Influence of urban land cover changes and climate change for the exposure of European cities to flooding during high-intensity precipitation

The extent and location of impervious surfaces within urban areas due to past and present city development strongly affects the amount and velocity of run-off during high-intensity rainfall and consequently influences the exposure of cities towards flooding. The frequency and intensity of extreme rainfall are expected to increase in many places due to climate change and thus further exacerbate the risk of pluvial flooding. This paper presents a combined hydrological-hydrodynamic modelling and remote sensing approach suitable for examining the susceptibility of European cities to pluvial flooding owing to recent changes in urban land cover, under present and future climatic conditions. Estimated changes in impervious urban surfaces based on Landsat satellite imagery covering the period 1984–2014 are combined with regionally downscaled estimates of current and expected future rainfall extremes to enable 2-D overland flow simulations and flood hazard assessments. The methodology is evaluated for the Danish city of Odense. Results suggest that the past 30 years of urban development alone has increased the city’s exposure to pluvial flooding by 6% for 10-year rainfall up to 26% for 100-year rainfall. Corresponding estimates for RCP4.5 and RCP8.5 climate change scenarios (2071–2100) are in the order of 40 and 100 %, indicating that land cover changes within cities can play a central role for the cities’ exposure to flooding and conversely also for their adaptation to a changed climate.

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