Methodology for qualitative urban flooding risk assessment

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EXTENDED ABSTRACT

Urban pluvial flooding has the potential to cause significant damage and disruption as it often occurs in highly urbanized areas (residential, commercial or industrial occupation). Flooding are already frequent events and their frequency is expected to increase due not only due to urbanisation but also due to expected climate changes (Ugarelli *et al.*, 2011).

Recent developments in urban flood modelling (e.g. Leitão, 2009; Maksimović *et al.*, 2009) allow carrying out reliable simulations of the whole drainage system, including both sewer and surface drainage systems. Several references can be found in the literature (e.g. Apel *et al.*, 2009; Douglas *et al.*, 2010) with examples of usage of urban drainage modelling results to estimate the consequences of flooding and consequently assess flooding risk.

In this study, 1D/1D model results are used to assess urban flooding risk caused by intense rainfall and subsequent surface water runoff and limited sewer hydraulic capacity. The risk approach used is based on the combination of likelihood and consequence levels, using a risk matrix - a qualitative risk assessment method. Five levels of both likelihood and consequence are defined by the risk analyst. Based on the risk level, different actions may be considered to tackle the flooding problem and mitigate its impacts.

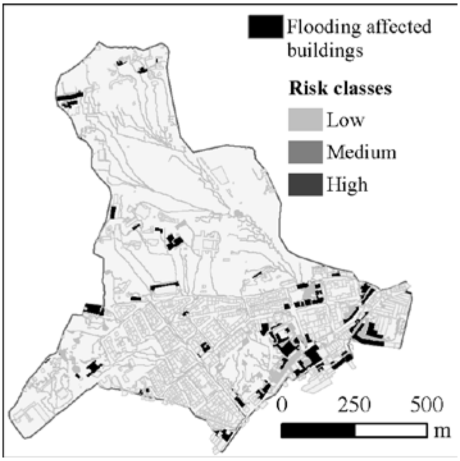
The methodology was applied to a real case, a small, densely urbanised catchment located in Lisbon (Portugal) that has experienced frequent pluvial flooding events in recent years. Two rainfall events (Storm A and Storm B) and three consequence dimensions were considered: flooding effects on public transportation services, properties and pedestrians safety.

Table 1. Consequence dimensions classes.

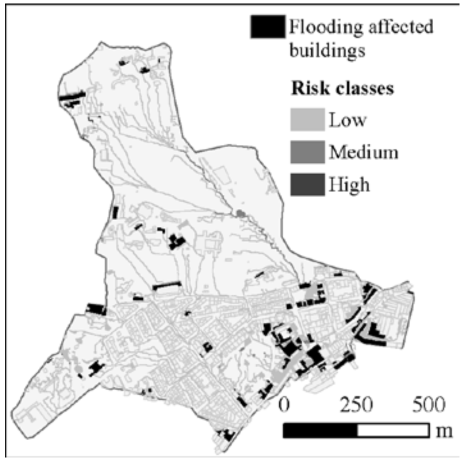
Consequence class		Dimensions		
		Effect on public transportation services (> 1 hour)	Number of affected properties	Pedestrians safety (*HR**)
1	Insignificant	No routes affected	0 properties affected	[0; 0.125[
2	Low	1 route affected	1 to 10 properties affected	[0.125; 0.75[
3	Moderate	2 to 3 routes affected	10 to 100 properties affected	[0.75; 1.25[
4	High	3 to 5 routes affected	100 to 1,000 properties affected	[1.25; 2.5[
5	Severe	> 5 routes affected	More than 1,000 properties affected	[2.5; +∞[

**HR* is the Flood Hazard rating as proposed by (HR Wallingford *et al.*, 2006).

The results showed that high-level of risk areas are mainly the result of high runoff velocities, representing a problem to pedestrian safety (Figure 1).



(a) Storm A.



(b) Storm B.

Figure 1. Flood risk.

The developed methodology showed to be reliable and easy to implement. One of the advantages of such methods is that the proper definition of classes helps reducing the subjectivity of the results. In addition, such qualitative methods may help reducing the false notion of accuracy when dealing with numeric results. Furthermore, it can be applied using existing data and easily upgraded when additional data become available.

References

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