Development and application of an optimization tool for urban drainage network design under uncertainty

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ABSTRACT

Sewer network optimization solutions require the designation of physical parameters such as pipe diameters and storm water storage dimensions, simultaneously minimizing the economical cost subject to operational constraints. These constraints, together with uncertainty, can lead to a complex and un-tractable optimization problem. Robust Optimization is one state-of-the-art methodology to deal with optimization problems under uncertainty. Its goal is to stochastically find a solution that works with any situation presented in a controlled set of uncertain scenarios, making it an attractive tool for urban drainage applications.

A Robust multi-objective optimization tool is developed which consists of the integration of a stratified sampling technique, an urban drainage hydrodynamic model and the NSGA-II optimizer. The robust MOO model was applied to a case study to evaluate its performance and the results are discussed. The conflicting objectives considered for this case study are intervention cost and flooding at the nodes, aiming to minimize both. Based on the results, it can be concluded that these tools provide a powerful decision support system that can easily become a strong ally of municipalities and local authorities when designing new or planning rehabilitation of urban drainage systems to face the ever changing challenges presented by nature and anthropogenic behaviour.

KEYWORDS

Drainage, modelling, NSGA-II, SWMM, uncertainty, urban flooding