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A methodology for urban flood resilience assessment

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In Europe, river floods have been increasing in frequency and severity [Szöllösi-Nagy and Zevenbergen, 2005]. Moreover, climate change is expected to exacerbate the frequency and intensity of hydro meteorological disaster [IPCC, 2007]. Despite efforts made to maintain the flood defense assets, we often observe levee failures leading to finally increase flood risk in protected area. Furthermore, flood forecasting models, although benefiting continuous improvements, remain partly inaccurate due to uncertainties arising all along data calculation processes.

In the same time, the year 2007 marks a turning point in history: half of the world population now lives in cities (UN-Habitat, 2007). Moreover, the total urban population is expected to double from two to four billion over the next 30 to 35 years (United Nations, 2006). This growing rate is equivalent to the creation of a new city of one million inhabitants every week, and this during the next four decades [Flood resilience Group]. So, this quick urban development coupled with technical failures and climate change have increased flood risk and corresponding challenges to urban flood risk management [Ashley et al., 2007], [Nie et al., 2009]. These circumstances oblige to manage flood risk by integrating new concepts like urban resilience.

In recent years, resilience has become a central concept for risk management. This concept has emerged because a more resilient system is less vulnerable to risk and, therefore, more sustainable [Serre et al., 2010]. But urban flood resilience is a concept that has not yet been directly assessed. Therefore, when decision makers decide to use the resilience concept to manage urban flood, they have no tool to help them. That is why this paper proposes a methodology to assess urban flood resilience in order to make this concept operational.

Networks affect the well-being of the people and the smooth functioning of services and, more generally, of economical activities. Yet, multiple networks that innervate the city are particularly sensitive to flooding, through their structures and geographic constraints. Because societal functions are highly dependent on networked systems and the operability of these systems can be vulnerable to disasters, there is a need to understand how networked systems are resilient. That is why, considering that networks can be regarded as the “flood gateway” [Lhomme et al., 2009], we will focus on the resilience assessment of these critical networks before urban resilience assessment.

The first part of this paper introduce resilience concept to well understand the importance of this concept to manage flood risk and of assessing this resilience. In a second part, this paper presents the use of safety methods to model network system dysfunctions during flood and then to produce resilience indicators. Finally it presents use of graph theory to assess adaptive capacity of these networks. These researches are the first steps toward the development of a GIS tool to optimize preparedness and recovery after a flood event.