Flood risk analysis in Wallonia

Micro- (and meso-)scale approaches

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Hazard modelling

END-TO-END FLOOD-RISK ANALYSIS PROCEDURE

FLOOD

INUNDATION

DAMAGE

Water retention (incl. large dams)

Enhance river conveyance (maintenance dredging, dikes ...)

Restrict/ban building in floodplains

Reduce vulnerability of assets

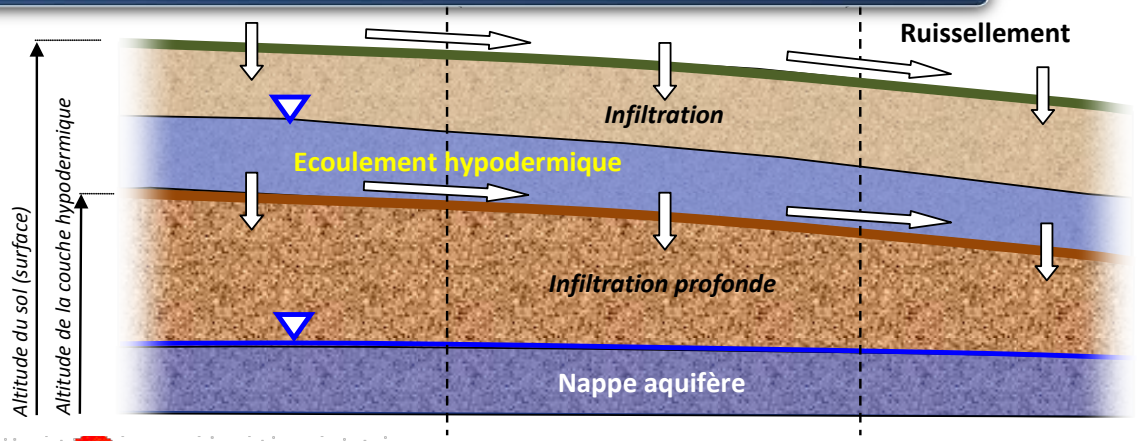
Vulnerability modelling

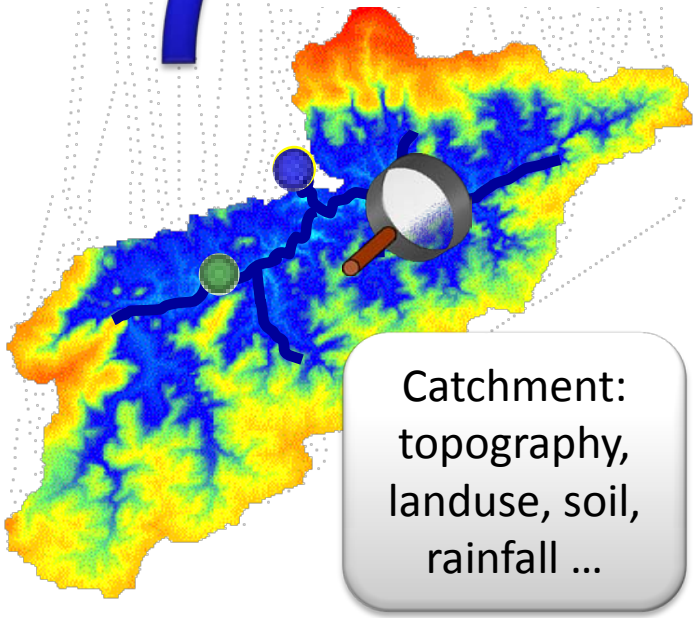
Business, industry

Agriculture

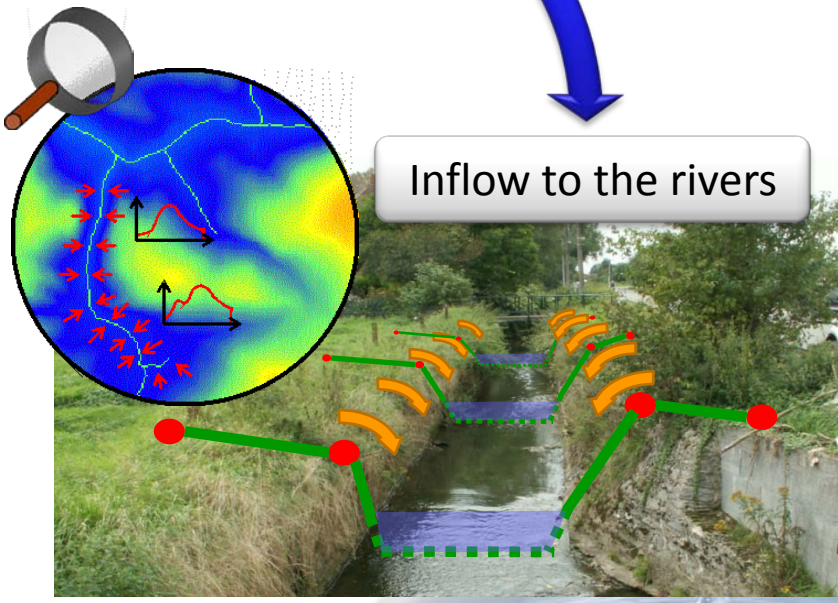
Traffic

PROCESS-ORIENTED RAINFALL-RUNOFF MODELLING & FLOOD ROUTING





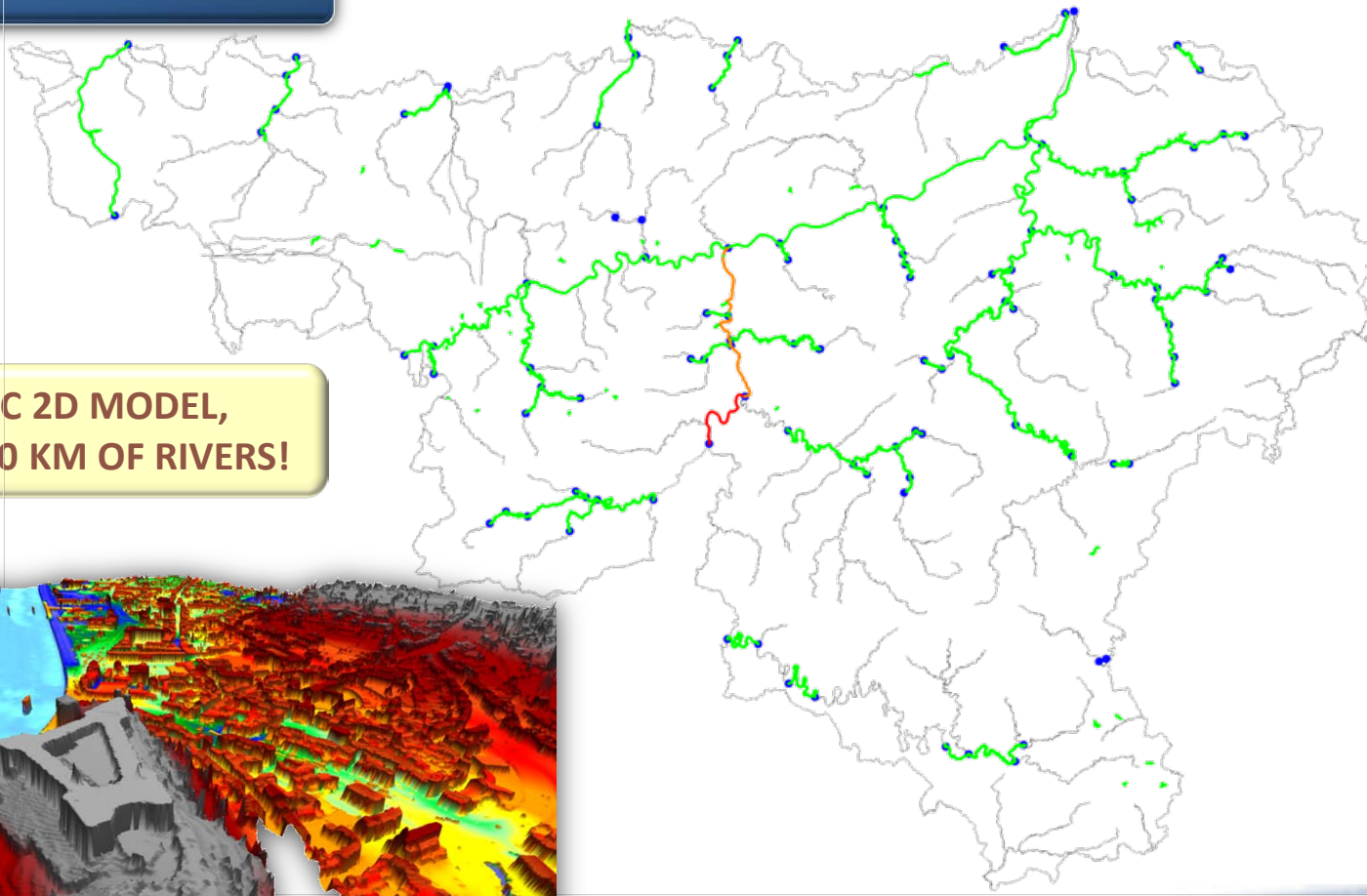
Catchment: topography, landuse, soil, rainfall …



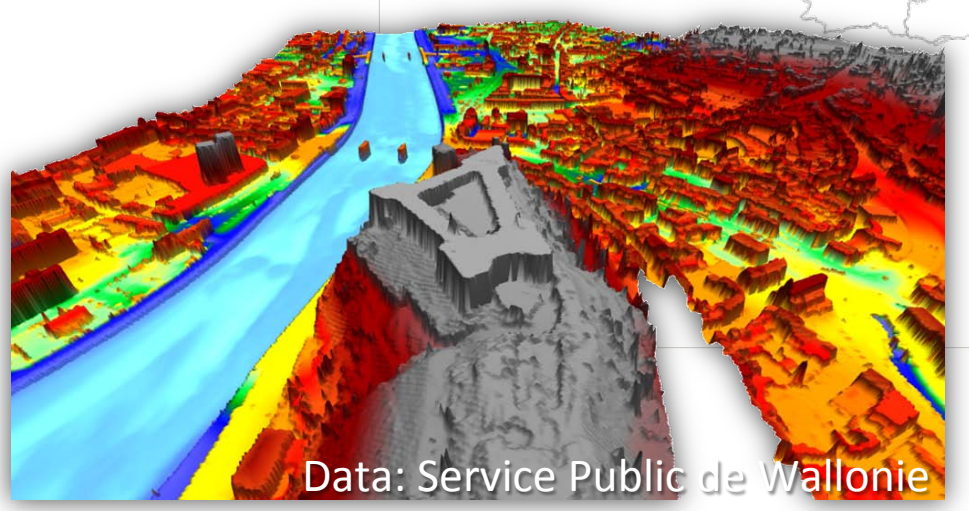
Inflow to the rivers

Khuat Duy, Archambeau, Dewals, Erpicum & Pirotton (2010). River modelling and flood mitigation in a Belgian catchment. *Proceedings of ICE : Water Management.* **163**(8) 417 –423.

DETAILED 2D INUNDATION MODELLING



FULLY DYNAMIC 2D MODEL, APPLIED TO > 1,000 KM OF RIVERS!

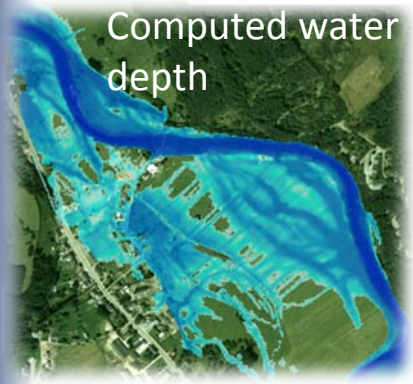


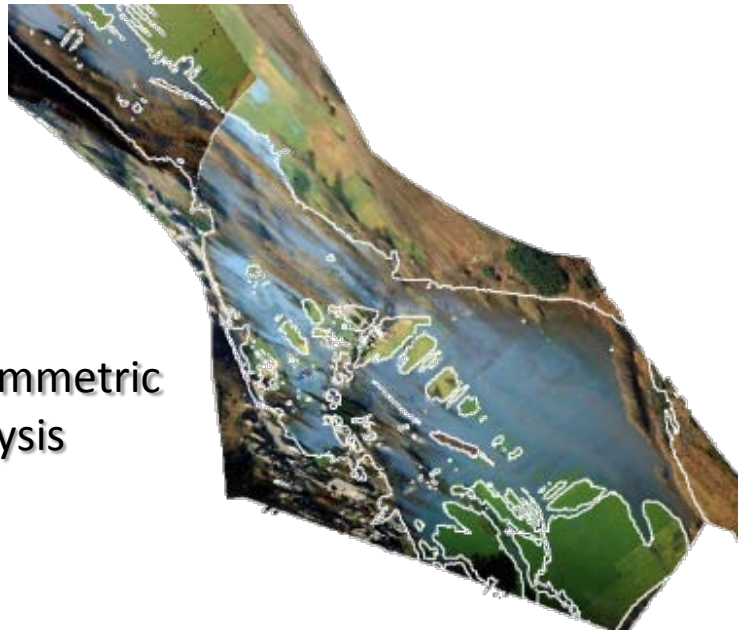
HIGH ACCURACY AND HIGH RESOLUTION TOPOGRAPHIC DATA

Erpicum, Dewals, *et al*. 2010. Detailed inundation modelling using high resolution DEMs. *Engineering Applications of Computational Fluid Mechanics*. **4**(2):196-208.

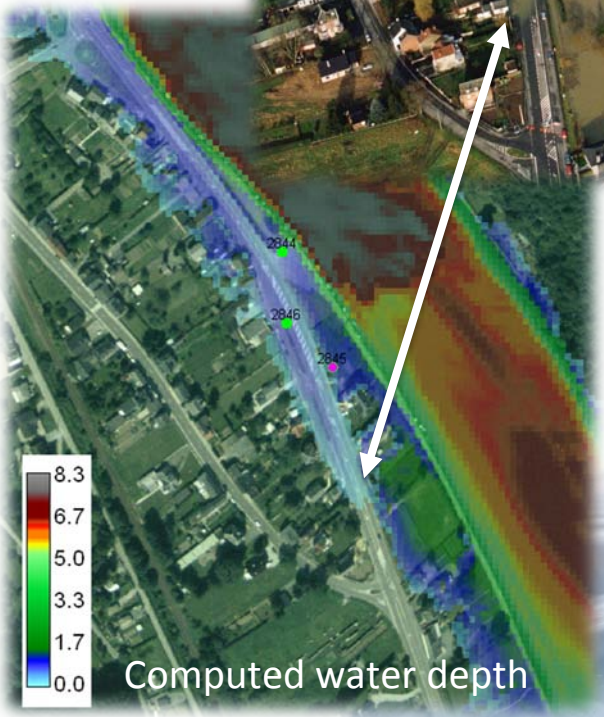
DETAILED 2D INUNDATION MODELLING

ACCURATE AND VALIDATED MODEL



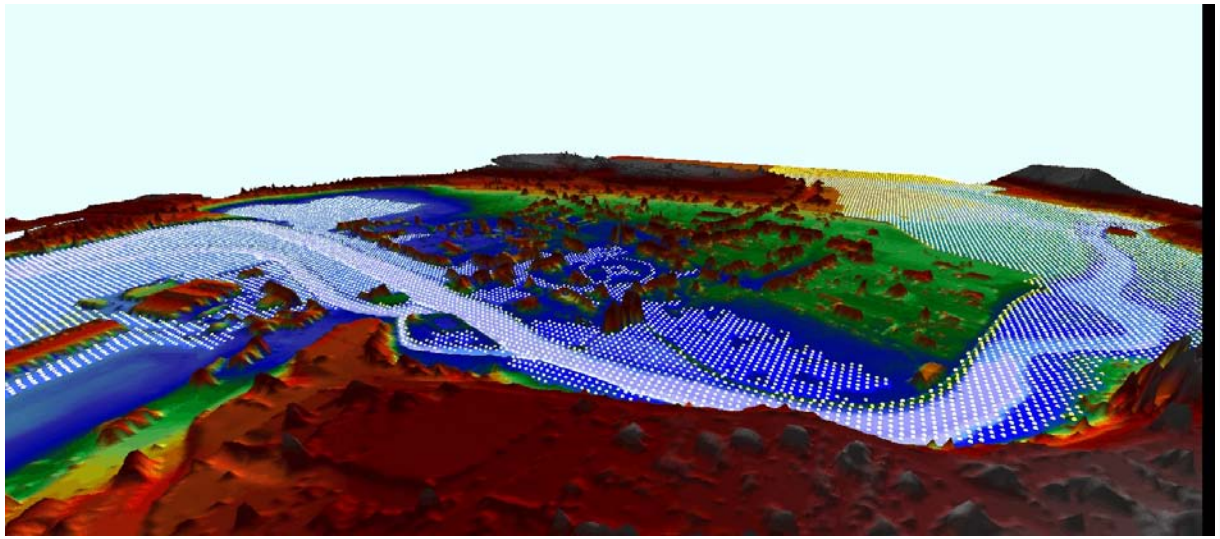


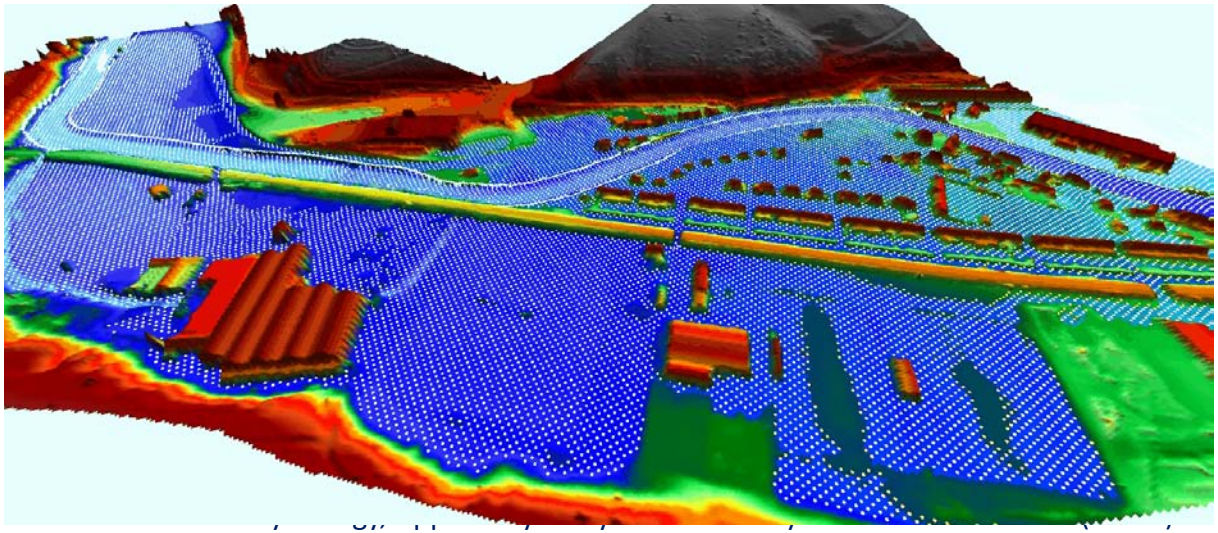
Photogrammetric analysis



DETAILED 2D INUNDATION MODELLING

WHY DETAILED FULLY DYNAMIC 2D MODELLING? LUXURY OR NECESSITY?



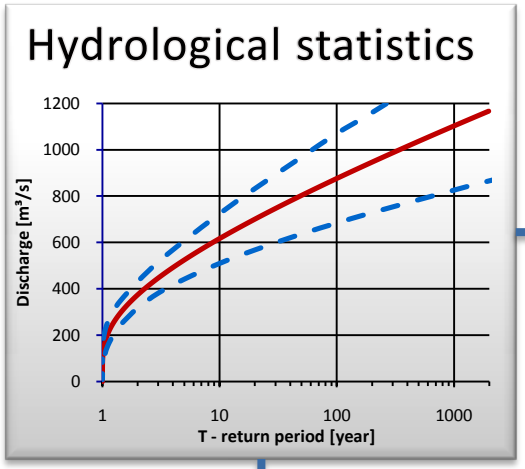


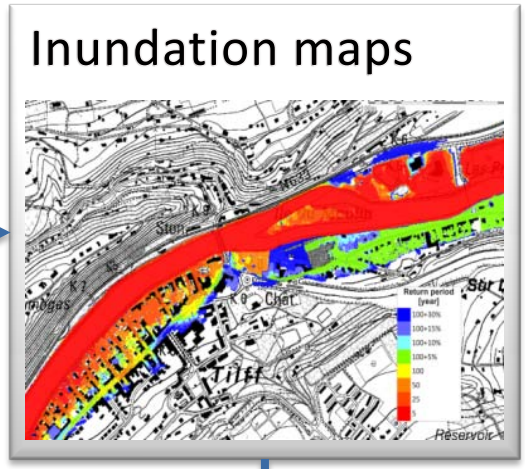
1. Complex urbanized floodplains

2. Consistent with inundation mapping conducted so far

3. Better insight into inundation dynamics

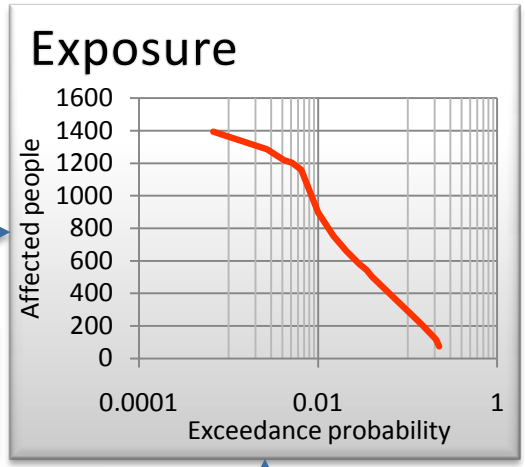
better understanding of the flow enhanced design of protection measures

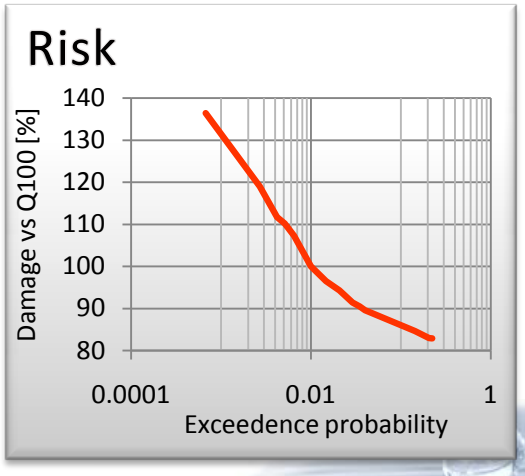




Flood frequency

Extent





+ Land use data …

Ernst, Dewals, Detrembleur, Archambeau, Erpicum, Pirotton (2010). Micro-scale flood risk analysis based on detailed 2D hydraulic modelling and high resolution land use data. *Nat. Hazards.* In press.

SCALE-DEPENDENT LANDUSE DATABASE

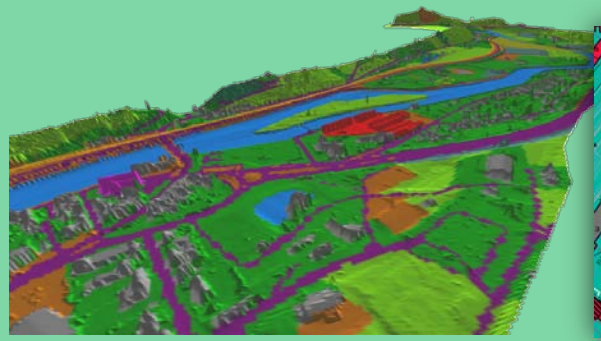
Micro-scale analysis

For technical planning

►Mainly cadastral data:

- Location of exposed buildings
- Building type and use

Complemented by Top10v-GIS and/or PICC data



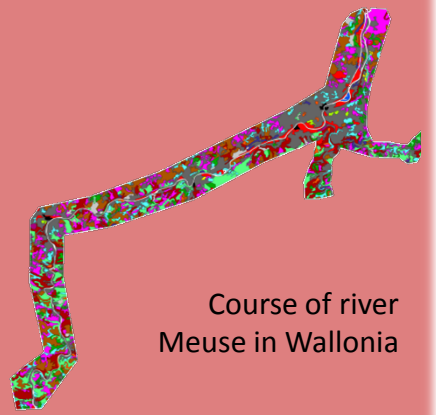
Data: IGN - Bruxelles

Data: SPW

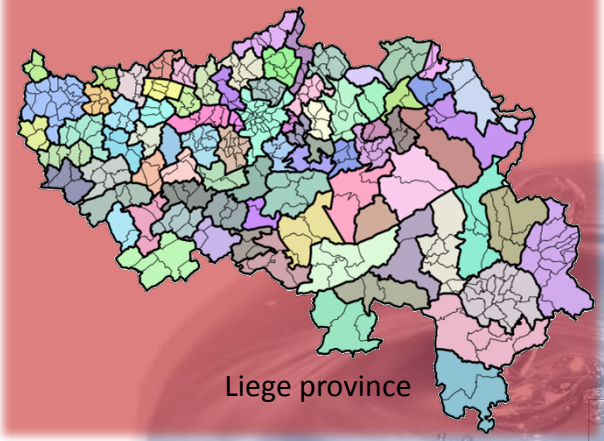
Meso-scale analysis

Catchment-scale analysis

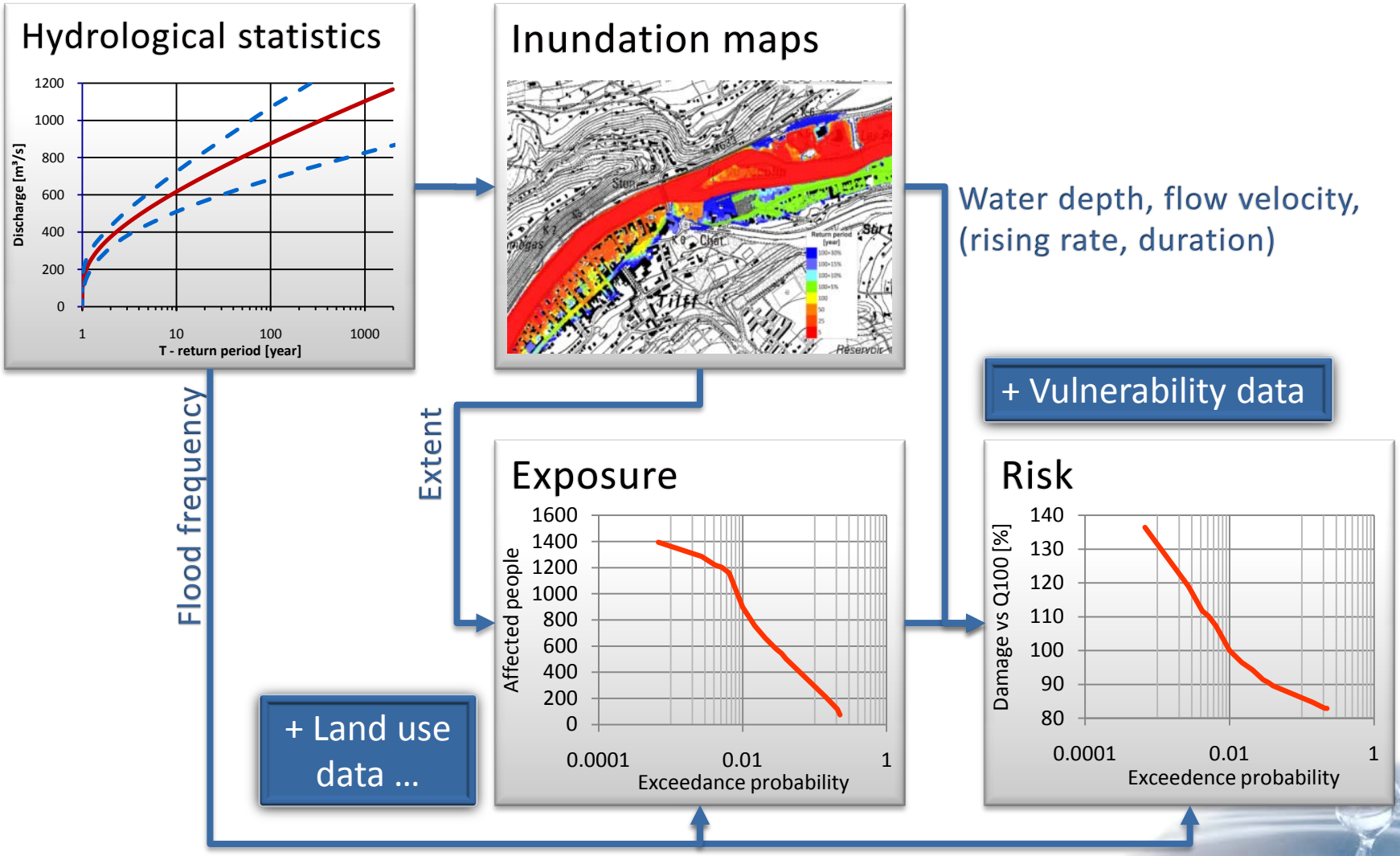
Mainly CORINE data



Course of river Meuse in Wallonia



Liege province



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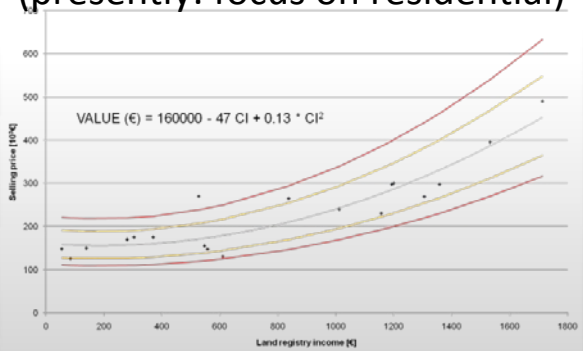
Cadastral income of **each** building

Building value correlation
(presently: focus on residential)



as a function of the cadastral income

Value of **each** asset

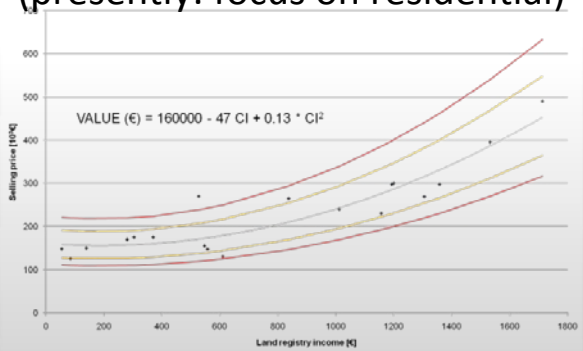
BELGIAN SCIENCE POLICY

ADAPT Project

► Need for better database and/or a better access to inventory with values of assets at risk

Cadastral income of **each** building

Building value correlation (presently: focus on residential)



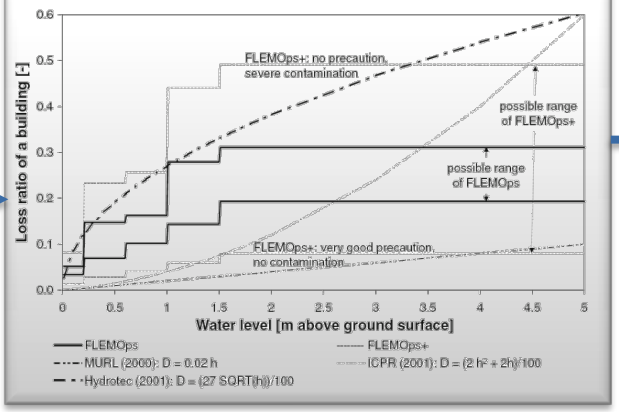
as a function of the cadastral income

Value of **each** asset

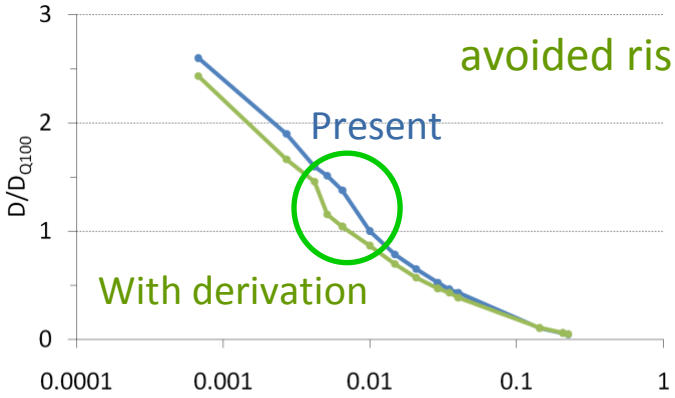
POTENTIAL DAMAGE (€)

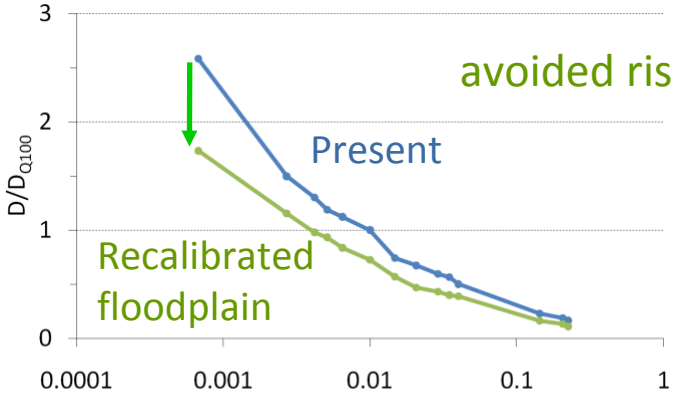
Relative damage

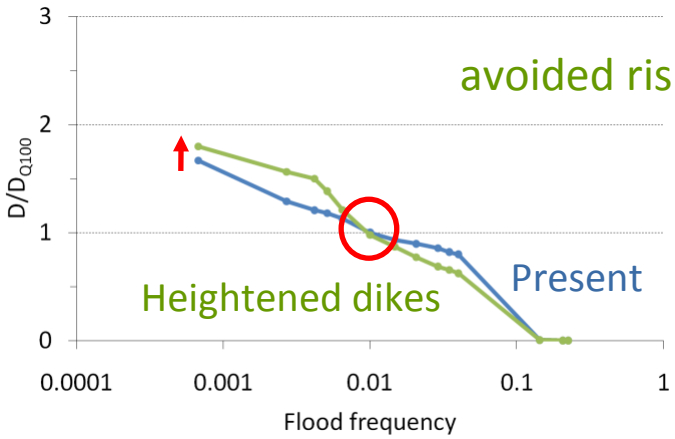
Damage function e.g. FLEMOps+



Water depth, velocity, (rising rate, duration)







"*A single number is not a big enough concept to communicate the idea of risk. It takes a whole curve*". Kaplan and Garrick (1981)

ON-GOING RESEARCH: AMICE PROJECT

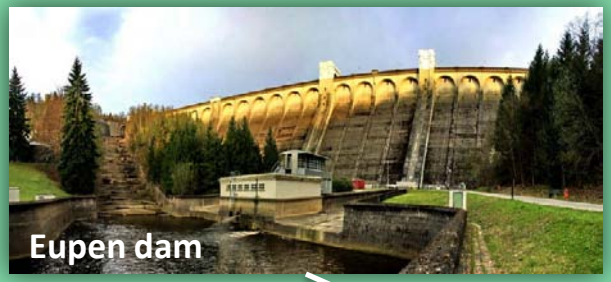
INTERREG IVB

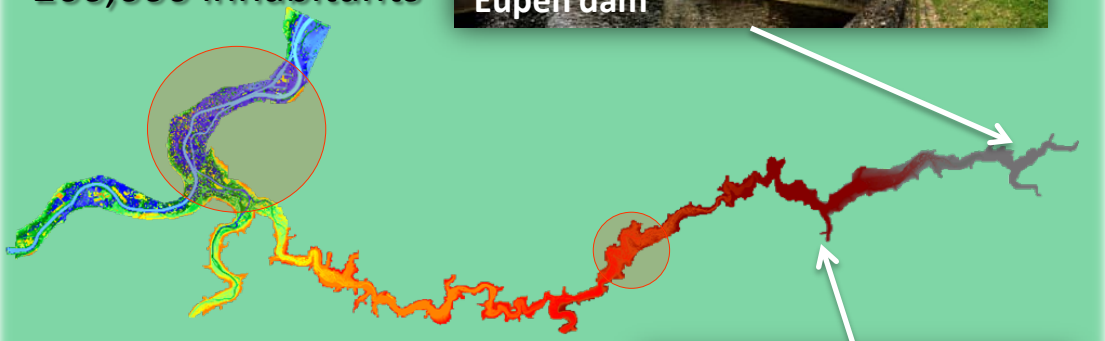
Micro-scale analysis

New operation rules for the Vesdre reservoirs

River length = 70km; catchment = 700 km²

Liège
200,000 inhabitants

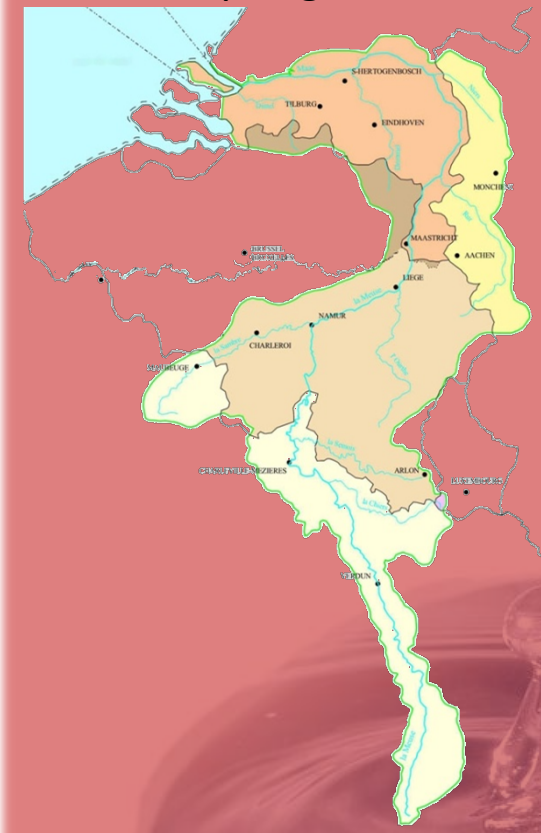




Verviers:
55,000 inhabitants

Meso-scale analysis

Flood risk analysis for the whole course of river Meuse, from spring to mouth



End-to-end flood risk analysis procedure embedded in our modelling system WOLF

Detailed 2D inundation modelling = genuine added value for understanding complex inundation processes and elaborate relevant protection strategies

Micro-scale analysis with consistency in data & model resolution throughout the procedure of hazard and vulnerability modelling

Flexible combination of micro- and meso-scale analyses depending on data availability and purpose of the study, *as well as social impact analysis (ADAPT project)*

For more details ...

see next issue of

Nat Hazards
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ORIGINAL PAPER

Micro-scale flood risk analysis based on detailed 2D hydraulic modelling and high resolution geographic data

Julien Ernst · Benjamin J. Dewals · Sylvain Detrembleur · Pierre Archambeau · Sébastien Erpicum · Michel Pirotton

Received: 15 June 2009 / Accepted: 10 March 2010

Abstract The paper presents a consistent micro-scale flood risk analysis procedure, relying on detailed 2D inundation modelling as well as on high resolution topographic and land use database. The flow model is based on the shallow-water equations, solved by means of a finite volume scheme on multi-block structured grids. Using highly accurate laser altimetry, the simulations are performed with a typical grid spacing of 2 m, which is fine enough to represent the flow at the scale of individual buildings. Consequently, the outcomes of hydraulic modelling constitute suitable inputs for the subsequent exposure analysis, performed at a micro-scale using detailed land use maps and geographic database. Eventually, the procedure incorporates social flood impact analysis and evaluation of direct economic damage to residential buildings. Besides detailing the characteristics and performance of the hydraulic model, the paper describes the flow of data within the overall flood risk analysis procedure and demonstrates its applicability by means of a case study, for which two different flood protection measures were evaluated.

Keywords Flood risk analysis · Micro-scale · Inundation modelling · Land use maps · Digital surface model · Finite volume

J. Ernst, B. J. Dewals have contributed equally to this article.

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