BENEFIT OF USING FLOOD RISK ANALYSIS AT THE MICRO LEVEL FOR EVALUATING LOCAL PROTECTION MEASURES

Benjamin Dewals[1], Sylvain Detrembleur[2],
Pierre Archambeau[3], Sébastien Erpicum[4] and Michel Pirotton[5]

INTRODUCTION

In numerous river basins, climate projections converge towards conditions leading to a significant increase in peak discharges both in terms of intensity and frequency. Therefore, managing flood risk will remain an issue of primary importance. Besides, it is currently shifting from the search for full protection against flooding towards the management of the impacts of flooding. In this respect, the elaboration of effective flood management strategies should rely on an integrated risk-based approach, encompassing not only hydraulic criteria but also economic, social and environmental factors. In addition, the considered level of detail in the analysis should be relevant given the available data and the expected outcomes. While such risk analyses have so far been mostly undertaken at a macro- or meso-scale, the herein described analysis is performed at a micro-scale, meaning that the considered assets are the individual buildings, parcels or facilities.

MICRO-SCALE RISK ANALYSIS

Refined flood risk analyses require an overall consistency in terms of spatial resolution, considered processes and accuracy between the expected results, hazard and vulnerability modelling, as well as available input data. Therefore, taking benefit of recent advances in their availability, the analysis presented here relies on a micro-scale procedure (Ernst et al. 2010), which involves hazard modelling by means of detailed 2D inundation modelling and modelling of socio-economic vulnerability based on high resolution land use, cadastral and statistical database. Environmental aspects will be incorporated in subsequent developments, while the analysis presently focuses on urbanized areas.

Hazard modelling

The inundation modelling has been conducted using the fully dynamic flow model WOLF 2D, developed at the University of Liege. Such two-dimensional hydraulic model represents reliably the hydrodynamic interactions between main channel and floodplains. It also provides the distribution of water depth and flow velocity in the floodplains, so that both the static and dynamic impacts of the flow may be characterized for all affected assets. The modelling approach applies therefore also for extreme floods such as induced by dam break or dam breaching (Roger et al. 2009; Erpicum et al. 2010b; Dewals et al. 2011).
The model has been run on a highly accurate DEM resulting from the combination of laser altimetry and, when available, sonar bathymetry. The typical grid spacing for the simulations is kept as low as 2m, which is definitely fine enough to represent the complex flow patterns occurring at the scale of individual buildings and streets in urbanized floodplains (Ernst et al. 2010; Erpicum et al. 2010a).

[1] Dr Benjamin Dewals. University of Liege, Research group Hydrology, Applied Hydrodynamics and Hydraulic Constructions (HACH), Chemin des Chevreuils 1 Bat B52/3+1, 4000 Liege, Belgium (email: b.dewals@ulg.ac.be).
[2] Ir Sylvain Detrembleur. University of Liege, HACH, Belgium (email: sylvain.detrembleur@ulg.ac.be).
[3] Dr Pierre Archambeau. University of Liege, HACH, Belgium (email: pierre.archambeau@ulg.ac.be).
[4] Dr Sébastien Erpicum. University of Liege, HACH, Belgium (email: s.erpicum@ulg.ac.be).
[5] Prof. Michel Pirotton. University of Liege, HACH, Belgium (email: michel.pirotton@ulg.ac.be).

Vulnerability modelling

The outcome of such detailed inundation modelling proves suitable as input for exposure analysis performed at the micro-scale. Accurate land use database have been exploited to identify each building or facility individually. Next, based on a multidisciplinary work, susceptibility of the assets has been characterized using a vulnerability index for psycho-social impacts and damage functions to evaluate direct economic losses for different categories of buildings and land uses (Ernst et al. 2010).

CASE STUDY

The applicability and performance of the risk analysis procedure will be demonstrated through the presentation of a case study, for which three different flood protection measures have been evaluated (Ernst et al. 2010). These include the rehabilitation of an old canal (acting as a derivation), increasing conveyance of a floodplain as well as heightening of a protection wall by means of mobile dikes. The risk-oriented analysis of these flood protection measures has lead to findings which would not have arisen from a more standard hydraulic study such as based on a design flood.

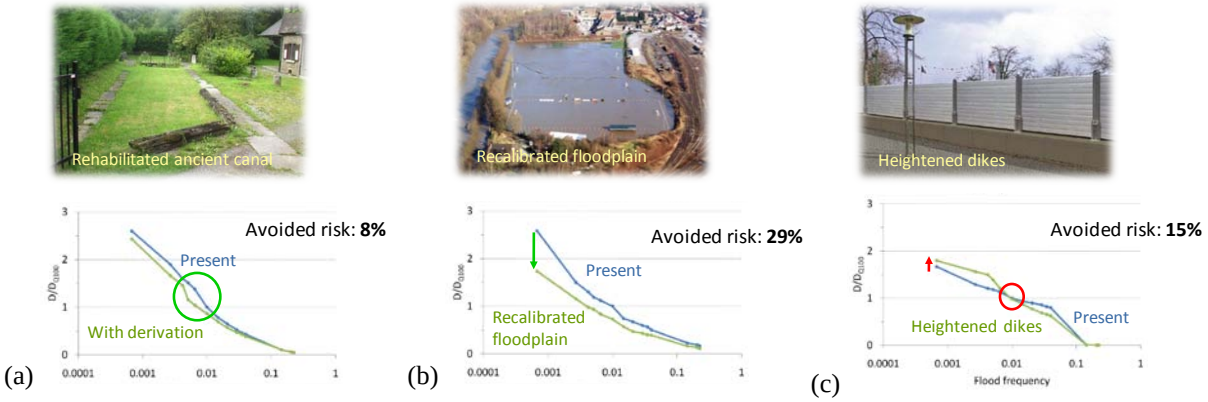

Fig. 1 Risk curves obtained in the present situation and considering three flood protection measures.

CONCLUSION

The described flood risk analysis procedure is now readily available for large scale applications and is currently being combined with catchment modelling (accounting for climate change projections) to evaluate upstream flood mitigation measures as well as for the fine tuning of reservoir operation rules in the framework of elaborating strategies to adapt to climate change.

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