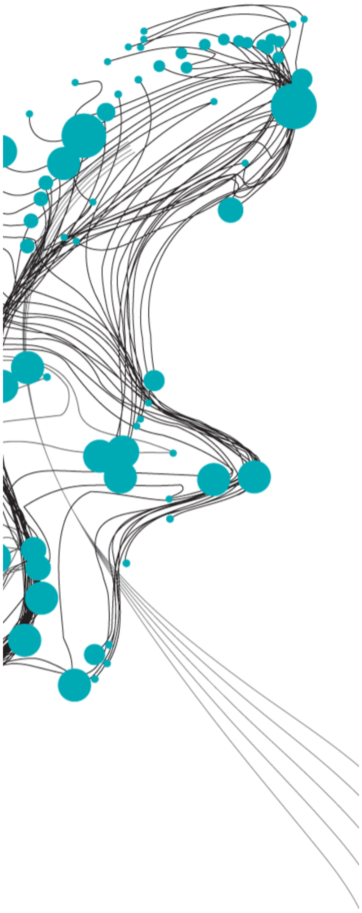
EFFECTIVENESS OF ADAPTATION MEASURES TO MAKE THE URBAN RAINWATER DISTRIBUTION MORE ROBUST AFTER CLOUDBURSTS



Higher frequencies of short and increasingly intense rainfall events and prolonged periods of drought are expected due to climate change. Particularly in urban areas, this results in both insufficient and excessive quantities of water, as well as water quality issues. Therefore, a robust spatial rainwater distribution is needed to retain (i.e. store) rainwater at desired locations, while also preventing excessive amounts of rainwater at locations where it causes damage, hindrance, and sewage overflows. Hence, the research aim was to study the effectiveness of adaptation measures to increase the robustness of spatial rainwater distribution, by quantifying effects of measures using a fully distributed 1D-2D hydrodynamic model 3Di.

The first step involved evaluating the model's performance during historical short and intense rainfall events, showing good performance compared to measurements and expert judgment. Secondly, *base scenarios* were established for short and intense design rainfall events under 2050 conditions, with varying cumulative rainfall depths (i.e. varying *extremeness*). These base scenarios were used to assess spatial rainwater distribution of the current urban area under future conditions. Lastly, proposed measures were implemented to study their isolated effectiveness in increasing the robustness of spatial rainwater distribution. The effects of measures were quantified relative to the base scenarios using the following four metrics: relative increase in retained rainwater, relative decrease of vulnerable buildings and inaccessible roads, and relative decrease in sewerage overflows. The four measures were implemented at a municipal scale. Two on private properties, being: storing roof runoff at 50% of the buildings (*Storepp*), and reducing impervious surface with 50% (*Erf50p*). The last two were implemented in the public space, being: lowering verges to 10 cm below adjacent road section elevation (*Road10*), and implementing 30 cm deep wadis/ bioswales (*Wadi30*). The measures showed varying effectiveness for assessed rainfall events and metrics. Measure *Erf50p* was least effective for all events and metrics. *Storepp* showed consistent effectiveness for all rainfall depths. *Road10* was most effective for all metrics during smaller rainfall depths, and in reducing inaccessibility of roads for all events. *Wadi30* was most effective to retain rainwater, reduce vulnerable buildings, and reduce overflows for larger rainfall depths. Yet, geographical features within urban areas are found to be significantly affecting the effectiveness of measures, stressing the importance of its location and implementation and thus the use of a high-resolution 1D-2D model. Outcomes of such an integral study should be shared with people related to urban adaptation, helping implementation of effective measures to ensure liveable urban areas under future climate conditions.

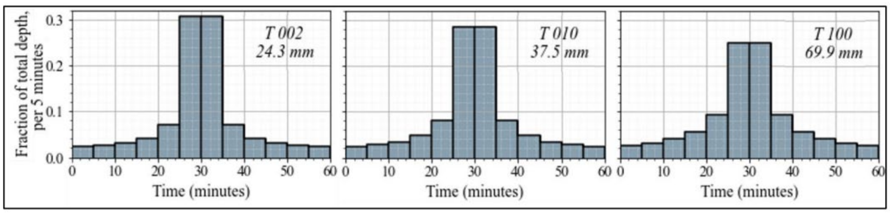


Figure 1: Used design rainfall events for 2050 climate conditions.

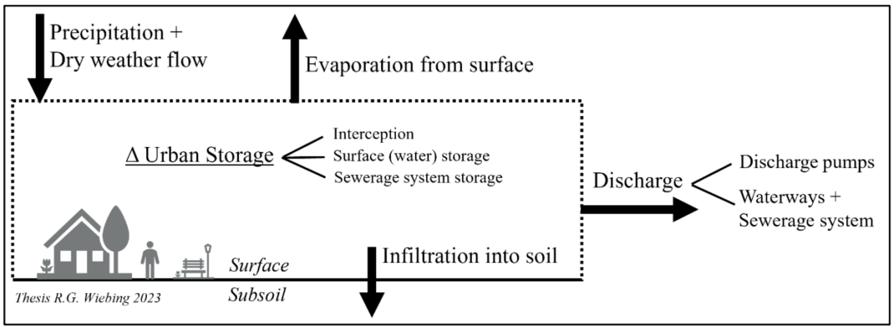


Figure 2: Calculated water balance terms within this study.

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