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Editorial

Urban Rainwater and Flood Management

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In recent decades, a wide range of approaches have been developed to mitigate hydrological impacts as well as the influence on water quality due to urbanization. However, there is still significant controversy over best practices, showing that rainfall and rainwater drainage in cities remains a complex and complicated area. There is a new trend towards more integrated approaches, which deal with changes in the flow regime and maintain water quality at the same time, and which try to consider rainwater as a resource, a means, and not just a problem which must be eliminated. The development of integrated models to predict and assess the effectiveness of alternative approaches to rainwater drainage in cities, considered part of the wider urban water cycle, has thus recently received considerable attention.

There is currently a new trend towards approaches which seek to restore runoff and water quality regimes with growing interest and recognition that restoring the natural water balance contributes to a healthier environment and improves living conditions in urban countries. Despite some progress, there are still many ambiguities in urban hydrology. Further research into the spatio-temporal dynamics of urban precipitation is required, in particular to improve short-term precipitation forecasts. All the problems and doubts are overshadowed by the uncertainty of climate change, which imposes the obligation to ensure that rainwater management systems are adaptable and resilient to change. Urban hydrology plays an important role in solving these problems.

The Special Issue "Urban Rainwater and Flood Management" presents fifteen scientific papers. A short characterization of each of them is presented in the following.

Li et al. [1] published the paper "Evaluating efficiency improvement of deep-cut curb inlets for road-bioretention stripes". This study aims to help more engineers and designers perform the curb inlet hydraulic design rather than only design it from a landscape perspective for road-bioretention strips since authors quantify the performance improvement of the deep-cut inlets based on two-dimensional overland flow simulation results. Their results provide useful information on the design and retrofit of curb inlets for the road-bioretention strips and help to determine whether and how the deep-cut should be implemented.

Saliba et al. [2] in their study "Deep reinforcement learning with uncertain data for real-time stormwater system control and flood mitigation" evaluate the effectiveness of Deep Deterministic Policy Gradient-based stormwater control in reducing flooding based on real rainfall data from Norfolk Virginia. They explore the robustness of a Deep Deterministic Policy Gradient implementation by utilizing uncertain forecasting and state data. This project demonstrates that Deep Deterministic Policy Gradient can overcome uncertain data to successfully reduce flooding.

Abd-Elaziz et al. [3], in their paper "Anthropogenic activity effects on canals morphology, case study: Nile Delta, Egypt", emphasized the adverse effects of improper canal dredging, which removes parts of the canal bed and expands the canal cross-section. Comparison of the two phases of canal cross-section measurements established the changes in the cross-sections, which affected the canal morphology, as well as the supplementary water, where expanded cross-sections required more surface water. The study also estimated the applied policy of rehabilitation of irrigation canals to restore the original cross-section by estimating the amounts of saved water.

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Xiong et al. [4] in their article "Comprehensive assessment of water sensitive urban design practices based on multi-criteria decision analysis via a case study of the University of Melbourne, Australia" focus on comprehensively assessing and optimizing water-sensitive urban design facility combinations based on analytic hierarchy process and multi-attribute utility theory through a case study of Melbourne University's Parkville Campus, taking functional, economic, social, and environmental aspects into account. Additionally, the assessment framework based on multi-criteria decision analysis described in this paper is strongly recommended to be promoted for the water sector to help solve decision-making problems.

Taha et al. [5] published "Study of Scour Characteristics Downstream of Partially Blocked Circular Culverts". The aim of this study was to investigate the effects of different inlet blockage ratios on clear-water scour depth and culvert transport efficiency. An empirical equation was developed to predict the relative scour depth under the present study conditions. Their results show that as the submergence ratio increases, the maximum scour depth decreases at the same discharge rate, and the relative energy loss also decreases in the non-blocked case.

Campos et al. [6] present a research paper entitled "On the rainfall intensity–duration–frequency curves, partial-area effect and the rational method: theory and the engineering practice" that evaluates the partial-area effect for the intensity-duration equation I = a/(td + b)c. Research has been done to look for intensity-duration equations with c > 1. This suggests that despite the recommendation for building depth duration rainfall-consistent equations ($c \leq 1$) published in the scientific literature since 1998, it has not fully become an integral part of hydrologic engineering practice. The authors provide some analysis to explain why the gap between theory and practice persists.

Ciupa and Suligowski [7] published the study "Impact of the city on the rapid increase in the runoff and transport of suspended and dissolved solids during rainfall—the example of the Silnica River (Kielce, Poland)". The purpose of this paper is to demonstrate the important role of an urban area in the rapid increase in river runoff and fluvial transport during rainfall-induced floods of various origins, as well as to present hydrotechnical solutions that can be implemented to reduce flood risk, using the example of the Silnica River, a watercourse that flows through the center of the city of Kielce (Poland).

Üneş et al. [8] in their article "River flow estimation using artificial intelligence and fuzzy techniques" estimate the river flow using Multiple Linear Regression, Adaptive Neuro-Fuzzy Inference System, Mamdani-Fuzzy Logic, M5 Decision Tree, Artificial Neural Network and Fuzzy Rules Generation Technique models. The aim of this study is to introduce a new method, a Fuzzy Mamdani–Fuzzy Rules Generation Technique for the accurate estimation of river flows.

Banihabib et al. [9], in their research work: "A hybrid intelligence model for the prediction of the peak flow of debris floods", proposed a new hybrid model by developing the artificial intelligence models (Bayesian Network and Support Vector Regression–Particle Swarm Optimization) to overcome the insufficiency of the Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) in predicting the peak flows of debris floods. The proposed model can be used to mitigate the hazards and risks of both typical and debris floods.

Krvavica and Rubinić [10], in their published study "Evaluation of design storms and critical rainfall durations for flood prediction in partially urbanized catchments", focus on flood assessment and evaluate multiple flow parameters, such as the water depth, water velocity, flow rate, and flood extent, which provide a more comprehensive view of the impact of design storms. They compare the results to historical flood events to provide a more objective performance assessment of different design storms.

Fathy et al. [11], in the paper "the negative impact of blockage on storm water drainage network", study the effect of blockage ratio on the efficiency of storm drainage systems. Three scenarios were considered through this study. Finally, an empirical equation was created to calculate system efficiency as a function of blockage ratio and system discharge.

Abd-Elhamid et al. [12], in the study "Evaluating the impact of urban growth on the design of storm water drainage systems", evaluated the relationship between urban growth and the cost of storm drainage networks. This could help the decision makers and designers in taking appropriate decisions based on the developed relationship between urban growth and the cost of storm drainage networks.

Maier et al. [13], in their research "Spatial rainfall variability in urban environments—high-density precipitation measurements on a city-scale", investigated the severity of the spatial variability of storms with validated data measured during two years basing analyses on event rainfall information. This shows the inaccuracies induced by using rainfall data whose resolution is too coarse for urban environments when measuring rainfall events.

Yang et al. [14] pointed out in the article "Hydrologic and pollutant removal performance of media layers in bioretention" that the technical and theoretical support required to optimize the structural form of the bioretention system is not enough at present, and there are still many challenges in the design and development of bioretention systems with a simple structure. Therefore, their study focuses on the functions of the filter, transition, and drainage layers to control runoff, to reduce pollution, and to prevent filter material loss in bioretention.

Üneş et al. [15], in their study "Flood hydraulic analyses: A case study of Amik Plain, Turkey", used data such as discharge, land cross section, Manning coefficient, and topography scale for flood modeling. They developed a flood model in the Hydrologic Engineering Center's River Analysis System (HEC-RAS) program, which is able to model one-dimensional steady or unsteady flow. The results of numerical models are presented as simulated maps.

Research into rainwater management is an important part of activities not only in the fields of agriculture and water management but also in engineering. Rainwater infiltration is an important issue, especially at present in connection with climate change, when it is necessary to slow down the outflow of water from the land, support the infiltration of water into the soil and increase the retention capacity of the ground. The importance of the presence of water in soil and rock is underlined by the fact that all processes in them are closely linked to water, and this, together with air, nutrients and heat, is the main condition for soil fertility.

With regard to this, the main focus of this Special Issue "Urban Rainwater and Flood Management" is to demonstrate new approaches to rainwater management. The results of the presented research can be helpful for developing scientific recommendations and technical guidelines for drainage systems in urban areas.

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