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# Uncertainty assessment of urban pluvial flood risk in a context of climate change adaptation decision making

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There has been a significant increase in climatic extremes in many regions. In Central and Northern Europe, this has led to more frequent and more severe floods. Along with improved flood modelling technologies this has enabled development of economic assessment of climate change adaptation to increasing urban flood risk. Assessment of adaptation strategies often requires a comprehensive risk-based economic analysis of current risk, drivers of change of risk over time, and measures to reduce the risk. However, such studies are often associated with large uncertainties. The uncertainties arise from basic assumptions in the economic analysis and the hydrological model, but also from the projection of future societies to local climate change impacts and suitable adaptation options. This presents a challenge to decision makers when trying to identify robust measures. We present an integrated uncertainty analysis, which can assess and quantify the overall uncertainty in relation to climate change adaptation to urban flash floods. The analysis is based on an uncertainty cascade that by means of Monte Carlo simulations of flood risk assessments incorporates climate change impacts as a key driver of risk changes over time. The overall uncertainty is then attributed to six bulk processes: climate change impact, urban rainfall-runoff processes, stage-depth functions, unit cost of repair, cost of adaptation measures, and discount rate.

We apply the approach on an urban hydrological catchment in Odense, Denmark, and find that the uncertainty on the climate change impact appears to have the least influence on the net present value of the studied adaptation measures-. This does not imply that the climate change impact is not important, but that the uncertainties are not dominating when deciding on action or in-action.

We then consider the uncertainty related to choosing between adaptation options given that a decision of action has been taken. In this case the major part of the uncertainty on the estimated net present values is identical for all adaptation options and will therefore not affect a comparison between adaptation measures. This makes the chose among the options easier. Furthermore, the explicit attribution of uncertainty also enables a reduction of the overall uncertainty by identifying the processes which contributes the most. This knowledge can then be used to further reduce the uncertainty related to decision making, as a substantial part of the remaining uncertainty is epistemic.