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Mapping overland flow hazard in order to enhance citizens' awareness of head catchment hydrology

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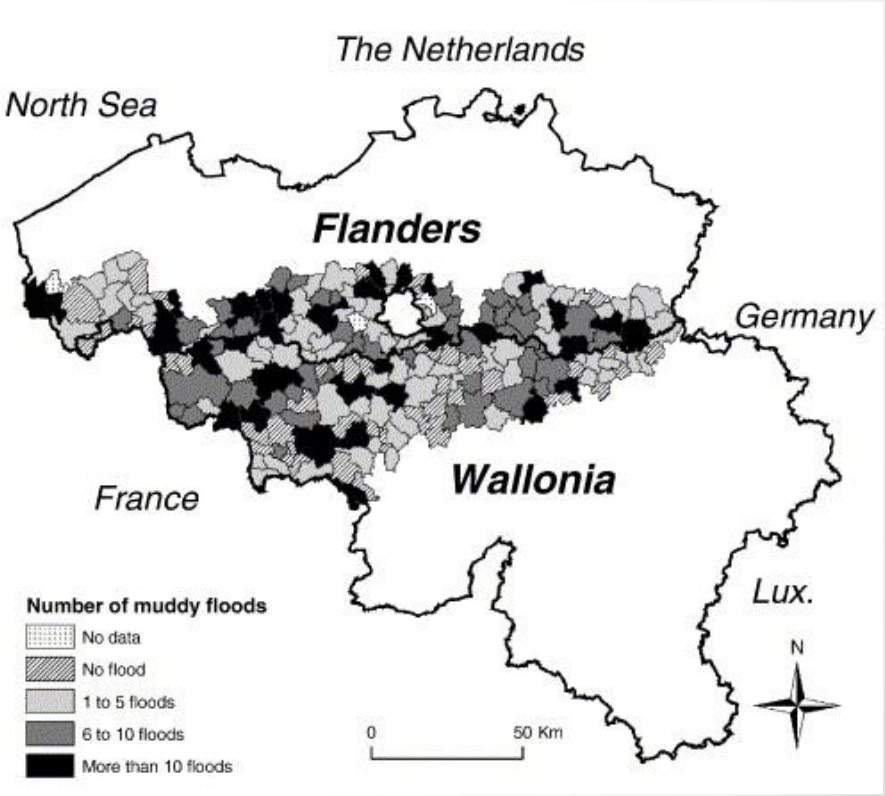
European context

- Between 1998 and 2004, Europe suffered from more than hundred major inundations,
  - 700 deaths,
  - the moving of about half a million of people
  - at least 25 billions Euros of economic losses covered by the insurance policies.
- ➔ 2007/60/CE directive
  - This directive aims at a better evaluation of the risks and a better coordination of prevention, protection and crisis management.
- In most countries, inundation maps ← rivers' overflowing

Belgian context

- The damages caused by muddy floods are higher than those caused by flooding of rivers.
  - The cleaning operations for a village after a storm can lead to an estimated cost of 11 000 €.
  - Loss of arable land.
  - physical and chemical alteration of rivers
  - psychological stress for people.



Frequency of muddy floods over a 10-year period in all municipalities of the study area; data for Wallonia (1991–2000) taken from Bielders et al. (2003), data for Flanders (1995–2004) derived from a questionnaire sent to all municipalities in 2005.

O. Evrard, C. Bielders, K. Vandaele, B. van Wesemael, Spatial and temporal variation of muddy floods in central Belgium, off-site impacts and potential control measures, CATENA, Volume 70, Issue 3, 1 August 2007, Pages 443-454, ISSN 0341-8162, 10.1016/j.catena.2006.11.011.

Belgium, Orp-Jauche
August 2011
Demarcin and Delheid

Troubling facts…

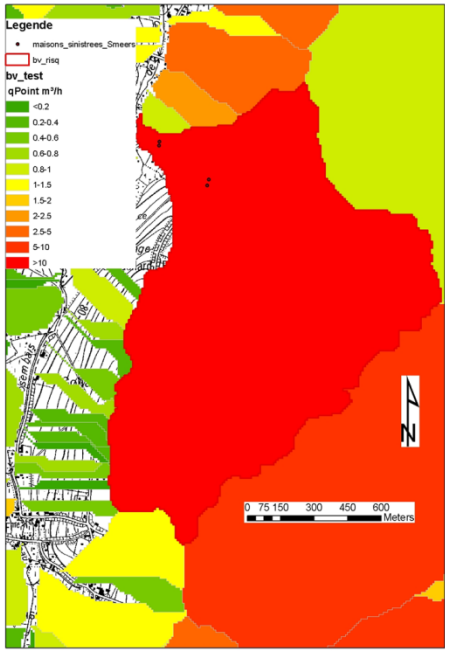
- The citizen's awareness is not sufficient
- To date, there is no building regulation in runoff inundation zones

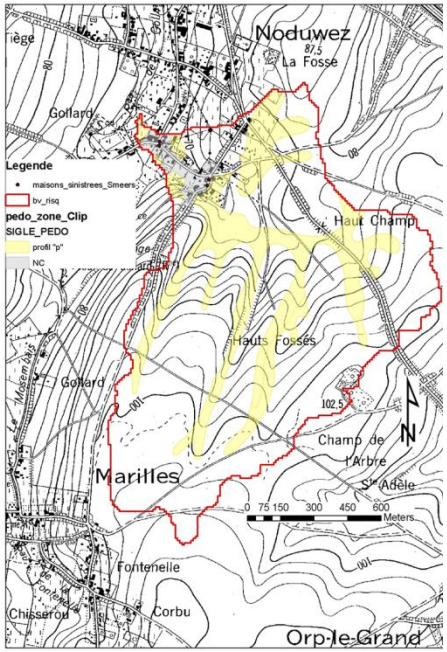
Objectives of the study

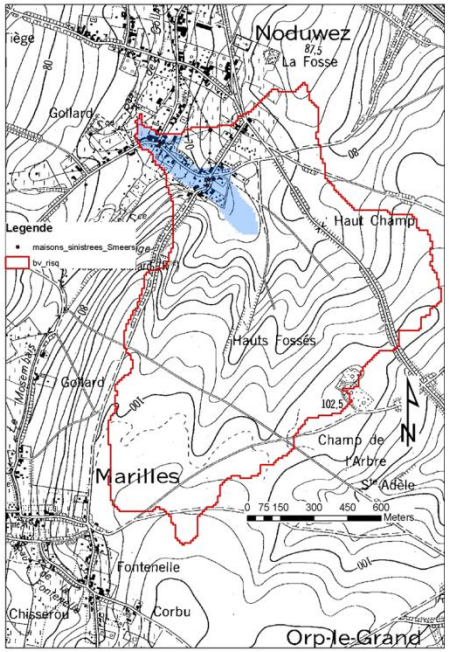
- In 2011 in Wallonia, political decision : "*overland flows and mudflows will be included in the flood hazard map*".
- Technical specifications
  - All the citizens "at the same level" ➔ use of data available on the whole region (17000 km²)
  - Maximal use of existing data
  - Minimising the zones affected by regulations
  - Regulations must lead to adapt the building project and not to forbid it
    - The land management plan fix the parcels' prices but doesn't take into account the natural risks. Therefore, a new hazard map is a loss of value for owners

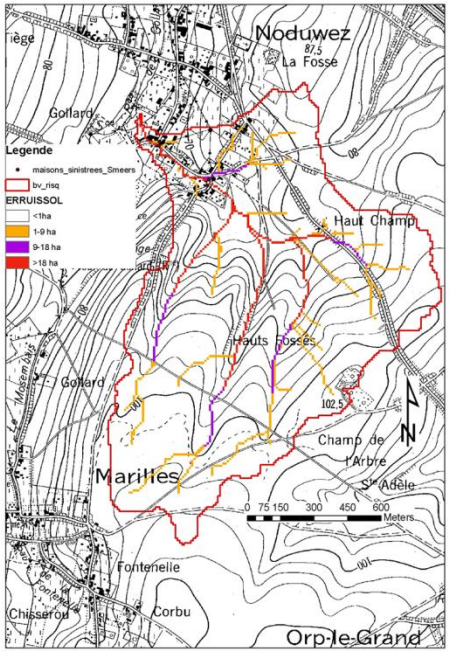
Mapping overland flow hasard

- Some methods were developped accross Europe, we tested their application in Wallonia



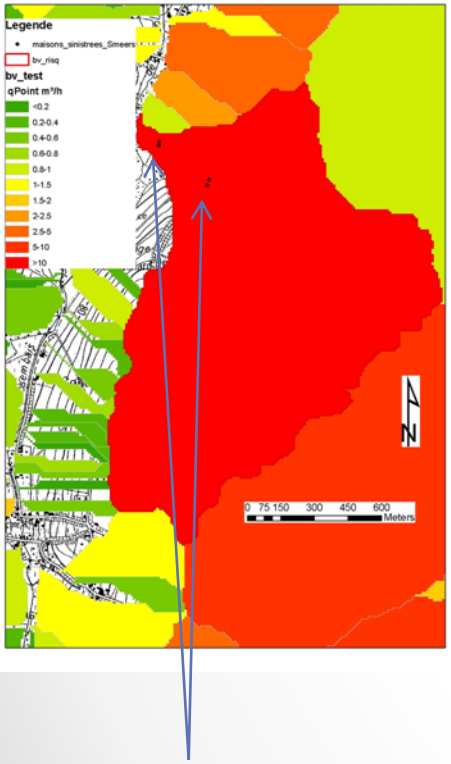






Example of a small catchment highly impacted in spring 2011

Example 1/3

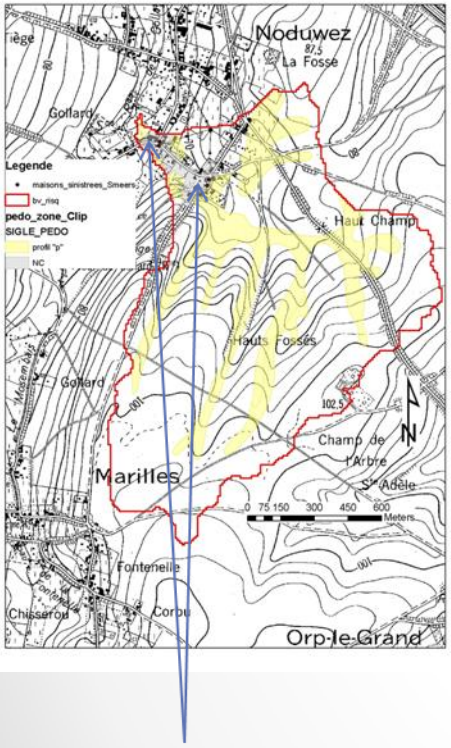


Houses flooded by runoff and mudflow

- Technic derived from a study in the Arno river catchment
- Includes
  - Concentration time
  - return period of a given intense rainfall

➔ the whole subcatchment is set « at risk »

Example 2/3



Houses flooded by runoff and mudflow

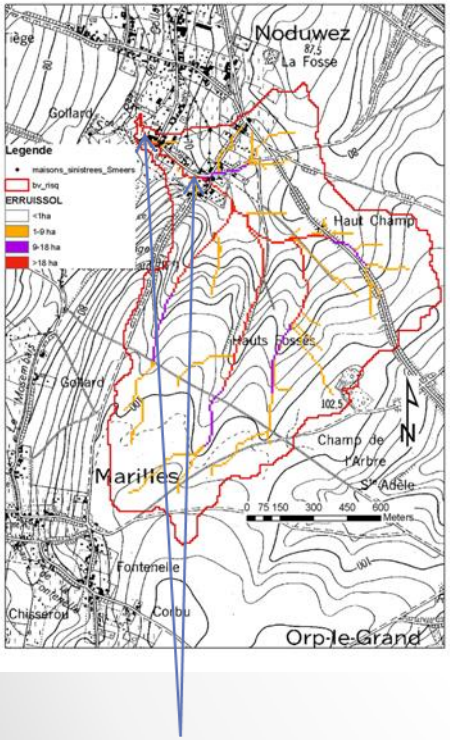
- Use of the colluvial soils (belgian soil map)
- Includes
  - Zones where colluvial and alluvial soils were identified

➔ Data not available in urbanised zones

Example 3/3

- Accumulation flow
- Includes
  - DEM

➔ No difference between soils, land use, concentration time….



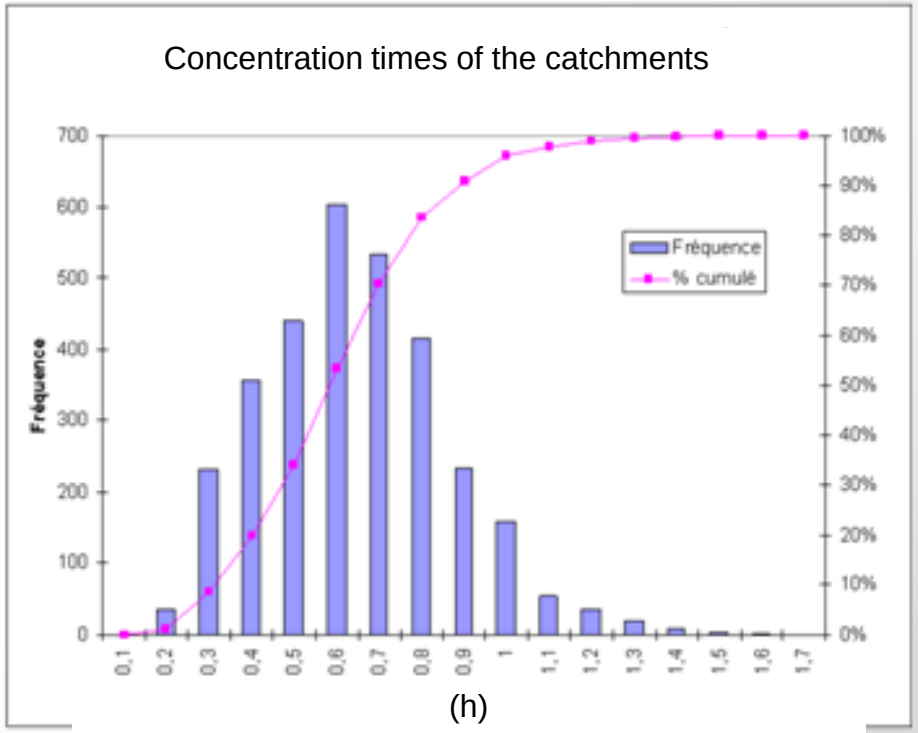
Houses flooded by runoff and mudflow

Method proposed

- Available data
  - Spatially distributed rainfall statistics
  - DTM (1/10'000)
  - Soil map (1/20'000)
  - Landuse map (1/10'000)
- lacking data
  - Small hydraulic infrastructures

Method proposed

- Pragmatic analysis
  - Automatic extraction of dry watersheds
  - the outlets are considered as the points where runoff inters the permanent river network
  - Rainfall : T 25, 50 and 100 years (statistics available for each city), duration 1 h
  - Land use -> following landuse map except in agricultural zones where soil are considered as bare.
  - CN calculation of runoff production
  - Unit hydrograph transfer to outlet
  - Extraction of **peak flow value**



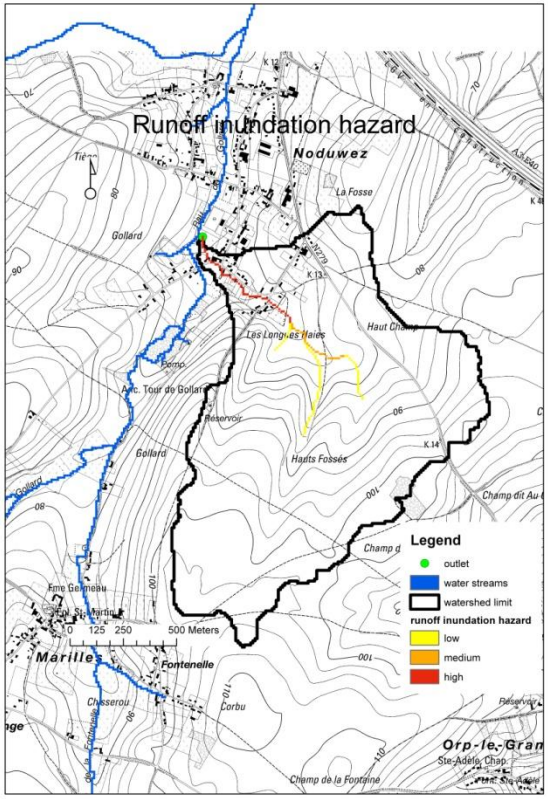
Method proposed

- Peak flow value is then distributed in the watershed proportionnaly to the flow accumulation of each pixel (10X10m resolution)

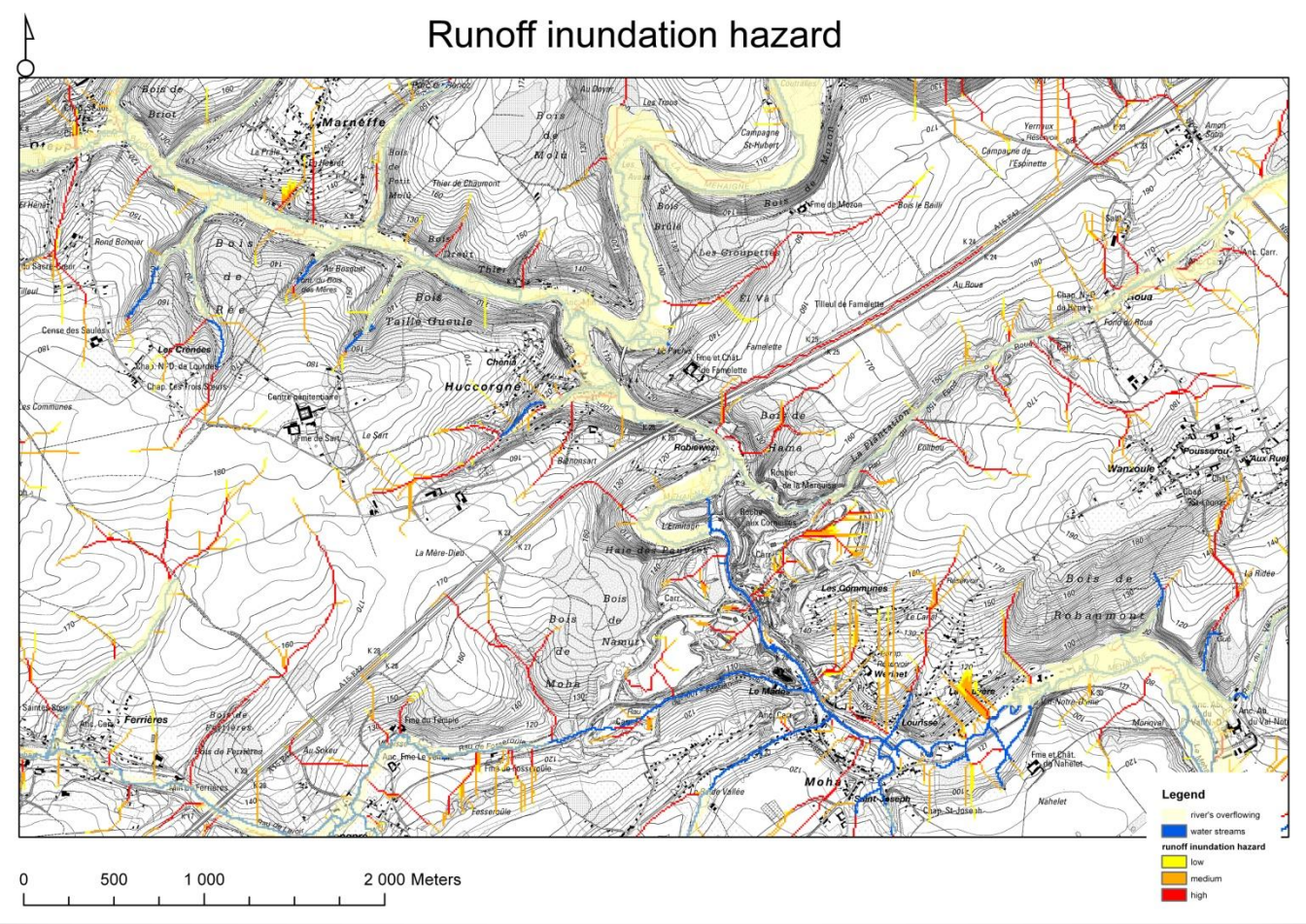
$$Qpp=(Qp*Sp)/(Sbv)$$

Qpp : peak value of a pixel
Qp : peak value at the outlet
Sbv : watershed area
Sp : flow accumulation of the pixel

- Then, the discharge values are classified = political decision
-



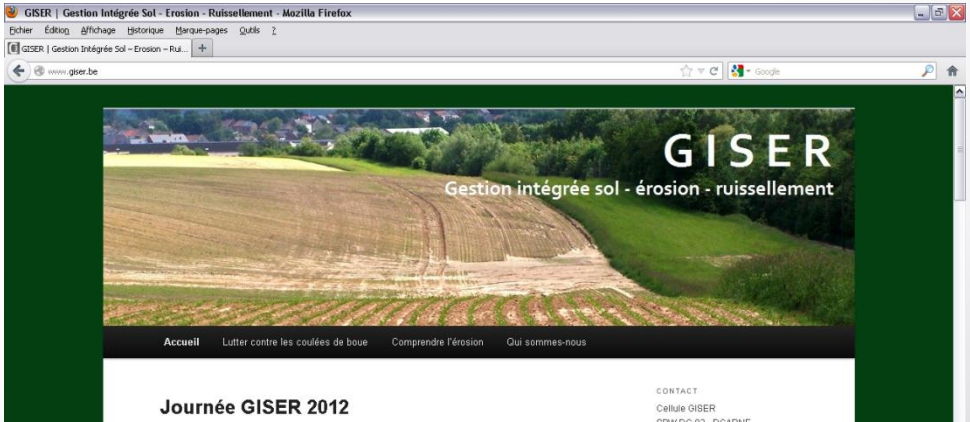
Combination with existing flooding map



Use of the map

- New building permit
  - Within 20 meters of a runoff axis, applicant will have to require an advice from the land management administration
  - He/She will have to check the project and, if necessary, recommand measures to limit the vulnerability of the new building.

- Existing building
  - In case of flooding, technical advisers will propose mitigation measures in the watershed as well as at the building's level
  - (specialised team of 4 people started in 2011) www.giser.be



Advantages and drawbacks

- ✓ The runoff and muddy floods hazards are mapped
- ✓ New buildings projects will have to take that into account

- ✘ Location on the runoff axis is based on a 10*10m DTM
- ✘ Small hydraulics are not known at the regional scale
- ✘ Existing houses remain unprotected

  - This is only a first attempt to deal with this particular phenomenon
  - An human analysis remains essential but only on limited zones identified to be at risk

Thank you

Founded by SPW

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