Hydrology Research

British Hydrological Society

IWA PUBLISHING

Hydrology Research Vol 54 No 8, iii doi: 10.2166/nh.2023.003

Editorial: Innovations, advances, and future challenges for the hydrological community

The 10th edition of the 'Hydrology Days' of the Italian Hydrological Society (SII-IHS) was held in Bologna (Italy) from 16 to 19 September 2019. During this event, hydrologists and stakeholders in the field of water resources management shared the results of their research and discussed the most relevant challenges that the hydrological community must face nowadays. With the celebration of the 10th anniversary, the SII-IHS promoted a Special Issue of *Hydrology Research* open to the participants of the 'Hydrology Days' as well as to other contributions related to the role of the hydrologist in a changing environment and the consequent challenges posed to the hydrological community.

This Special Issue of *Hydrology Research* includes 10 peer-reviewed papers reflecting inter- and multidisciplinary aims and topics discussed during the 'Hydrology Days' of the SII-IHS. The contributions collected in this Special Issue are organized into the following three main topics: (1) *Climate change and geo-hydrological risk*, (2) *Tools and techniques for improving the comprehension of catchment hydrology and river hydraulics*, and (3) *Sustainable use of water resources*.

The first group of papers focuses on climate change and its implications on hydrological regimes, water availability, and on geo-hydrological risk. Biondi *et al.* (2023) presented an operational tool for the assessment of geo-hydrological risk associated with the combined effects of multiple forcing elements. The analysis of a wide database of damaging events that occurred in Italy within the time frame 2004–2011 allowed them to classify the most recurring triggering factors, the related representative phenomena, and the consequently damaged assets and causes of fatalities. The proposed methodology can be applied for a detailed characterization of past events, as well as for the prediction of potentially damaging effects under prescribed scenarios. Boyko *et al.* (2022) analyzed climatic projections of precipitation from 19 models of the Climate Model Intercomparison Project 5, predicting densities of precipitation for selected prognostic time windows for the Po River valley, in Italy. Their results showed that the annual precipitation volume over the study area will not change notably in the future, while its temporal distribution is predicted to be affected. These potential changes are expected to generate a considerable strain on the area's natural storage capacity and on the water flows that are needed to satisfy irrigation demand as well as hydro-electric and thermal energy production.

The second group of papers investigates different tools and techniques aimed at improving the comprehension of both catchment hydrology and river hydraulics. Bahmanpouri *et al.* (2023) analyzed two hydraulic complexity metrics, M1 and M2, using laboratory data and field data collected along the Tiber River (Italy). The authors showed that the investigation of the hydraulic complexity parameters could be useful to explain the heterogeneity of the habitats, as well as to evaluate ecological and biological patterns in rivers with noteworthy flood rates, such as the Tiber River. Datta *et al.* (2022) investigated how Digital Elevation Models (DEMs), DEM resolutions, and area threshold values influence the delineation of three watersheds in Bangladesh (Halda, Sangu, and Chengi). Results showed that DEM source influences the slope, and DEM resolution affects the basin perimeter of a watershed, while size and shape are independent of the area threshold values. Longobardi & Villani (2023) investigated the Base Flow Index (BFI), one of the most common indices of low flows, and the climatic and catchment properties influencing this metric. The authors observed a prominent role of geological catchment characteristics on the BFI, with poorly and well-drained catchments behaving differently in response to similar climate-forcing variability. Furthermore, the authors showed that the correlation between the BFI and precipitation, at the annual scale, is affected by both climate variability and catchment properties, and that the BFI variability is strongly conditioned by climate intra- and inter-annual variability. Petroselli *et al.* (2022) investigated the performance of STORAGE (STOchastic RAinfall GEnerator), a recently developed version of the Neyman–Scott Rectangular Pulse model for rainfall continuous-time simulation at the sub-daily scale. Making use of the Vistula catchment (Poland) case study, the authors showed how the model correctly reproduced the statistical behavior of rainfall extremes as a function of duration. STORAGE seems to be a robust synthetic rainfall generator for design purposes, able to produce continuous rainfall data that can be used as input for a continuous rainfall–runoff approach.

The last group of papers investigates different strategies to ensure sustainable management of water resources, both in urbanized and rural environments. Concerning urban areas, Cristiano *et al.* (2022) presented an innovative nature-based solution, which combines the retention capacity of traditional green roofs with the retention capacity of a rainwater harvesting system,

and investigates the potential benefit of this tool in an urban environment, in terms of water management and thermal properties. The potential of these nature-based solutions is also explored by Mobilia *et al.* (2023), who investigated the effectiveness of green roof retrofitting as a measure to mitigate the effects of damaging hydrological events. The authors took advantage of remote sensing (SAR) images over the Sarno River basin, an area characterized by high population density and high exposure to floods. This contribution identified a clear correlation between the temporal evolution of urbanization in the region (which resulted in a severe increase in the extent of the impervious surface) and the frequency of harmful hydrological events over the last two decades. Different scenarios of green roof retrofitting proved to be effective in reducing stormwater production. As far as rural areas are concerned, Forzini *et al.* (2022) proposed a methodology to select suitable locations for *pokharis*, traditional Nepalese water ponds, based on a geographic information system (GIS), multi-criteria decision-making, and participatory research. In the context of climate changes, the restoration of existing *pokharis* or the creation of new ones could improve the population's economic and living conditions, increasing water availability. Finally, Peli *et al.* (2023) proposed a novel, GIS-based application of Benfratello's method to estimate the climatic water deficit and the irrigation deficit at the field and catchment scale. By using a limited number of parameters, the authors estimated the irrigation demand in the Bonifica della Capitanata consortium (Italy), proving the effectiveness of the tool for the management of water resources in semiarid agricultural areas, in the context of climatic and land use changes.

The Guest Editors would like to acknowledge all reviewers for their valuable contributions in the peer-review process and Emma Gulseven, Emma Buckingham at IWA Publishing, and the Subject Editor, Professor Elena Volpi, for their helpful guidance and support.

Guest Editors
Elena Cristiano
University of Cagliari, Cagliari, Italy

Marco Peli
University of Brescia, Brescia, Italy

Martina Siena
Politecnico di Milano, Milan, Italy

Giulia Zuecco
University of Padova, Legnaro, Italy

REFERENCES

Bahmanpouri, F., Termini, D., Barbetta, S., Dionigi, M. & Moramarco, T. 2023 Significance of hydraulic complexity parameters M_1 and M_2 based on the laboratory and field data. *Hydrology Research* **54** (3), 303–312. https://doi.org/10.2166/nh.2023.089.

Biondi, D. & Scarcella, G. E. 2023 Pasquale Versace; CERCA (Cascading effects in risk consequences assessment): an operational tool for geo-hydrological scenario risk assessment and cascading effects evaluation. *Hydrology Research* **54** (2), 189–207. https://doi.org/10.2166/nh.2023.088.

Boyko, O., Reggiani, P. & Todini, E. 2022 Post-processing climate projections of precipitation for the Po river basin: will Italy's North become water-constrained? *Hydrology Research* **53** (11), 1414–1427. https://doi.org/10.2166/nh.2022.063.

Cristiano, E., Annis, A., Apollonio, C., Pumo, D., Urru, S., Viola, F., Deidda, R., Pelorosso, R., Petroselli, A., Tauro, F., Grimaldi, S., Francipane, A., Alongi, F., Noto, L. V., Hoes, O., Klapwijk, F., Schmitt, B. & Nardi, F. 2022 Multilayer blue-green roofs as nature-based solutions for water and thermal insulation management. *Hydrology Research* **53** (9), 1129–1149. https://doi.org/10.2166/nh.2022.201.

Datta, S., Karmakar, S., Mezbahuddin, S., Hossain, M. M., Chaudhary, B. S., Hoque, E., Abdullah Al Mamun, M. M. & Baul, T. K. 2022 The limits of watershed delineation: implications of different DEMs, DEM resolutions, and area threshold values. *Hydrology Research* **53** (8), 1047–1062. https://doi.org/10.2166/nh.2022.126.

Forzini, E., Piemontese, L., Bresci, E., Barthod, B., Bielser, F., Sylvestre, M., Adhikari, N., Pun, S. & Castelli, G. 2022 Identification of suitable sites for traditional *pokhari* water harvesting in mountain rural communities of the Himalaya. *Hydrology Research* **53** (11), 1340–1356. https://doi.org/10.2166/nh.2022.027.

Longobardi, A. & Villani, P. 2023 Baseflow index characterization in typical temperate to dry climates: conceptual analysis and simulation experiment to assess the relative role of climate forcing features and catchment geological settings. *Hydrology Research* **54** (2), 136–148. https://doi.org/10.2166/nh.2023.026.

Mobilia, M., Longobardi, A., Amitrano, D. & Ruello, G. 2023 Land use and damaging hydrological events temporal changes in the Sarno River basin: potential for green technologies mitigation by remote sensing analysis. *Hydrology Research* **54** (3), 277–302. https://doi.org/10.2166/nh.2023.036.

Peli, M., Rapuzzi, C., Barontini, S. & Ranzi, R. 2023 Application of Benfratello's method to estimate the spatio-temporal variability of the irrigation deficit in a Mediterranean semiarid climate. *Hydrology Research* **54** (4), 451–474. https://doi.org/10.2166/nh.2023.081.

Petroselli, A., De Luca, D. L., Młyński, D. & Wałęga, A. 2022 Modelling annual maximum daily rainfall with the STORAGE (STOchastic RAinfall GEnerator) model. *Hydrology Research* **53** (4), 547–561. https://doi.org/10.2166/nh.2022.100.