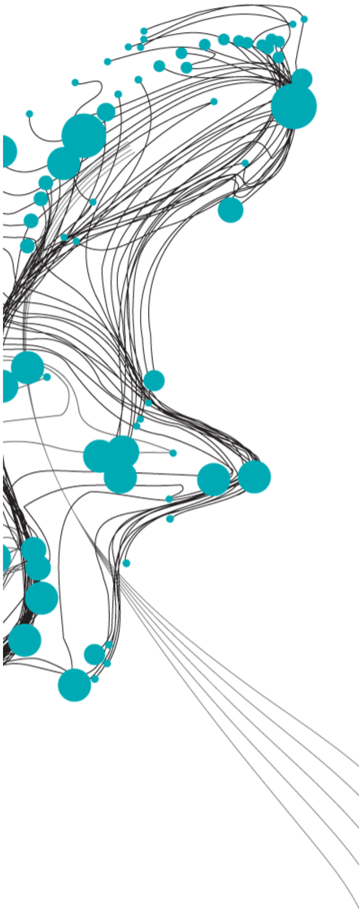
IMPROVEMENT OF RAINFALL-RUNOFF SIMULATIONS ON URBAN UNPAVED SURFACES

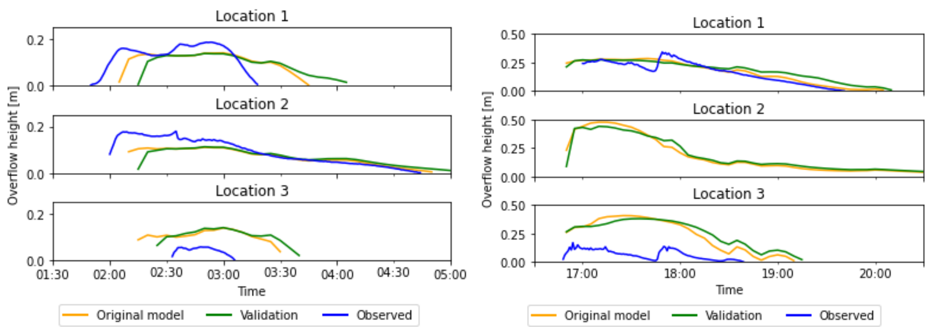


Preventing flooded streets and tunnels in urban environments during the past decades increasingly depends on the results of simulation models. These models can indicate vulnerable areas where during rainfall events sewage systems overflow or water floods the streets. Permeable areas are an important factor in the rainfall-runoff process, but unlike impermeable surfaces they are more difficult to implement into simulation models due to differences in soil characteristics like for example infiltration capacity.

Usually models are calibrated to match simulated output with observational data, but that is not always an option since observational data are sometimes unavailable. Standard parameter values are an estimation and are often not accurate enough to provide reliable model output. The objective of this research is to find parameters that have the most influence on rainfall-runoff processes on unpaved urban surfaces and to find a method of applying parameter values based on soil types. This will make it possible to apply parameter values to ungauged areas.

The two most important parameters are initial infiltration and limiting infiltration from the Horton infiltration method. The initial infiltration is the amount of infiltration that can infiltrate into a soil at the start of a rainfall event, while the limiting infiltration is lowest infiltration value the soil can have when it is saturated. These parameters were found using a sensitivity analysis combined with two rainfall events: one with a return period of one year and the other one with a return period of 100 years. These parameters were then calibrated by comparing simulated sewage overflow to observed values at these locations. Kling-Gupta Efficiency (KGE) scores were used to quantify differences between observed and simulated overflow and find the most optimal parameter combination for the study area. Out of the two rainfall events used for calibration, only the one with a relatively large amount of rainfall produced good model results.

The temporal validation, where two different rainfall events were used in the same study area, showed good KGE scores for large intensity rainfall events. Figure 1 shows the simulations compared to the observations for the two rainfall events. The original model performs slightly better than the validated model. For the spatial validation at a different location with other soil types, no conclusions could be drawn due to either inaccuracies in available observations or poor model performance, or both. This means that part of the research goal was not achieved, since it is unclear what the performance of the model with the new parameter values is at a different location with other soil types.



a b

Figure 1 Temporal validation for rainfall events 1 (a) and 2 (b). Overflow height is the water level downstream of a sewage overflow location. Simulation results are close to the original model. Simulations at Location 3 do not match observed values. For Location 2 in Figure b, no observational data was available.

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