Uncertainty assessment of climate change adaptation options in urban flash floods

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Abstract:

Adaptation is necessary to cope with the increasing flood risk in cities due to anthropogenic climate change in many regions of the world. The choice of adaptation strategies can and should be based on a comprehensive risk-based economic analysis to indicate the net benefits of proposed options. However, the analysis is complicated by irreducible uncertainties about present and future hydrologic conditions as well as the present and future vulnerability of the area in question. Further, modelling of the actual hazards given the hydrologic conditions also entails substantial uncertainty.

The work presented is based on a flood risk framework that is in accordance with the EU flood directive, but adapted and extended to incorporate anticipated future changes due to city development and hydrologic extremes. The framework is used to study the importance of inherent uncertainties in order to find robust adaptation options. The case study is a small urban catchment where no significant city development is anticipated. Therefore the main focus is on estimation of impact of uncertainties related to present and future hydrological conditions, impacts on assets, and costing of the damages. The uncertainties are calculated using Monte Carlo simulations and thus the resulting uncertainties are described by probability density functions.

Two different adaptation options are studied to reduce the increase in risk of flooding, namely increasing the pipe capacity and the use of local infiltration measures to hold water back from flood prone areas. The two options represent classical engineering solutions and water sensitive urban design, respectively. These options are compared to a business-as-usual scenario, where no adaptation is foreseen in the area. The results indicate that infiltration is less cost-effective regardless of the uncertainties from climate change impacts and /or damage estimation procedure when considering the ability to reduce the risk of flooding. The description of the correlation structure between the key inputs proved to be important in order to obtain a correct description of the resulting uncertainties.

The study shows that uncertainties associated with climate adaptation benefits are large, but still it is possible to choose no-regret adaptation options. The introduced procedure provides an important tool for achieving an explicit and thorough uncertainty analysis of the risk-based economic evaluation.