

## Editorial: Water and environmental challenges in a changing world: the perspective of the 13th International Conference on Hydroinformatics HIC 2018

The IAHR/IWA Joint Committee on Hydroinformatics is a community of scientists working on the application of information and communications technologies (ICTs) in addressing the increasingly serious problems of the equitable and efficient use of water in its various and really different forms. The community is thus composed of particularly wide and lively research areas widening from numerical modelling to the development of new sensors and tools, from the interpretation of increasing amounts of data, to the analysis and management of complex systems requiring the integration of physically based models, data and controls for practical applications. Today, multi-disciplinarity is the key to tackle challenges for sustainable management of water resources, especially considering the increasing complexity in the *water world*. It is thus fundamental to link the mathematical laws describing the water bodies and the new technologies given by the ICT and information science scientific communities.

In this framework, the 13th International Conference on Hydroinformatics 2018 (HIC 2018) held in Palermo, Italy, was the concrete location where researchers, working in very different areas related to water problems, over an entire week. The attention of the scientific community on HIC 2018 was demonstrated by presence of several International Water Association Specialist Groups. More than 400 attendees came to Palermo from about 40 countries all over the world (with the largest delegations from China, UK, Italy and South Korea). [Figure 1](#) shows the distribution of delegates' nationalities.

The conference covered seven main topics: technologies for water management and monitoring; remote sensing; big-data; knowledge and water data management; hydraulic and hydrologic modelling; climate change impacts; environmental and coastal hydroinformatics. Moreover, the International Scientific Committee proposed 12 special sessions on topics of special interest for the technical-scientific community:

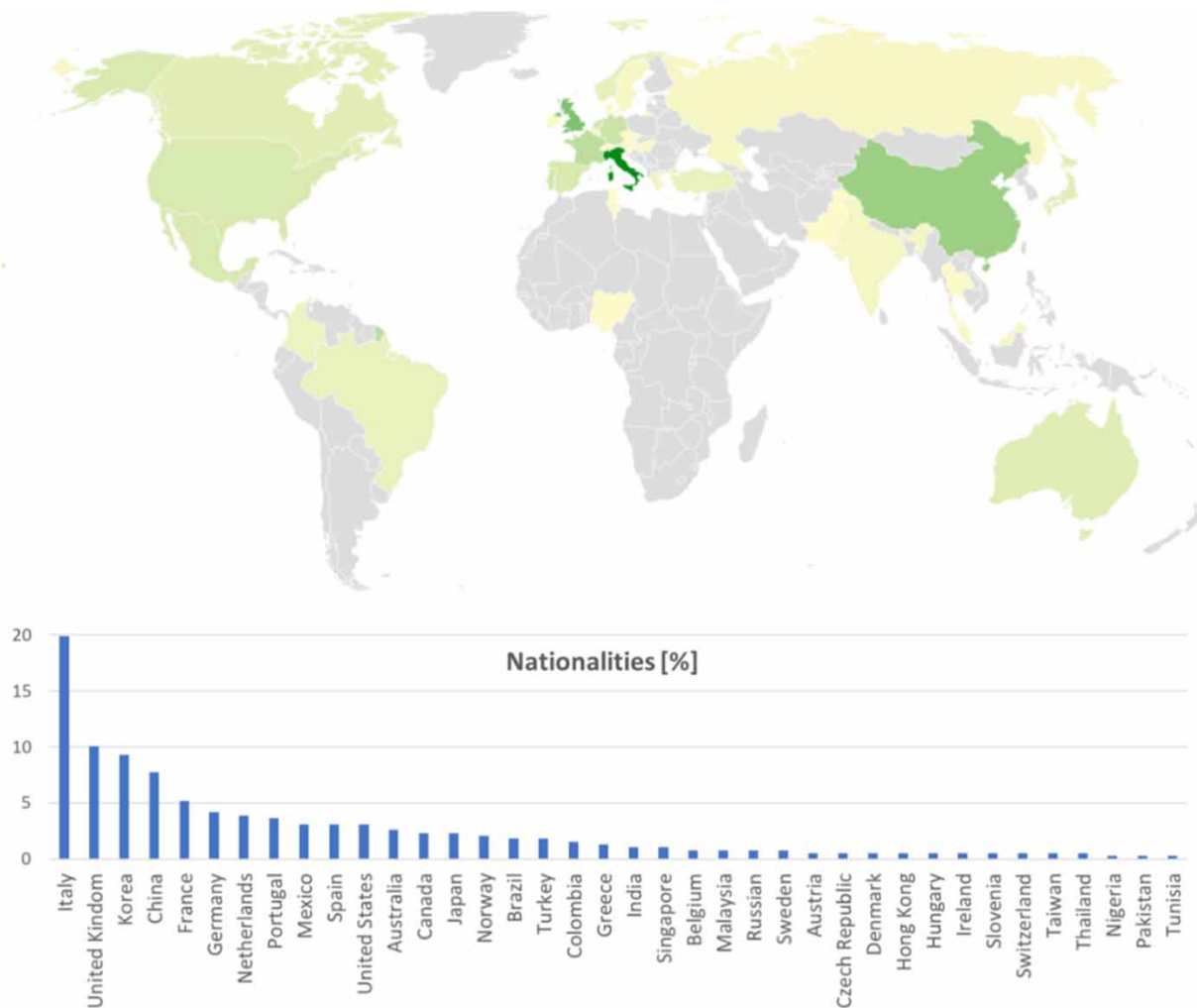
1. Data assimilation of spatial information for hydrologic and hydraulic models

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2. Complex Network Theory and applications to water systems
3. Climate change impacts on urban water systems: flooding forecasting and warning
4. Integrated use of the water reservoirs
5. IA techniques for Smart Water Systems: Smart Sensors, Smart Networks and Serious Gaming
6. Model predictive control for water management
7. Development and application of the next generation of shallow flow models
8. Long-term resilience of water systems: input data analysis
9. Monitoring network optimization and model choice: information for predictions and value for decisions
10. Simulation of fluvial eco-hydraulic and morphodynamic processes
11. Advance in uncertainty estimation of hydro-science in a changing environment
12. Time series analysis for climate change detection

This special issue includes 16 papers selected among 412 presented at HIC 2018 in various themes related to hydroinformatics. The articles followed the standard peer-review process of the *Journal of Hydroinformatics* with three/four independent reviews for each paper. The 16 papers can be subdivided into five main topics.

The first three articles deal with numerical models to predict the water hydrodynamic in terms of flow fields and contaminant dispersion. [Di Cristo et al. \(2020\)](#) present a two-phase shallow-water morphodynamical model, particularly suited to the analysis of fast geomorphic transients, applied to the numerical simulation of the propagation of a dam-break wave over an erodible floodplain in the presence of a rigid obstacle. [Wang et al. \(2020\)](#) focus attention on the investigation of the wake flow around a circular patch of cylinders with different solid volume fraction (SVF), analyzing the spatial evolution of the wake flow behind the patch and the correlation between the flow pattern and the wake flow stability. [Yang et al. \(2020\)](#) propose a generic sampling method to interpret the output of the



**Figure 1** | Nationalities of delegates at HIC 2018.

random walk method, a meshfree scheme, and highlight the importance of accurately taking diffusion into account in studying the mixing phenomena.

Further, four articles investigate problems related to floods in urban and coastal areas and to wastewater treatments. [Sambito \*et al.\* \(2020\)](#) analyze an approach for positioning water quality sensors based on the Bayesian decision network (BDN). The analysis is focused on soluble conservative pollutants, such as metals. The methodology incorporates several sources of information, including network topology, flows and non-formal information about the possible locations of contamination sources. The methodology was tested using two sewer systems with increasing complexity. [Pinho \*et al.\* \(2020\)](#) apply

hydroinformatics tools for the identification and characterization of the key factors responsible for flood events; moreover, they propose a flood early warning system resulting from the studied flood events. [Gibson \*et al.\* \(2020\)](#) propose an integrated and participatory methodological approach to assess the risk and enhance the resilience of interconnected critical infrastructures to urban flooding under climate change. The proposed methodology has been applied to protect coastal communities.

[Visanji \*et al.\* \(2020\)](#) present a new methodology for a decision support tool (WiSDOM), which focuses on producing treatment solutions suited to treating water for reuse to Indian Water Quality Standards. Basically, the study aims at finding optimal wastewater treatment

solutions to calculate the removal of different contaminants of emerging concern (CECs) found in developing countries.

Three studies are focused on problems concerning water distribution networks. [Braun \*et al.\* \(2020\)](#) develop a mathematical method to investigate water distribution networks with an alternative spectral approach that uses polynomial chaos expansion and has the potential to give results of comparable accuracy to Monte Carlo sampling through the definition of a stochastic model. This approach is applied in order to evaluate the influence of uncertain demands on the water age. [Simone \*et al.\* \(2020\)](#) propose the use of edge betweenness metrics, tailored for water distribution networks from Complex Network Theory, to analyze the network domain of several real systems. Results show that the metric can represent a useful tool for supporting analysis, design and management tasks since it captures the role of topological network features on its emergent hydraulic behavior. [Fellini \*et al.\* \(2020\)](#) present an algorithm for real-time fault detection in the SCADA system of a modern water supply system (WSS) in an Italian alpine valley. A coupled model of the hydraulic and remote-control system is developed to test the performance of the WSS. Simulations show that the occurrence of errors in the sensors causes significant worsening in the economic, energy and mechanical performance of the infrastructure.

Four studies are related to hydrological and climate change problems. [Grasso \*et al.\* \(2020\)](#) develop a tool, named MultiRain, to compute depth-duration-frequency (DDF) curves, both related to a point and integrated over an area, from multiple regional statistical analyses. The MultiRain procedure is based on Python scripting, geographic information system (GIS) functions and web technologies, and can be performed via web browser or in a desktop GIS environment. A demonstration version has been built with four different regional analyses proposed in 20 years for the north west of Italy. [Dimitriadis & Koutsogiannis \(2020\)](#) observe that geophysical processes are often characterized by long-term persistence inducing large statistical bias, thus propose to examine the most probable value (i.e. mode) of the estimator of variance to adjust the model for statistical bias. Particularly, they performed an extensive Monte Carlo analysis based on the climatogram (i.e. variance of the average process vs scale) of the simple scaling (Gaussian Hurst-Kolmogorov) process, and show that its

classical estimator is highly skewed especially in large scales. [Real-Rangel \*et al.\* \(2020\)](#) introduce a transparent framework for monitoring the spatiotemporal distribution of drought hazard, based on uni- and multi-variate standardized drought indices that use reanalysis datasets of hydrological variables available freely and globally. The framework provides a significant extension to the capabilities for national drought monitoring and it is being used by the Mexican water authority in the decision-making process related to drought severity assessment. [Chen \*et al.\* \(2020\)](#) analyze the problem of vegetation change in China regions, attributing growing season vegetation activity to climate change and human activities and investigating the interactions among different driving variables. The authors performed Mann-Kendall trend analysis, Pearson correlation analysis, and partial correlation analysis. They observed that dynamic relationship between vegetation activity and the driving variables reflected the acclimatization and adaption processes of vegetation, which needs further investigation.

Lastly, two studies are in the fields of groundwater and erosion. [Tapoglou \*et al.\* \(2020\)](#) propose a study to examine the uncertainty of various aspects of a combined artificial neural network (ANN), kriging and fuzzy logic methodology, which can be used for the spatial and temporal simulation of hydraulic head in an aquifer. This simulation algorithm was applied in a study area in Miami, USA. [Francipane \*et al.\* \(2020\)](#) develop a geographic object-based image analysis to detect and map gullies based on very high resolution (VHR) imageries, considering that mapping of gullies through conventional field surveying can be an intensive and expensive activity. The authors used a one-meter resolution LIDAR DEM (digital elevation model) to identify gullies. The tool has been calibrated for two relatively large gullies surveyed in the Calhoun Critical Zone Observatory (CCZO) area in the southeastern United States.

The complexity of the problems and the different approaches used within the articles published in this special issue clearly shows the multi-disciplinary feature of the researches focused on water bodies. Thanks to the vivacity of the hydroinformatics community, day by day fundamental advances are made in understanding complex phenomena related to water physics as well as in novel methodologies and tools to drive sustainable and efficient management of natural and artificial water systems.

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