local solutions and local knowledge when implementing adaptation and mitigation measures. Indigenous knowledge may be applicable and help with solutions, and so do local scientific findings with evidence-based records that could be the basis for comparative studies between locations. We recognise science's increasing value for decision-making when going from simple data transfer, through interactive information services, towards networking in knowledge-action systems (e.g., among scientists, practitioners, communicators and the general public). The world searches for means to translate scientific results into wisdom, but challenges arise from an information overload. Hydrological scientists need training in co-creation to increase user up-take of science by water-information and communication technology. Moreover, new methods in science communication using art, story-telling and creative events, need further scientific evaluation of their impact on citizens' attitudes.

Structure and organisation (HOW?)

The decade will be a bottom up process empowered by local hydrologists and scientists using open science and local data/methods when solving local water problems. We envisage that the building of local knowledge and cooperation can inform scientists working under similar situations or facing unexpected events worldwide (e.g., learning from floods or droughts in one catchment will inform hydrologists and water management in other catchments). To facilitate leadership and continuation throughout the decade, the science for water solutions decade will be organised with a management team and defined work clusters of actions for collaborative work based on initiatives by the community. Leadership will rotate on a two-year basis. It will be fully open to new initiatives suggested by any IAHS member and such actions will also be open for participation by anyone who wishes to contribute in line with IAHS core values (https://iahs.info/About-IAHS.do). The new decade strives for tangible results and transparency, and therefore, the work will be reported regularly and progress will be followed and monitored. The IAHS communication and editorial teams will provide information and community tools, such as the IAHS web site, joint publications, social media channels and the "Digital Water Globe"-platform.