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Staged cost optimization of urban storm drainage systems based on hydraulic performance in a changing environment

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Abstract. Urban flooding causes large economic losses, property damage and loss of lives. The impact of environmental changes, mainly urbanization and climatic change, leads to increased runoff and peak flows which the drainage system must be able to cope with to reduce potential damage and inconvenience. Allowing for detention storage to compliment the conveyance capacity of the drainage system network is one of the approaches to reduce urban floods. Contemporary practice is to design systems against stationary environmental forcings – including design rainfall, landuse, etc. Due to the rapid change in the climate- and the urban environment, this approach is no longer appropriate, and explicit consideration of gradual changes during the life-time of the drainage system is warranted. In this paper, a staged cost optimization tool based on the hydraulic performance of the drainage system is presented. A one dimensional hydraulic model is used for hydraulic evaluation of the network together with a genetic algorithm based optimization tool to determine optimal intervention timings and responses over the analysis period. The model was applied in a case study area in the city of Porto Alegre, Brazil. It was concluded that considerable financial savings and/or additional level of flood-safety can be achieved by approaching the design problem as a staged plan rather than one-off scheme.

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