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Effects of spatio-temporal scale and uncertain urban development on long-term planning of urban water management

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Abstract: To develop long-term strategies for urban water management, we need to consider potential impacts from urban development, changing climate and changing socio-economic conditions. Therefore, urban water models are linked to modelled projections of these influencing factors. The linkage of urban development and urban water models is relatively new with only few examples available. The required spatial and temporal resolution in urban development models is still unknown, and it is not clear what impact variations have on indicators used to assess the functioning of water management, e.g., pollutant emissions, flood risk, maintenance cost, etc. Further, some indicators might be strongly affected by urban development when focussing on selected locations, while little variation is observed on the city scale.

This work focusses on assessing how different levels of spatial and temporal variability in urban development affect various aspects of urban water management. Our approach is to simulate urban development for Odense, Denmark, considering increasing levels of uncertainty of when, where and in what form future developments occur. The simulated urban development projections are subsequently applied as input to hydrological and hydraulic simulations of the urban water cycle. This analysis provides insight on which water management parameters are affected by urban development, which spatial and temporal scales are required, as well as how detailed simulations of urban development are needed as an input for planning urban water management. The evaluation needs to consider that sustainable water management involves a variety of ecosystems services which need to be evaluated by planning models.

Keywords: strategic planning; urban development; risk assessment; water quality