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Climate change adaptation accounting for huge uncertainties in future projections - the case of urban drainage

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Hydrological design parameters, which are currently used in the guidelines for the design of urban drainage systems (Willems et al., 2013) have been revised, taking the Flanders region of Belgium as case study. The revision involved extrapolation of the design rainfall statistics, taking into account the current knowledge on future climate change trends till 2100. Uncertainties in these trend projections have been assessed after statistically analysing and downscaling by a quantile perturbation tool based on a broad ensemble set of climate model simulation results (44 regional + 69 global control-scenario climate model run combinations for different greenhouse gas scenarios).

The impact results of the climate scenarios were investigated as changes to rainfall intensity-duration-frequency (IDF) curves. Thereafter, the climate scenarios and related changes in rainfall statistics were transferred to changes in flood frequencies of sewer systems and overflow frequencies of storage facilities. This has been done based on conceptual urban drainage models. Also the change in storage capacity required to exceed a given overflow return period, has been calculated for a range of return periods and infiltration or throughflow rates. These results were used on the basis of the revision of the hydraulic design rules of urban drainage systems. One of the major challenges while formulating these policy guidelines was the consideration of the huge uncertainties in the future climate change projections and impact assessments; see also the difficulties and pitfalls reported by the IWA/IAHR Joint Committee on Urban Drainage - Working group on urban rainfall (Willems et al., 2012).

We made use of the risk concept, and found it a very useful approach to deal with the high uncertainties. It involves an impact study of the different climate projections, or – for practical reasons – a reduced set of climate scenarios tailored for the specific type of impact considered (urban floods in our case study), following the approach proposed by Ntegeka et al. (2014). When the consequences of given scenarios are high, they should be taken into account in the decision making process. For the Flanders' guidelines, it was agreed among the members of the regional Coordination Commission Integrated Water Management to consider (in addition to the traditional range of return periods up to 5 years) a 20-year design storm for scenario investigation. It was motivated by the outcome of this study that under the high climate scenario a 20-year storm would become – in order of magnitude – a 5-year storm. If after a design for a 5-year storm, the 20-year scenario investigation would conclude that specific zones along the sewer system would have severe additional impacts, it is recommended to apply changes to the system or to design flexible adaptation measures for the future (depending on which of the options would be most cost-efficient). Another adaptation action agreed was the installation of storm water infiltration devices at private houses and make these mandatory for new and renovated houses. Such installation was found to be cost-effective in any of the climate scenario's. This is one way of dealing with climate uncertainties, but lessons learned from other cases/applications are highly welcomed.

References

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