Detailed 2D hydrodynamic modelling as an onset for evaluating socio-economic impacts of floods

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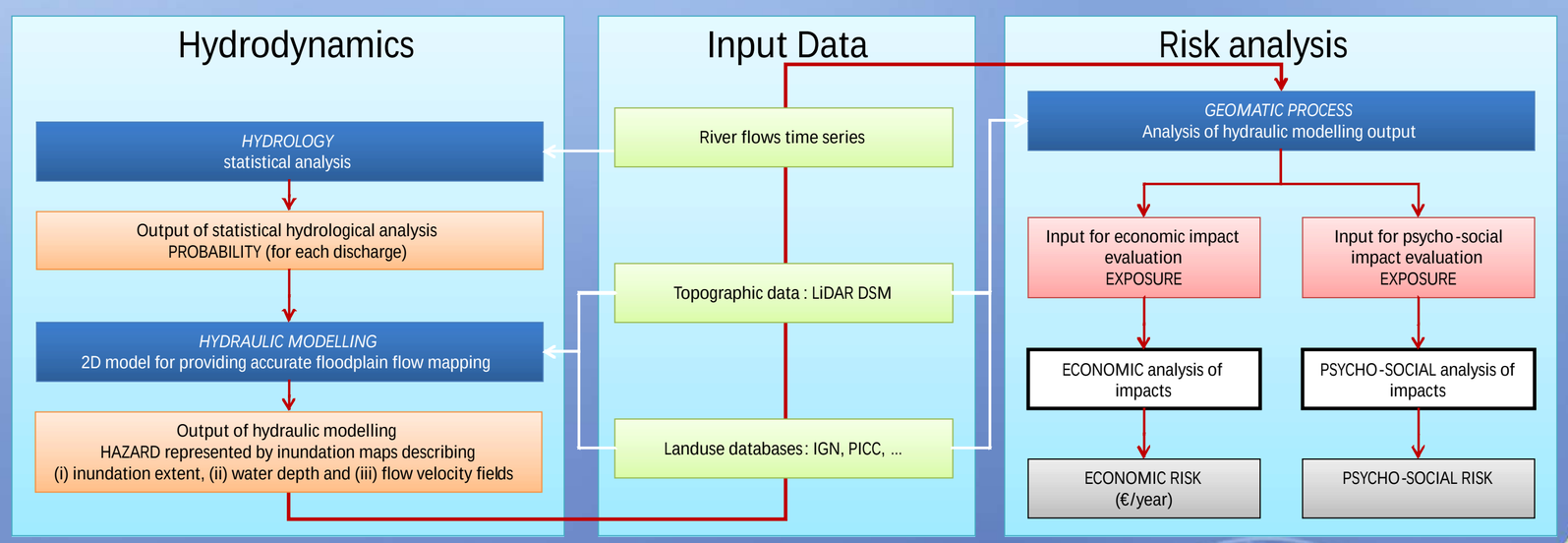
Methodology : general flow chart



WOLF : flood modelling and analysis tool...

The modelling system 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.

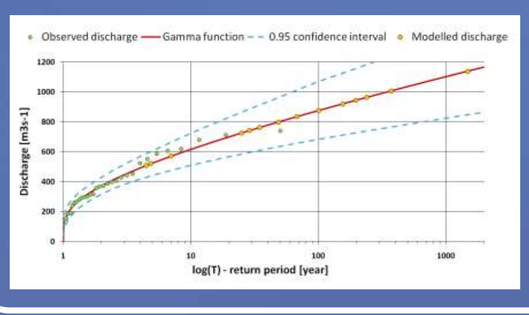
This research is carried out within the framework of the development of WOLF. Notably, it aims at developing flood damage evaluation methodology which is described in this paper. For policy makers or river managers, this information is as important as inundation maps (flood extent, water depth, and flow velocity).

INPUTS

River flow time series

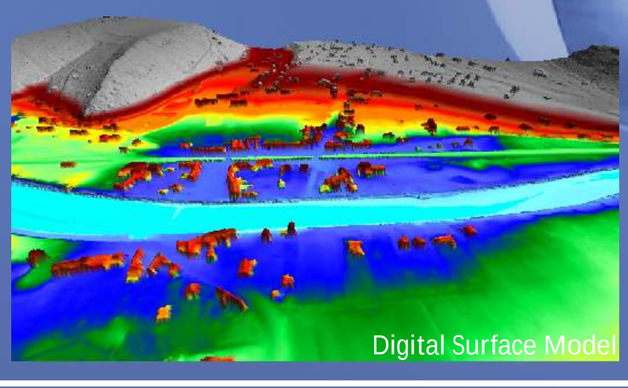
River flows times series are used at the beginning of the process of flood risk evaluation.

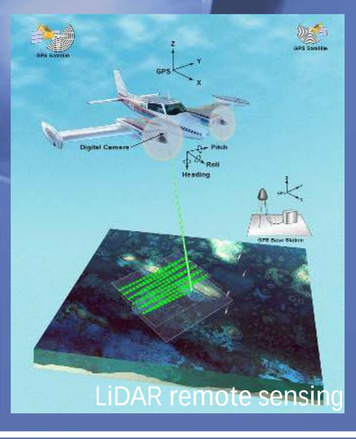
From this rough data set, a statistical function is fitted (such as Gamma function) and the associated confidence intervals can be also computed. Then a probability can be worked out for each discharge.



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.

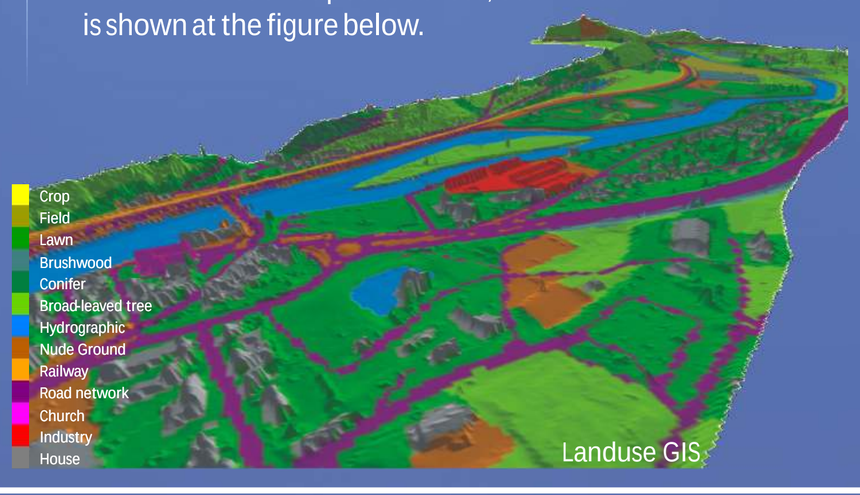

Digital Surface Model



LiDAR remote sensing

Land and building use databases

GIS landuse information links the hydrodynamic modelling with the risk analysis process. Very accurate database are used in order to identify each asset, each building, its use and other information such as postal adress, etc. A sketch of the data used is shown at the figure below.



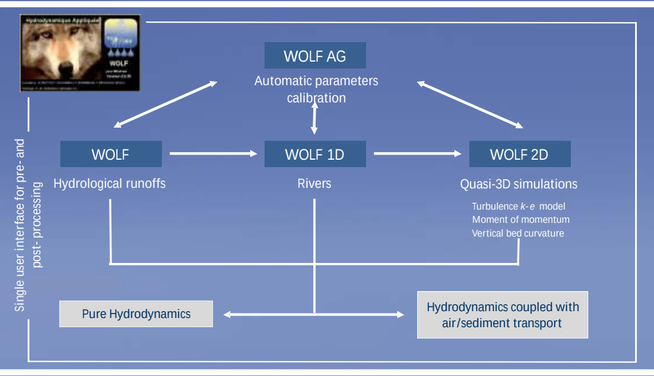
Landuse GIS

MODELS

HYDRAULIC MODELLING

WOLF modelling system:

- Only 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:

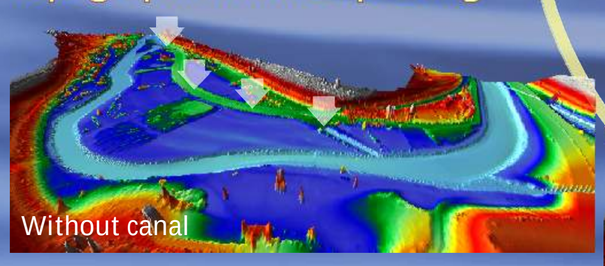
- Object oriented process (analyse of each asset)
- Run at the same scale as the hydraulic modelling : 2m
- Hydraulic model on a DSM leading to a pre-processing step of computing the water depth inside “over grounded” assets
- Economic estimation with FLEMO relative damage functions

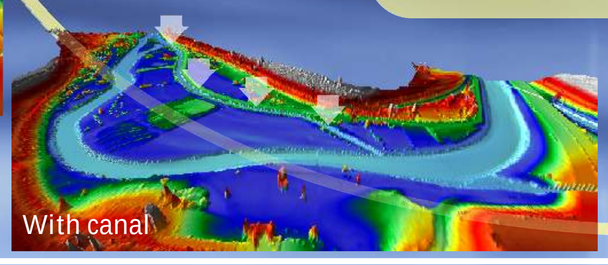
APPLICATION

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 inducing a reduction of the water level upstream.

Historical survey has been carried out in order to determine the course and the gauge of the ancient canal on the current topographic model.

The numerical simulations have been performed with the WOLF2D model ant the whole methodology has been applied on the inundation maps.

Input for economic impact evaluation
EXPOSURE

Input for psycho-social impact evaluation
EXPOSURE

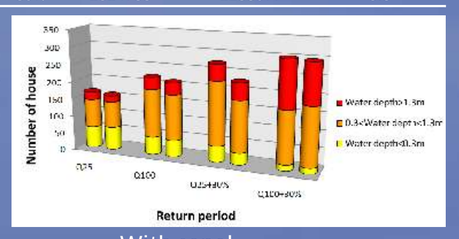
People affected by the flood for each social class

Output of the geomatic process

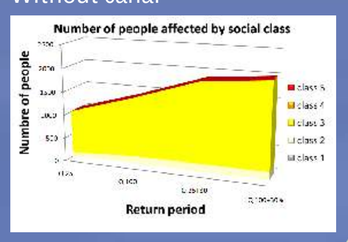
Economic losses estimation

Return period [year]	Actual Situtation [€]	Canal rehabilitated [€]	Saving in %
25	381024	352220	7.6
100	634519	591155	6.8
25 + 30%	867734	747062	13.9
100 + 30%	1314783	1238677	5.8

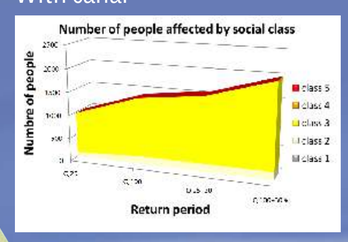
Building affected by the flood (respectively without and with the canal rehabilitated)



Without canal

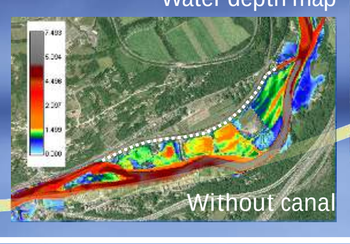


With canal

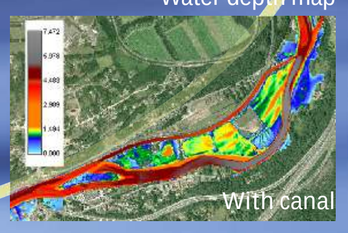


Hydraulic modelling : inundation maps

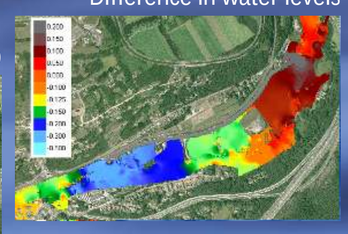
Water depth map


Without canal

Water depth map


With canal

Difference in water levels



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