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Modeling pluvial flooding damage in urban environments: spatial relationships between citizens' complaints and overland catchment areas

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Extreme weather events such as floods and storms are expected to cause severe economic losses in The Netherlands. Cumulative damage due to pluvial flooding can be considerable, especially in lowland areas where this type of floods occurs relatively frequently. Currently, in The Netherlands, water-related damages to property and contents are covered through private insurance. As pluvial flooding is becoming heavier and more likely to occur, sound modelling of damages is required to ensure that insurance systems are able to stand as an adaptation measure. Current damage models based on rainfall intensity, registries of insurance claims, and classifications of building types are unable to fully explain damage variability. Further developments assessing additional explanatory factors and reducing uncertainties, are required in order to significantly explain damage. In this study, urban topography is used as an explanatory factor for modelling of urban pluvial flooding. Flood damage is evaluated based on complaints data, a valuable resource for assessing vulnerability to urban pluvial flooding.

Though previous research has shown coincidences between the localization of high complaint counts and large size catchments areas in Rotterdam, additional research is needed to establish the precise spatial relationship of those two variables. This additional task is the focus of the presented work. To that end a data base of complaints, that was made available by the Municipality Administration of the City, will be analysed. It comprises close to 36800 complaints from 2004 to 2011. The geographical position of the registries is aggregated into 4 to 6-digit Postal Code zones, which represents entire streets or relative positions along a street, respectively. The Municipality also provided the DEM, characterized by a spatial resolution of 0.5 m $\times$ 0.5 m, a vertical precision of 5 cm, and an accuracy better than two standard deviations of 15 cm.

First the localization of complaints will be tested for spatial randomness: the distribution of Global Moran's I will be used as a measure of spatial aggregation of complaints. We expect high values of spatial aggregation, that would confirm the existence of a spatial structure in the distribution of complaints. Then we will probe how much does the extent of catchment areas influence such distribution of complaints. That will be done through both an ordinary least squares regression and a geographically weighted regression. By contrasting the results from these two regressions, the relationship between complaints and size of catchment area across the urban environment will be evaluated.

The results will confirm whether complaints have a spatial distribution pattern. Furthermore, the results will provide insight into the importance of the size of catchment areas as a significant factor for complaints distribution, and for the assessment of urban vulnerability to pluvial flooding in the City of Rotterdam.