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Systematic flood modelling to support flood-proof urban design

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Urban flood risk is influenced by many factors such as hydro-meteorological drivers, existing drainage systems as well as vulnerability of population and assets. The urban fabric itself has also a complex influence on inundation flows. In this research, we performed a systematic analysis on how various characteristics of urban patterns control inundation flow within the urban area and upstream of it.
An urban generator tool was used to generate over 2,250 synthetic urban networks of 1 km^2. This tool is based on the procedural modelling presented by Parish and Müller (2001) which was adapted to generate a broader variety of urban networks. Nine input parameters were used to control the urban geometry. Three of them define the average length, orientation and curvature of the streets. Two orthogonal major roads, for which the width constitutes the fourth input parameter, work as constraints to generate the urban network. The width of secondary streets is given by the fifth input parameter. Each parcel generated by the street network based on a parcel mean area parameter can be either a park or a building parcel depending on the park ratio parameter. Three setback parameters constraint the exact location of the building whithin a building parcel.
For each of synthetic urban network, detailed two-dimensional inundation maps were computed with a hydraulic model. The computational efficiency was enhanced by means of a porosity model. This enables the use of a coarser computational grid , while preserving information on the detailed geometry of the urban network (Sanders et al. 2008). These porosity parameters reflect not only the void fraction, which influences the storage capacity of the urban area, but also the influence of buildings on flow conveyance (dynamic effects).
A sensitivity analysis was performed based on the inundation maps to highlight the respective impact of each input parameter characteristizing the urban networks. The findings of the study pinpoint which properties of urban networks have a major influence on urban inundation flow, enabling better informed flood-proof urban design.

References:
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