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Resilience assessment of urban areas protected by dikes

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More and more floods occurred over the last decade in the world, causing important damages. Moreover, levees are often not well maintained, so they hardly resist to major floods and can break easily. At French national scale, the length of levees, estimated to 7500 kilometers, and the lack of data all along these infrastructures complicates their management. In this frame, levee managers need approaches and tools in order to be helped in their maintenance decision. The usual risk definition is done by the multiplicative effect of hazard and vulnerability, here the hazard represents the probability to observe extreme natural event or extreme anthropological pressure, which are supposed to give rise to damage and disaster. From a hydrological point of view the major extremes events are indeed extreme rainfall and flood, which, in a urban environment could have a strong impact on the human activity giving ride to risk.

The goal of our research is to develop methods modeling urban resilience. The first part modeling levee failure mechanisms and allowing performance levee assessment. The failure mechanisms are modeled as series of functional failures representing the relevant physical processes (Pilarczyk 1998). We used tools for modeling complex systems and representing the organic links between the sequences of failures in the structures (Zwingelstein 1996). The methods integrated in an existing GIS dedicated to levee management will contribute to obtain a spatial decision support system aiding levee managers in their maintenance decision. News functionalities have to be developed, in particular, to provide a synthetic vision of levees conditions and performance all along their length (Gervais 2010). We made some tests in a specific area to integrate the level of vulnerability behind dikes to improve the levee manager decision process. The prototype was tested on a 2 km levee located in the south of France, near Montpellier. We assessed the levee performance relating to internal erosion failure mechanism.

This operation consisted first in collecting field data on this levee. The second phase consisted in entering data in the prototype and finally in executing the performance model calculation.

Our test also showed that the levee segments, homogeneous in term of performance level, were long enough from an operational maintenance perspectives.

Nevertheless, even with this possibility to prioritize maintenance actions based on levee performance, this is not enough to guide the choices. Indeed, vulnerability behind levees has to be assessed to make levee managers able to choice where to start.

The second part determines the vulnerability of each area. Four indicators have been used to assess the vulnerability dimension (critical facilities at stake in area protected by levee) and to match it with levee performance to better prioritize management actions. This is what we have been started in developing indicators and spatial analysis to be able to cross levee performance and city vulnerability.

Maps of the levee performance and urban vulnerability were produced and mixed at the end of the procedure for assessing urban flood resilience.

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