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Editorial

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Achieving sustainable clean water for all and managing urban flood risk are two grand challenges for our societies. Both of them are strongly linked to climate change, urbanisation and ageing of infrastructures. Addressing them requires new paradigms to be developed through novel multi- and interdisciplinary approaches involving engineering and other disciplines, such as governance. The interplay between these two grand challenges is remarkably demonstrated by the first two contributions in this issue. In a briefing article, Caffoor *et al.* (2017) report on an on-going initiative aimed at delivering disruptive socio-technical solutions for water service provision; whereas the paper of Mugume *et al.* (2017) investigates the influence of rainwater harvesting on the resilience of urban drainage systems to flooding.

Caffoor *et al.* (2017) reflect on the sustainability of current water supply systems, which rely heavily on centralised, ageing and rapidly deteriorating buried infrastructure. While innovative sensing techniques using autonomous vehicles could be game-changing to achieve cost-effective asset rehabilitation, alternate options include the development of water treatment at the point of use and the use of distributed sources from green infrastructure such as sustainable urban drainage. Particularly, rainwater harvesting has the potential to deliver multiple benefits in terms of water supply, water quality compliance and storm water control, as also exposed by Mugume *et al.* (2017).

Caffoor *et al.* (2017) go one step further by highlighting the natural linkage between water and energy infrastructure, viewing the former as an opportunity for distributed energy storage, heat transfer and recovery, as well as distributed generation of renewable energy. These issues relate closely to an overarching objective of sustainable cities, which consists of moving from an open system depending on the hinterland (e.g. for providing water and energy) towards a more circular model (EEA, 2015). As engineering cannot solve these challenges alone, socio-technical solutions are necessary to reach truly adaptable and resilient water systems.

The concept of resilience plays a key part in the analysis detailed by Mugume *et al.* (2017). Resilience-based approaches assess the continuity and efficiency of system functioning during or after the occurrence of a system failure. Mugume *et al.* (2017) apply the so-called global resilience analysis method to evaluate the performance of the wide-scale implementation of dual-purpose rainwater harvesting for a case study in Kampala, Uganda. A broad range of failure scenarios is tested, involving random cumulative failures in the links in the urban drainage network. For each scenario, the residual functionality of the system is quantified. In the considered case study, the catchment-scale implementation of multifunctional systems proves more effective than conventional single-objective approaches for reducing impacts of urban flooding. The most promising results are obtained for strategies combining rainwater harvesting with improved sewer asset management. A complementary contribution on resilience in real-world urban flood management was presented recently by Nie (2015).

Another vital aspect of safe and sustainable water supply is the optimal operation of reservoirs. In contrast to the resilience approach described by Mugume *et al.* (2017), the analysis presented by Celeste and Ventura (2017) uses vulnerability ratios to assess the performance of reservoir management based on 100 synthetic inflow scenarios. Vulnerability is defined here as a measure of the magnitude of system failures. Celeste and Ventura (2017) compare two parameterisation–simulation–optimisation models (PSO) to an explicitly stochastic optimisation model (SDP) for a reservoir in north-eastern Brazil. An interesting finding is that one of the PSO models performs better than the SDP and therefore proves particularly appealing for reservoir operators due to its greater simplicity compared to the more common SDP.

Worldwide, sedimentation threatens the sustainability of reservoir operation and of the services reservoirs provide, including water supply, hydropower and flood control (Petkovsek and Roca, 2014). Turbidity currents are one major mechanism of reservoir sedimentation. Xia *et al.* (2017) derive refined governing equations for the steady motion of a turbidity current, including the effect of the momentum correction factor. Based on these equations, they propose an improved criterion for predicting the plunge of turbidity currents, valid for relatively high sediment concentrations. The new criterion is calibrated using laboratory observations and verified based on three independent datasets, including prototype measurements. This confirms the predictive capacity of the proposed criterion.

In the final paper of this issue, Alizadeh *et al.* (2017) tackle the important topic of river flow forecasting. They investigate the applicability of various artificial intelligence methods for

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forecasting daily inflows into a reservoir in Iran (catchment of 850 km^2). They consider different sets of input variables (meteorological data, flow discharge data, or a combination of both). In the case study, the best results were obtained with an artificial neural network model using sub-series components as inputs obtained by discrete wavelet transform of the original time series (Krishna *et al*., 2012). When flow discharge on antecedent days is included in the input structure, accurate forecasts are obtained for a lead time of up to four days.

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