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Role of Satellite Precipitation Products in Real-Time Predictions of Urban Rainfall-Runoff by Using Machine Learning Modelling

Cristiane Girotto[1], Farzad Piadeh[1], Kourosh Behzadian[1], Massoud Zolgharni[1], Luiza Campos[2], and Albert Chen[3]

[1]School of Computing and Engineering, University of West London, London, UK
[2]Dept of Civil, Environmental and Geomatic Engineering, University College London, London, UK
[3]College of Engineering, Mathematics and Physical Sciences, University of Exeter, UK

The accurate prediction of runoff features such as water level and flow is valuable for planning and operation of urban drainage systems (UDS), especially for appropriately acting as flood control mechanisms during extreme rainfall events which are constantly impacted by climate change variables [1]. In addition, cost-effective design, and operation of flood control measures such as smart UDS require highly accurate rainfall predictions across the catchment area, i.e., intensity and duration [2]. Furthermore, sufficient lead time is needed to activate the control mechanisms on the UDS without affecting the accuracy of the predictions. It seems that the emerging use of satellite precipitation products (SPPs) is promising for obtaining predictions with longer lead times [3]. Hence, more exploration of potential runoff predictions by using SPPs is worth investigating to achieve a more accurate and longer lead time.

This study employs a type of SPPs i.e., global precipitation measurement-integrated multi-satellite retrieval product (GPM-IMERG) to predict rainfall-runoff duration, peak and volume, as well as changes in flow over the course of the event at 30-minute intervals. In order to train and validate the machine learning model, the data from GPM-IMERG V06 was merged with ground data from the catchment precipitation gauge and flow sensor. The methodology is demonstrated by its application to the rainfall-runoff modelling of a real-world small urban sub-catchment area and its performance is evaluated by comparing it with the runoff predictions from physically based simulation models [4].

Results show that while using SPPs solely can provide accurate predictions, significant improvement can be obtained when this data is integrated with ground monitoring data. The model output can be utilised for better design, planning and management of UDS technologies as flood control tools and consequently real-time operation of UDS in urban flooding.

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