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Editorial

Water 2021 Best Paper Award

Water Editorial Office

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To acknowledge the continued support of the journal's esteemed authors and recognize their outstanding scientific accomplishments, the Water Editorial Office has announced the Water 2021 Best Paper Award. Nominations were chosen from papers published in Water from 1 January 2019 to 31 December 2019. Following a review process by the Evaluation Committee chaired by the Editor-in-Chief, Dr. Jean-Luc PROBST, six winners, as follows, were selected.

Water Quality Indices: Challenges and Application Limits in the Literature [1].

Moez Kachroud, Fabienne Trolard, Mohamed Kefi, Sihem Jebari and Guilhem Bourrié (Figure 1). *Water* **2019**, *11*(2), 361, doi:10.3390/w11020361. Available link: https://www.mdpi.com/2073-4441/11/2/361.

Figure 1. From left to right and up to down: Dr. Fabienne Trolard, Dr. Moez Kachroud, Dr. Sihem Jebari, Dr. Guilhem Bourrié and Dr. Mohamed Kefi.

The increasing population, the expansion of economic activities and urban sprawl are leading to increased demand for water. The overuse of surface water and groundwater is jeopardizing numerous resources because of the reduction of the available quantities and the deterioration of their quality. Since Horton in 1965, many authors have sought to aggregate different variables characterizing the quality of water into a single value called the Water Quality Index (WQI). This index is intended to facilitate the operational management of water resources and their allocation to different uses. Detailed and operational descriptions of the main WQI calculations were reviewed with: (1) an historical analysis of the evolution of WQI calculation methods by looking both at the choice of variables and the methods of weighting and aggregating these variables into a final single value; (2) an illustration of the contradictions observed in the final result when, on the same database, the WQI was calculated by different methods; and (3) the significant progress possible via fuzzy logic to define a WQI adapted to a specific water use.

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This literature review was carried out during the PhD thesis (2016–2018) of Moez Kachroud, carried out within the framework of an international joint study, supported by the Perdiguier Fundation (Avignon University), among the UMR AU-INRAE Emmah at Avignon (France), the Institut National Agronomique de Tunis, the Carthage University and the CERTE at Borj Cedria (Tunisia).

The Use of Non-Conventional Water Resources as a Means of Adaptation to Drought and Climate Change in Semi-Arid Regions: South-Eastern Spain [2].

Álvaro-Francisco Morote, Jorge Olcina and María Hernández (Figure 2). *Water* **2019**, *11*(1), 93; doi:10.3390/w11010093. Available link: https://www.mdpi.com/2073-4441/11/1/93.

Figure 2. From left to right: Dr. Alvaro-Francisco Morote, Professor Jorge Olcina and Professor María Hernández.

Drought is a climatic risk with notable repercussions for water supply systems. In Spain, due to its geographical location, drought episodes constitute one of the main natural risks of atmospheric origin. The conventional resources provided by reservoirs, aquifers and water transfers are those most exposed to drought situations. In the light of this, the use of non-conventional resources (desalination and treated water) is presented as an alternative source and a means of adaptation to the increasingly scarce precipitation which may result from the effects of climate change. The aims of this study are: (1) to analyze the main measures for management and planning implemented during recent decades in south-eastern Spain (Segura River Basin) to respond to drought situations, focusing on the role played by non-conventional water resources (desalination and treated water); and (2) to assess the level of resilience of this territory on the basis of the measures implemented, especially coinciding with the current drought of 2015–2018. The results demonstrate that the study area (despite being one of the driest places of Spain) is less vulnerable to drought than regions with an Atlantic climate and greater availability of water. This has been possible thanks to the integration of non-conventional water resources as a means of adaptation to confront this natural risk, which is estimated to become more intense and frequent in the future owing to climate change.

A Brief Review of Random Forests for Water Scientists and Practitioners and Their Recent History in Water Resources [3].

Hristos Tyralis, Georgia Papacharalampous and Andreas Langousis (Figure 3). *Water* **2019**, *11*(5), 910; doi:10.3390/w11050910. Available link: http://www.mdpi.com/2073-4441/11/5/910.

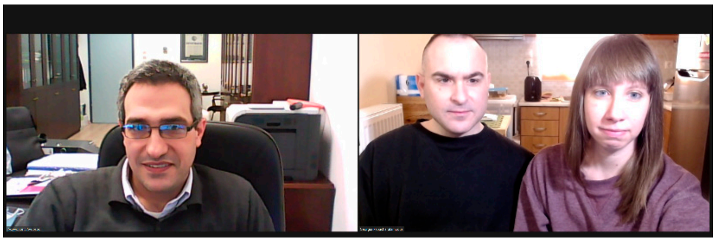

Figure 3. From left to right: Andreas Langousis (M), Hristos Tyralis and Georgia Papacharalampous (L).

In this review, we discussed the theory of random forests (a machine learning algorithm), their recent developments and their applications in water resource management and hydrology. Random forests are simple and fast algorithms with high predictive performance, which can also assist the interpretation of natural phenomena. Their properties have been recently explored in the area of water resources, resulting in an exponential increase of their use. In addition, due to their flexibility, numerous RF variants have appeared lately to improve various aspects of modeling. Applications include modeling streamflow, water quality, flow-related statistics, ecology, precipitation and more, within regression, classification, probabilistic prediction and inference settings.

The existing implementations have been restricted in applications of Breiman's original algorithm to regression and classification models, while numerous developments could also be useful for solving diverse practical problems. We expect an even higher increase of their use, as big data become rapidly available. Better understanding of the theoretical properties of the algorithm and its limitations, as well as the conditions that may hinder applicability of random forests, constitute some additional important topics for future consideration.

Our team is interested in understanding hydrological systems using statistical learning, machine learning and stochastic modeling. In this review, we aimed to popularize random forests with a particular focus on an audience consisting of hydrologists and water resource managers and practitioners.

Hydrological Effectiveness of an Extensive Green Roof in Mediterranean Climate [4]**.**

Stefania Anna Palermo, Michele Turco, Francesca Principato and Patrizia Piro (Figure 4). *Water* **2019**, *11*(7), 1378; doi: 10.3390/w11071378. Available link: https://www.mdpi.com/2073-4441/11/7/1378.

Figure 4. From left to right: Patrizia Piro, Francesca Principato, Stefania Anna Palermo and Michele Turco.

Sustainable urban stormwater management is one of the main challenges of the last few years. Thus, to mitigate the environmental impacts due to the combined effect of urbanization and climate change, nature-based approaches, as green roofs, represent sustainable strategies to control stormwater by exploiting "otherwise" unused urban spaces. Based on the potentiality of these green infrastructures, the paper presented the results of a continuous field monitoring campaign conducted on a full-scale extensive green roof located at the University of Calabria (Italy) in a Mediterranean climate region. Moreover, it evaluated the influence of soil depth on green roof retention by considering the measured soil hydraulic properties and varying the thickness using a physically based modeling approach. The main findings confirmed the optimal retention capacity of the extensive green roof in the Mediterranean climate and the significant role this system plays in the mitigation of urban flooding.

The analyses presented in the paper were conducted in the Urban Hydraulic and Hydrology Lab (LIU) of the Department of Civil Engineering at the University of Calabria—scientific director Prof. Patrizia Piro (www.liucs.it). The lab carries out experimental and numerical analyses of innovative and advanced techniques in urban stormwater management.

Forecasting Groundwater Table in a Flood Prone Coastal City with Long Short-Term Memory and Recurrent Neural Networks [5].

Benjamin D. Bowes, Jeffrey M. Sadler, Mohamed M. Morsy, Madhur Behl and Jonathan L. Goodall (Figure 5). *Water* **2019**, *11*(5), 1098; doi: 10.3390/w11051098. Available link: http://www.mdpi.com/2073-4441/11/5/1098.

Figure 5. Clockwise starting from the left: Ben Bowes, Mohamed Morsy, Jeff Sadler, Jon Goodall and Madhur Behl.

In this paper, we explored deep machine learning with long short-term memory (LSTM) neural networks to create groundwater table forecasts using a unique dataset of groundwater table observations from wells distributed throughout the flood-prone coastal city of Norfolk, Virginia, USA. Many coastal cities like Norfolk suffer frequent flooding from storm events and are increasingly threatened by sea level rise and climate change. The groundwater table level in these low-relief coastal cities can be an important but overlooked factor in the recurrent flooding these locations face; the groundwater table can influence both the capacity of the shallow subsurface to store infiltrated runoff and can reduce the effectiveness of stormwater management systems through inflow and infiltration. As an alternative to more traditional physics-based models, deep learning LSTM models learned the response of the groundwater table to storm events and were found to outperform standard recurrent neural networks. Using uncertain forecasts of rainfall and tide, LSTM predicted the response of the groundwater table to storm events and showed promise for real-time forecasting. As groundwater table levels increase due to sea level rise, forecasts of the groundwater table will become an increasingly valuable part of coastal flood modeling and management.

Team: This research was conducted by members of the University of Virginia's Link Lab that are part of the interdisciplinary Data-driven Management for Interdependent Stormwater and Transportation systems (dMIST) research team, with support from the US National Science Foundation (Award #1735587). The goal of our research team is to leverage advances in computing, cyber-physical systems and data science to address problems and challenges associated with water resource management, such as improving community and infrastructure resilience to climate change.

Effectiveness of Rainwater Harvesting Systems for Flood Reduction in Residential Urban Areas [6]**.**

Gabriele Freni and Lorena Liuzzo (Figure 6). *Water* **2019**, *11*(7), 1389; doi:10.3390/w11071389. Available link: https://www.mdpi.com/2073-4441/11/7/1389.

Figure 6. From left to right: Lorena Liuzzo and Gabriele Freni.

The paper investigates the reliability of rainwater harvesting (RWH) systems in terms of stormwater retention and water saving. Specifically, the performance of RWH tanks to supply water for toilet flushing in more than 400 single-family houses in a residential area of in Sicily (Southern Italy) was analyzed in an area with high susceptibility to flooding. The yield-after-spillage algorithm was used to simulate the daily water balance of the RWH tanks. The effect of the RWH implementation on flood volumes in the area of study was quantified using FLO-2D. The results pointed out that the implementation of RWH systems at the urban catchment scale has important implications for urban water management. Specifically, RWH systems have a remarkable role in the reduction of flood volumes, providing an important contribution to avoiding potential drainage system failures during storm events. The installation of RWH tanks in the urban catchment has implications for the extension of the flooded area even if a complete mitigation strategy requires the integration of specific measures such as detention tanks or an increase in pipe capacity, and RWH effectiveness is affected by the magnitude and frequency of rainfall events.

Lorena Liuzzo and Gabriele Freni have a long scientific collaboration that started at Palermo University, where both worked as post-doc fellows, and continued throughout the years, producing 13 journal papers and several contributions to conference proceedings. Their joint research activities mainly focus on urban runoff management, climate change and the use of distributed data in hydrologic applications.

We believe that these six papers are valuable contributions to *Water* and the scientific research field. On behalf of the *Water* Editorial Board, we would like to congratulate these teams for their excellent work. In recognition of their accomplishment, they will receive the privilege of publishing an additional research article or review paper free of charge in open-access format in *Water*, after the usual peer-review procedure. We would also like to

take this opportunity to thank all of our authors for your continued support of *Water* and thank the Buildings Editorial Board for voting and helping with this "Best Paper Award".

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