A risk-based approach for designing climate-proof flood protection

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Keywords: hydraulic modeling, socio-economic impact, flood protection design, climate change.

In the framework of the Belgian national research project "*ADAPT - Towards an integrated decision tool for adaptation measures*", a risk-based decision-support system (DSS) is developed with the aim of selecting the most cost-effective flood protection strategies. Based on detailed 2D hydraulic modelling combined with high resolution and high accuracy land use database as well as socio-economic datasets, integrated risk analysis is conducted to evaluate the benefits of different flood protection measures. The tool is dedicated to the integrated evaluation of flood management strategies in the context of increased flood risk as a result of climate change, considering hydraulic, economic, social as well as environmental parameters to quantify both the benefits (in terms of avoided risk) and the cost of each strategy.

While such risk analyses are mostly undertaken at a macro- or meso-scale, the present approach is performed at a micro-scale, meaning that the considered assets are the individual buildings or facilities. The methodology relies on a consistent approach in terms of accuracy of input data, hydraulic modelling and expected results. Indeed, besides detailed hydraulic modelling conducted on computational grids as fine as 2m by 2m, exploited data include laser altimetry (LIDAR), high resolution and high quality land use maps as well as other complementary vector geographic datasets providing socioeconomic information at a micro-scale. Next to the flow modelling and the exposure analysis conducted for each building or facility individually, the procedure involves social impact analysis (accounting for social vulnerability and adaptive capacity of communities) and the evaluation of direct economic damage based on different relative damage functions. The outcomes of this risk analysis are subsequently exploited in the DSS to evaluate the effectiveness of individual flood protection measures.

Finally all costs and benefits (avoided risk) are combined to enable the evaluation of flood protection strategies. Every scenario for which benefits outweigh costs potentially adds to welfare. The scenario with the highest contribution per Euro invested should ideally be realised first. The extended cost-benefit analysis is complemented by uncertainty and sensitivity analyses of the results.

The applicability of the overall automatic procedure is demonstrated by the evaluation of inundation hazard, exposure and flood risk for a case study along river Ourthe in the Meuse basin (Belgium). For validation purpose, recent flood events are first simulated and a base scenario is considered. Next, the effectiveness of a number of flood protection measures is evaluated.