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Potential of 3D City Models to assess flood vulnerability

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Vulnerability, as the product of exposure and susceptibility, is a key factor of the flood risk equation. Furthermore, the estimation of flood loss is very sensitive to the choice of the vulnerability model. Still, in contrast to elaborate hazard simulations, vulnerability is often considered in a simplified manner concerning the spatial resolution and geo-location of exposed objects as well as the susceptibility of these objects at risk. Usually, area specific potential flood loss is quantified on the level of aggregated land-use classes, and both hazard intensity and resistance characteristics of affected objects are represented in highly simplified terms.

We investigate the potential of 3D City Models and spatial features derived from remote sensing data to improve the differentiation of vulnerability in flood risk assessment. 3D City Models are based on CityGML, an application scheme of the Geography Markup Language (GML), which represents the 3D geometry, 3D topology, semantics and appearance of objects on different levels of detail. As such, 3D City Models offer detailed spatial information which is useful to describe the exposure and to characterize the susceptibility of residential buildings at risk. This information is further consolidated with spatial features of the building stock derived from remote sensing data. Using this database a spatially detailed flood vulnerability model is developed by means of data-mining. Empirical flood damage data are used to derive and to validate flood susceptibility models for individual objects. We present first results from a prototype application in the city of Dresden, Germany. The vulnerability modeling based on 3D City Models and remote sensing data is compared i) to the generally accepted good engineering practice based on area specific loss potential and ii) to a highly detailed representation of flood vulnerability based on a building typology using urban structure types. Comparisons are drawn in terms of affected building area and estimated loss for a selection of inundation scenarios.