Flood Protections Design Based on Micro-scale Risk Modelling

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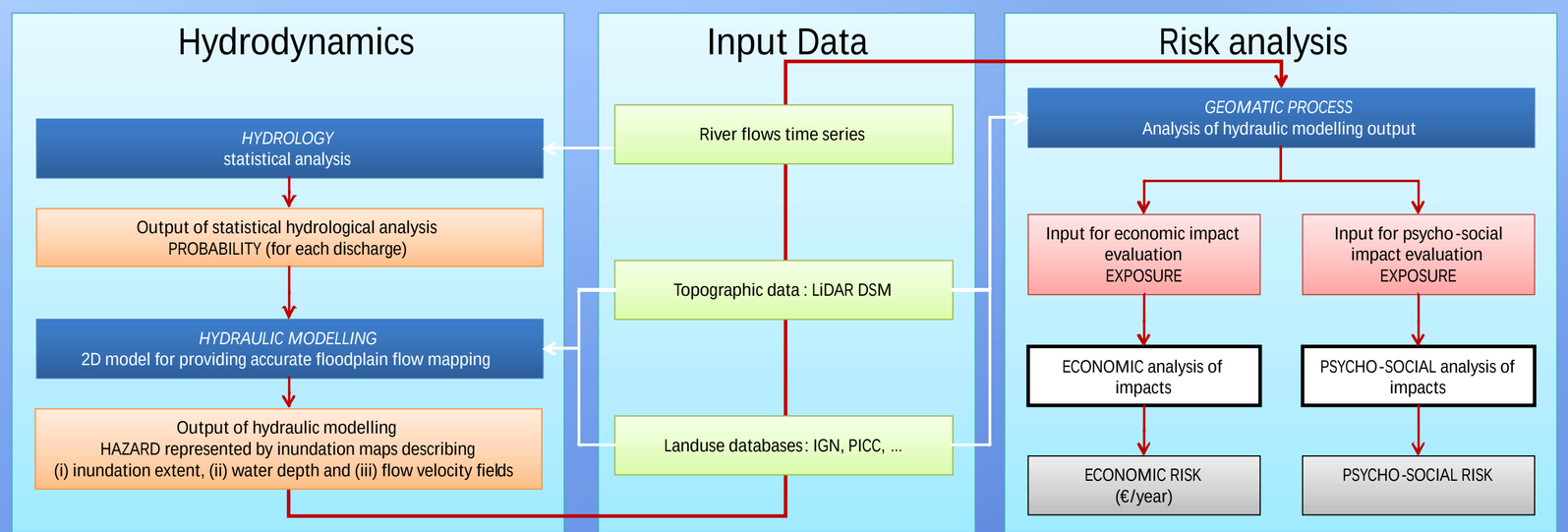
Methodology : General Flow Chart



WOLF : Model and Analyse a Flood...

This research is carried out within the framework of the development of the modelling system WOLF. Notably, it aims at developing flood damage evaluation methodology. For policy makers and river managers, this output is a very helpful supplementary information in relation to inundation maps (flood extent, water depth, and flow velocity).

WOLF has been developed for almost ten years at the University of Liege (HACH). WOLF includes a complete set of numerical models for simulating free surface flows.

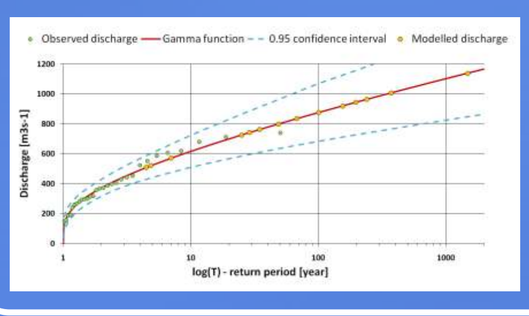
A user-friendly GIS interface makes the pre- and post-processing operations very convenient. Import and export operations are easily feasible from and to various classical GIS tools. Different layers of maps can be handled to analyse information related to topography, ground characteristics, vegetation density and hydrodynamic fields.

INPUTS

River Flow Time Series

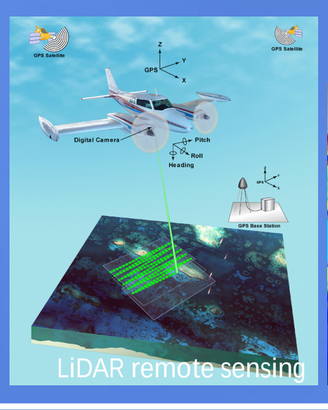
River flow times series are used at the beginning of the flow process.

From this rough data set, a statistical function is fitted (such as Gamma function) and the associated confidence intervals can be also computed. Then a probability can be worked out for each discharge value.

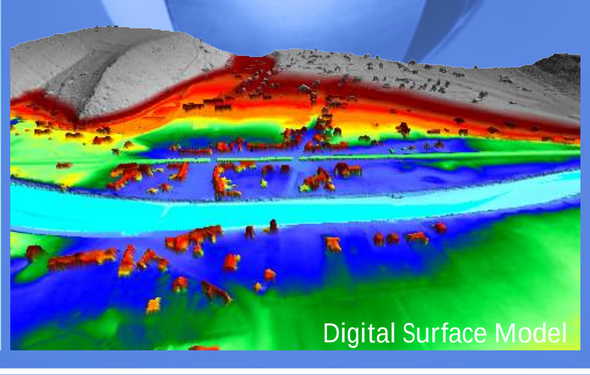


Topographic Data : LiDAR DSM

LiDAR (Light Detection and Ranging) is a remote sensing technology. Like the similar radar technology, which uses radio waves instead of light, the distance to an object is determined by measuring the time delay between transmission of the pulse and detection of the reflected signal.

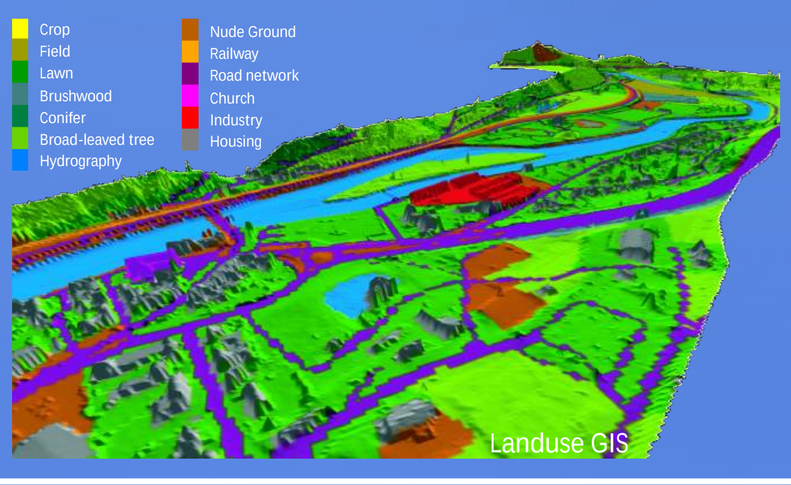


LiDAR remote sensing


Digital Surface Model

Land and Building Use Databases

GIS landuse information links hydrodynamic modelling to risk analysis process. Very accurate database is used in order to identify each asset, each building and complementary information such as type, postal adress, estimated value, etc.



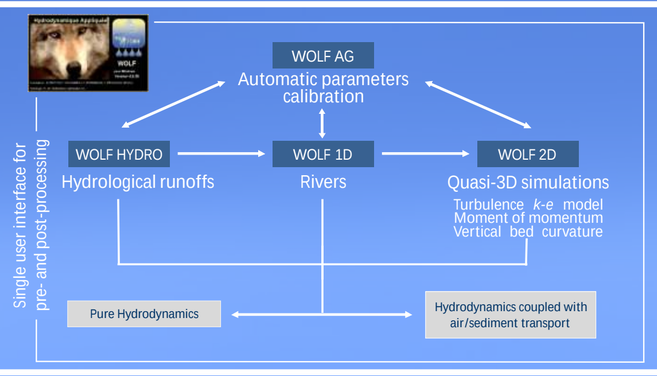
Landuse GIS

MODELS

HYDRAULIC MODELLING

WOLF modelling system:

- The 2D model is used in this study
- 2D fully dynamic
- Velocity field in the floodplain
- Complex topography such as urban area
- Modules are included into a single user interface



GEOMATIC PROCESS

Special features of the method:

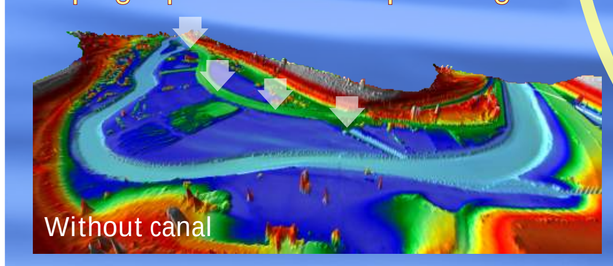
- Object oriented process (analysis of each asset)
- Run at the same scale than the hydraulic modelling : 2m
- Hydraulic model on a DSM leading to a pre-processing step of computing the water depth inside "over grounded" assets
- Economic estimation with FLEMO relative damage functions

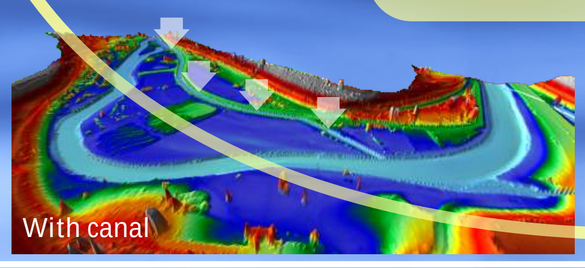
APPLICATION

Historical Survey

Former situation — Current situation

Topographic Model Updating


Without canal


With canal

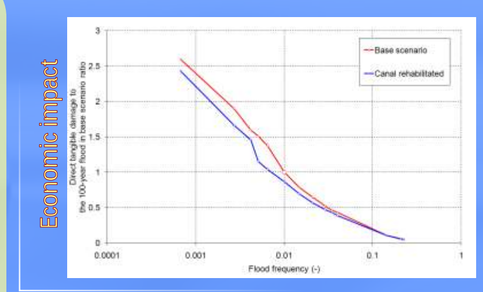
Flood Protection Measure Assessment :

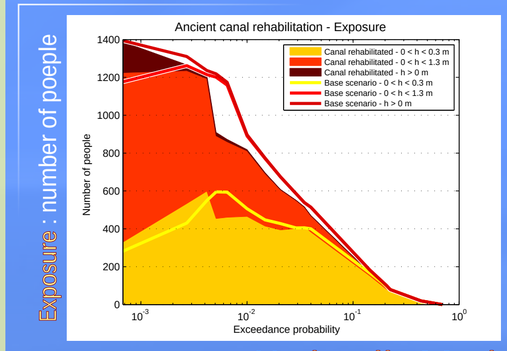
The measure consists in the rehabilitation of an ancient canal formely operated for inland navigation.

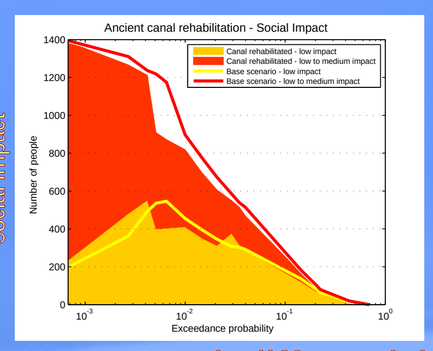
It intends to increase the discharge capacity of the river, and thus to induce a water level reduction upstream.

Historical survey has been carried out in order to determine the course and the cross section of the ancient canal on the current topographic model. Hydraulic modelling has been performed with the model WOLF2D and the whole risk analysis methodology has been applied.

Output of the Geomatic Process

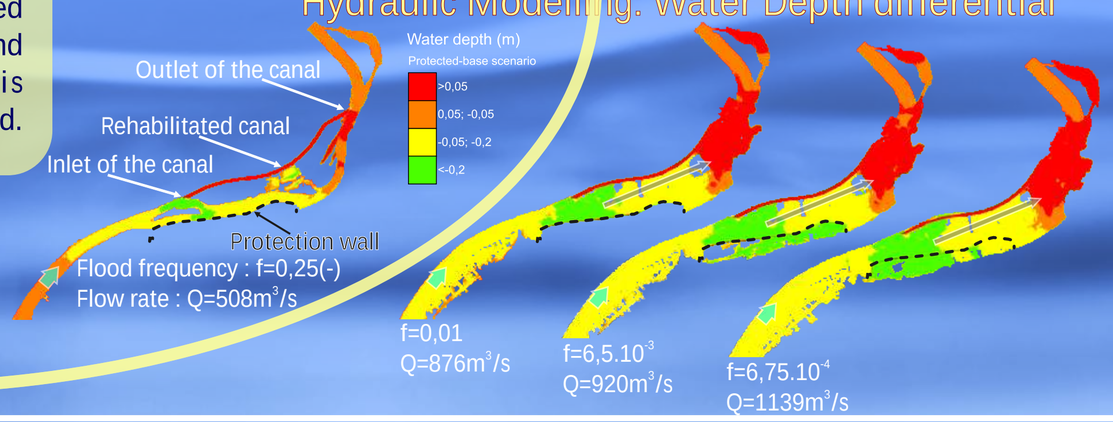






- Hazard shifted from a vulnerable area to a non-vulnerable one
- Increasing effectivness of an existing protection wall, design for a 100-year flood, to discharges slightly above a 200-year flood
- Annual avoided risk 40000€/year

Hydraulic Modelling: Water Depth differential



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