Presentation of a surface runoff susceptibility mapping method and test on the Lézarde catchment (Paris Basin, France)

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1 Contexte

2 Challenge

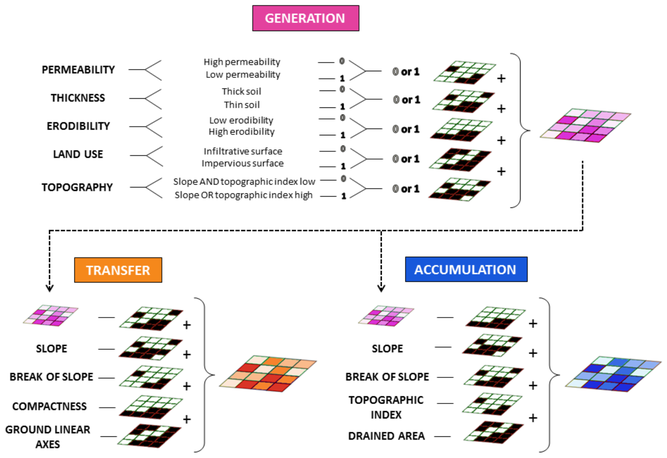
Intense surface runoff occurs quickly and is difficult to measure on large territories, only limited observations are available

→ How to better know and understand the surface runoff hazard?

→ How to evaluate the relevance of the hazard representation method?

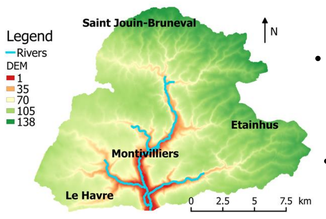
3 The IRIP method

« Indicator of Intense Pluvial Runoff » (French acronym)



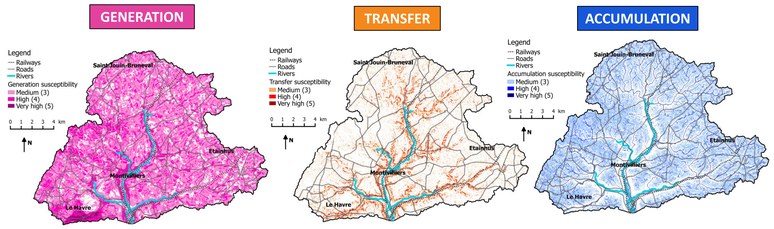
Provides 3 susceptibility maps of 3 surface runoff stages
1/ generation 2/ transfer 3/ accumulation
Susceptibility levels ranging from 0 to 5

4 The study area



- 210 km²
- Large plateaux/ narrow valleys
- Short permanent river network/ dense talweg network
- Silt and clay with flint stones
- Oceanic climate

5 Application of IRIP



Global high generation susceptibility (levels 3 & 4) and locally very high for urban areas (5)

Very high transfer susceptibility on the valley sides and low susceptibility on the plateaux

Very high accumulation susceptibility in the talwegs and the rivers and low susceptibility on the valley sides

6 Evaluation method

1. Use of proxy data

- Two risk regulatory zoning maps for surface runoff flooding and soil erosion
- Geolocalized impacts of surface runoff on roads and railway sections

2. Contingency table

		Observed event: Yes	Observed event: No
IRIP Forecast	Yes	True positives (T+)	False positives (F+)
	No	False negatives (F-)	True negatives (T-)

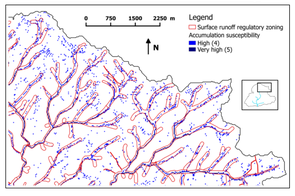
3. Related correspondance indicators:

- Success ratio (SR) = $\frac{(T+)}{(T+)+(F+)}$
- Probability of detection (POD) = $\frac{(T+)}{(T+)+(F-)}$
- False alarm ratio (FAR) = $\frac{(F+)}{(T+)+(F+)}$

Indicators ranging from 0 to 1
SR + FAR = 1

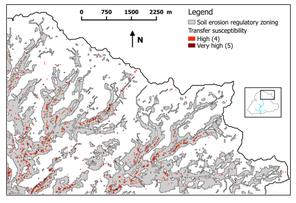
7 Are the IRIP maps relevant?

1. Surface runoff zoning



- **Success ratio of 0.91** using a 50 meters buffer area aroud the regulatory zoning and considering pixels with an IRIP susceptibility level of 5
- 0.82 using a 25m buffer; 0.64 without buffer

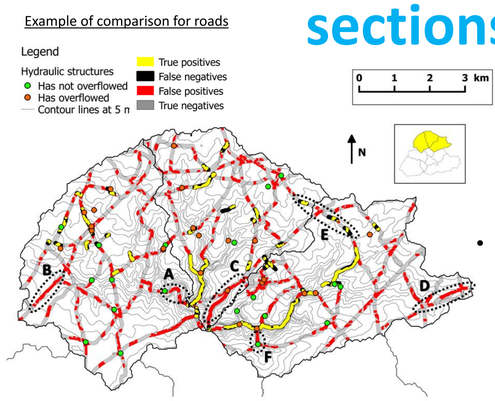
2. Soil erosion zoning



- **Success ratio of 0.92** using a 50 meters buffer area aroud the regulatory zoning and considering pixels with an IRIP susceptibility level of 4 and 5
- 0.89 using a 25 m buffer; 0.72 without buffer

8 Are the IRIP maps able to detect impacted network sections?

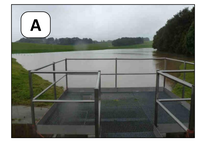
Example of comparison for roads



	Roads	Railways
Probability of detection	**0.73**	**0.80**
False alarm ratio	**0.77**	**0.92**

With respect to a buffer area of 25 meters both sides of the network - Not taking into account isolated pixels

- Promising probabilities of detection
- False alarm ratios should be reduced considering hydraulic protective structures and the vulnerability of road and railway infrastructures



Hydraulic structures protect the network from floodwater

Drainage ditches can protect roads and not all of them are referenced

DEM coarse resolution does not detect that the road is elevated regarding the nearby field and thus protected

Roads cutting talwegs transversally can be flooded over a spread section whereas IRIP only detects the intersection point

Photo credits: Google Street View

9 Origins of discrepancies

The evaluation method

- Standard verification indicators only assess a small part of the IRIP information
- Indirect relationship between susceptibility maps and surface runoff impacts: Rainfall patterns, exposure and vulnerability

The comparison data

- Exhaustiveness
- Representativeness
- Biases in measuring and collecting the data
- Location accuracy

The IRIP method

- Input data accuracy
- Indicator combination and computation method
- The IRIP "yes" forecast thresholded at ≥ 4
- Presence of natural sinkhole not taken into account

10 Conclusion

- IRIP, a simple and robust method to a have global view of the susceptibility of territories to intense surface runoff hazards.
- Vulnerability of the transportation network to surface runoff must be characterized to better assess sections the most susceptible to be impacted.