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Editorial

Editorial—Modelling of Floods in Urban Areas

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Citation: Leandro, J.; Shucksmith, J. Editorial—Modelling of Floods in Urban Areas. *Water* **2021**, *13*, 1689. https://doi.org/10.3390/w13121689

Received: 16 June 2021
Accepted: 17 June 2021
Published: 18 June 2021

Understanding the risk of flooding in urban areas is a societal priority. The often-referenced challenges to flood prevention posed by climate change and rapid urbanization remain as pertinent as ever. Flood models have a variety of functions including real time warning, risk mapping, scenario evaluation, and the development of asset investment strategies. However, there are many significant technical challenges associated with the characterisation and representation of the numerous complex physical and hydrodynamic processes involved. Amongst others, these include rainfall-runoff, the heterogeneity of rainfall and surface topography at urban scales, and hydraulic interactions between overland and piped drainage systems. Recent advances in data driven techniques mean new approaches are increasingly becoming available alongside established hydrodynamic based methods, which can make real-time flood forecasting a possibility. Novel sensing, data acquisition systems, and experimental techniques also offer new opportunities for improved calibration, validation, and testing of flood models.

The aim of this special issue is thus to publish the latest advances and developments concerning the modelling of flooding in urban areas and contribute to our scientific understanding of the flooding processes and the appropriate evaluation of flood impacts. This issue contains contributions of novel methodologies including flood forecasting methods, data acquisition techniques, experimental research in urban drainage systems and/or sustainable drainage systems, and new numerical and simulation approaches in nine papers with contributions from over forty authors.

Selected highlights from each contribution are summarised as follows:

The paper "GIS Based Hybrid Computational Approaches for Flash Flood Susceptibility Assessment" [1] proposes and compares several novel hybrid computational approaches of machine learning methods for flash flood susceptibility mapping. About 320 past flash flood events and nine flash flood influencing factors, such as distance from rivers, aspect, elevation, slope, and land use were analyzed for the development of flash flood susceptibility maps. The results of this study suggested that the AdaBoostM1 based Credal Decision Tree has the best predictive capability in terms of accuracy.

The article "Modeling Urban Flood Inundation and Recession Impacted by Manholes" [2] introduces the flood inundation and recession model (FIRM) which is coupled to the commonly used SWMM urban drainage modelling package. FIRM computes the spread of surcharging water flow from a manhole based on the local topography evaluated using LIDAR elevation data. The model is validated using observations of a manhole overflow event in Edmunds, United States. Given the simplicity of the model, the paper highlights the potential further use of models of this type within real time or flood forecasting tools when considering flooding caused by surcharging manholes.

The editor choice article "CFD Modelling of the Transport of Soluble Pollutants from Sewer Networks to Surface Flows during Urban Flood Events" [3] utilises a 3D model of a surcharging urban drainage manhole structure in order to study the transport of soluble contamination from drainage networks into flood flows. The model is validated against an experimental dataset from a scaled physical model at the University of Sheffield, before being used to consider mixing processes and associated key timescales for pollutants to enter surface flows. The paper highlights further research opportunities in this area concerning the fate and transport of contaminants in urban flood water.

The featured article "Modelling Pluvial Flooding in Urban Areas Coupling the Models Iber and SWMM" [4] develops a free distribution dual drainage model linking the models Iber and Storm Water Management Model (SWMM). The dual drainage model links a 2D overland flow model and a 1D sewer network model with a Dynamic-link Library (DLL) that contains the functions in which the SWMM code is split. The developed model is particularly useful for urban areas, allowing the user to plan, evaluate and design new or existing urban drainage systems in a realistic way.

The editor choice article "Multistep Flood Inundation Forecasts with Resilient Backpropagation Neural Networks: Kulmbach Case Study" [5] presents an artificial neural networks (ANN) forecast framework for faster flood predictions. The framework is able to perform multi step forecasts for 1–5 h in a matter of seconds, triggered by a forecast threshold value. The ANN uses a high spatial resolution of 4 m × 4 m. For the historical flood events, the results show that the ANN outputs have a good forecast accuracy of the water depths for (at least) the 3 h forecast with over 70% accuracy, and a moderate accuracy for subsequent forecasts.

The featured article "Urbanization and Floods in Sub-Saharan Africa: Spatiotemporal Study and Analysis of Vulnerability Factors—Case of Antananarivo Agglomeration (Madagascar)" [6] performs a spatiotemporal analysis of the agglomeration of Antananarivo. It shows that urbanization leads to increased exposure of populations and constructions to floods. The study highlights that a share of the urban expansion in flood-prone zones is related to informal developments that gather highly vulnerable groups with very little in terms of economic resources. The authors suggest that an integration of flood risk management in spatial planning policies is an essential step to guide decisions in a sustainable way.

The feature article paper "Flood Suspended Sediment Transport: Combined Modelling from Dilute to Hyper-Concentrated Flow" [7] presents a modelling approach suitable for characterising the suspended sediment distribution within flood flows over a wide range of sediment concentrations. The model is parameterized and validated using a series of independent experimental laboratory datasets. The work highlights the opportunity to provide additional capability to flood flow modelling which may be relevant to health impact assessment and hazard evaluation.

The review paper "Porosity Models for Large-Scale Urban Flood Modelling: a Review" [8] considers recent developments in this specific approach to flood modelling. The review paper considers current and ongoing challenges associated with the effective parameterisation of different families of porosity models, and highlights ongoing work, for example, to improve the physical grounding of underlying modelling approaches and reduce mesh scale dependence of model parameters. A key recommendation is to establish suitable independent benchmark test cases for model testing, parameterisation, and evaluation.

The article "Development of a Simulation Model for Real-Time Urban Floods Warning: A Case Study at Sukhumvit Area, Bangkok, Thailand" [9] describes the development of a real time urban flood warning system deployed in the 24 sq.km case study area utilising 1D/2D dual drainage hydrodynamic modeling in conjunction with forecasted rainfall. The simulation is validated based on historic flooding records and, based on this analysis, the approach is shown to give a good representation of areas at risk. Based on an evaluation of previous rainfall events, the methodology can provide a flood warning lead time in the order of 10 min, which is limited by computational requirements.

This special issue highlights some of the ongoing challenges and the large variety of ongoing activity and techniques currently being used to model and understand flooding processes in urban catchments. We would highlight the variation of modelling techniques being used by the authors. In closing, we would like to acknowledge the work of the reviewers and all of the authors' submissions to this special issue. We hope you enjoy reading it.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: No new data were created or analyzed in this study. Data sharing is not applicable to this article.

Conflicts of Interest: The authors declare no conflicts of interest.

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