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EGU23-4311
EGU General Assembly 2023

Real-Time Urban Flood Forecasting: Application of Hybrid Modelling Using Both Physically based and Data-Driven models

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Today, urban flood forecasting is modelled well by hydrologists through physically based models in which different weather data, characteristics of catchments and streams/conduits are used as inputs to provide water level in UDS or water depth of surface runoff [1]. However, continuous access to these data can be challenging and demanding for model calibration or real-time applications that result in lack of providing accurate forecasting [2]. Alternatively, data-driven models can be used in hydrology and data sciences to provide high-speed, less data demanding, and more accuracy for especially short-term water level/depth of urban flooding [3]. However, these models can be inaccurate when new situations, especially new climate change based extreme events, occurred because these models are unable to understand and be adapted with different physical and hydrological situation of catchments [4]. Therefore, while both approaches are well-explored in simulating rainfall-runoff relationship over the urban catchments of interest, coupling these models sound promising and worth investigating in real-time applications of flood warning systems.

The present study critically investigates the applications of real-time hybrid models in which physically based and data-driven models are coupled together as integrated platform to take advantages of each type of modelling. The results show three different approaches have been highlighted in this area: (1) using physically-based models to provided up-to-date input data for machine-learning based modelling, (2) applying data-mining techniques to extract the rainfall-runoff features that are used for physically-based models, particularly different types of storm water management model, (3) error bias adjustment or interpolation of forecasts by using both physically-based and data-drive modelling.

Results also indicate that the first approach have been usually expressed when input database faces missing data problem, high value uncertainty or highly impacted by climate-related extreme events. This approach was also used for small-scale but dense city area without flexibility in surface lands or underground modifications. On the other hand, the second approach have been presented where big database are available and data screening are required. Furthermore, this modelling approach is more appropriate for high variability and high coverage catchment areas. Finally, the last modelling approach outperforms other approaches in covering both quality and quantity of data resources. However, integration of interpolation and bias adjustment of individual models still have remains as open case than should be more tested in the future.

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