Current and future pluvial flood hazard analysis for the city of Antwerp

Patrick Willems (1), Hossein Tabari (1), Jan De Niel (1), Els Van Uytven (1), Griet Lambrechts (2), and Geert Wellens (3)

(1) KU Leuven, Hydraulics section, Dept. Civil Engineering, Leuven, Belgium (patrick.willems@bwk.kuleuven.be), (2) City of Antwerp, Francis Wellesplein 1, 2018 Antwerp, Belgium , (3) Rio-link, Dijkstraat 8, 2630 Aartselaar, Belgium

For the city of Antwerp in Belgium, higher rainfall extremes were observed in comparison with surrounding areas. The differences were found statistically significant for some areas and may be the result of the heat island effect in combination with the higher concentrations of aerosols. A network of 19 rain gauges but with varying records length (the longest since the 1960s) and continuous radar data for 10 years were combined to map the spatial variability of rainfall extremes over the city at various durations from 15 minutes to 1 day together with the uncertainty.

The improved spatial rainfall information was used as input in the sewer system model of the city to analyze the frequency of urban pluvial floods. Comparison with historical flood observations from various sources (fire brigade and media) confirmed that the improved spatial rainfall information also improved sewer impact results on both the magnitude and frequency of the sewer floods.

Next to these improved urban flood impact results for recent and current climatological conditions, the new insights on the local rainfall microclimate were also helpful to enhance future projections on rainfall extremes and pluvial floods in the city. This was done by improved statistical downscaling of all available CMIP5 global climate model runs (160 runs) for the 4 RCP scenarios, as well as the available EURO-CORDEX regional climate model runs. Two types of statistical downscaling methods were applied for that purpose (a weather typing based method, and a quantile perturbation approach), making use of the microclimate results and its dependency on specific weather types. Changes in extreme rainfall intensities were analyzed and mapped as a function of the RCP scenario, together with the uncertainty, decomposed in the uncertainties related to the climate models, the climate model initialization or limited length of the 30-year time series (natural climate variability) and the statistical downscaling (albeit limited to two types of methods). These were finally transferred into future pluvial flash flood hazard maps for the city together with the uncertainties, and are considered as basis for spatial planning and adaptation.