



6th May 2020

**Nabil HOCINI¹,
Olivier PAYRASTRE¹,
Eric GAUME¹,
François BOURGIN²,
Philippe DAVY³,
Dimitri LAGUE³,
Frédéric PONS⁴,
Léa POINSIGNON⁴**

Evaluation of several automated inundation-mapping methods in a flash-flood context

¹ GERS-LEE, Univ Gustave Eiffel,
IFSTTAR, F-44344 Bouguenais, France

² University Paris-Saclay, INRAE, UR
HYCAR, Antony, France

³ Géosciences Rennes, 35042 Rennes,
France

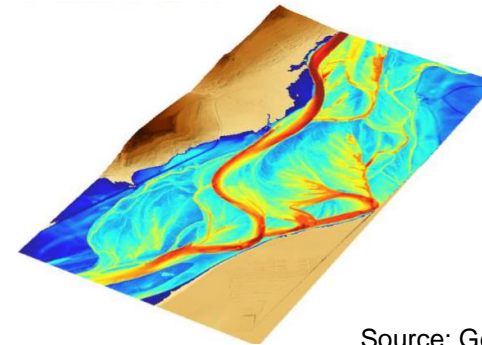
⁴ Cerema Méditerranée, 13290 Aix-en-
Provence, France

Experimentation of flood mapping approaches in a flash-flood context:

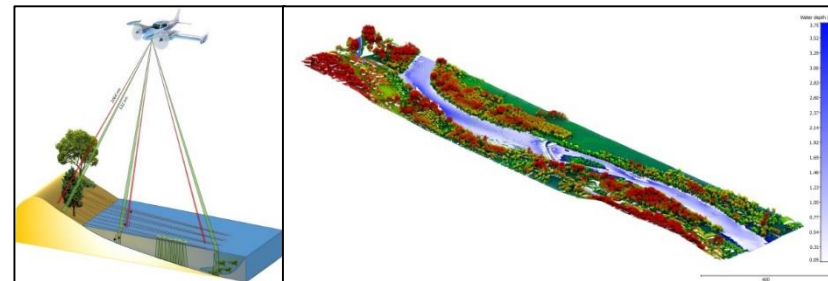
- Small rivers with limited terrain input data:
 - high resolution DTMs (5m or 1m resolution) but no bathymetry
- Large river network to be covered at regional scales:
 - high automatisisation level, no model calibration, computation time should be limited
- Integration in real time forecasting chains should be possible: catalogs of scenarios

Questions adressed here:

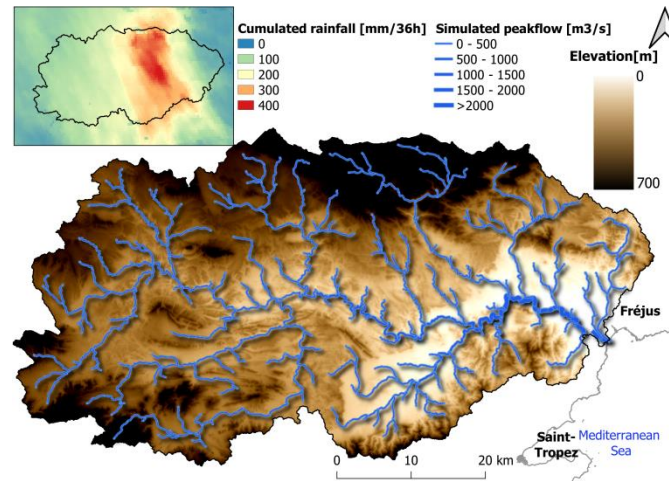
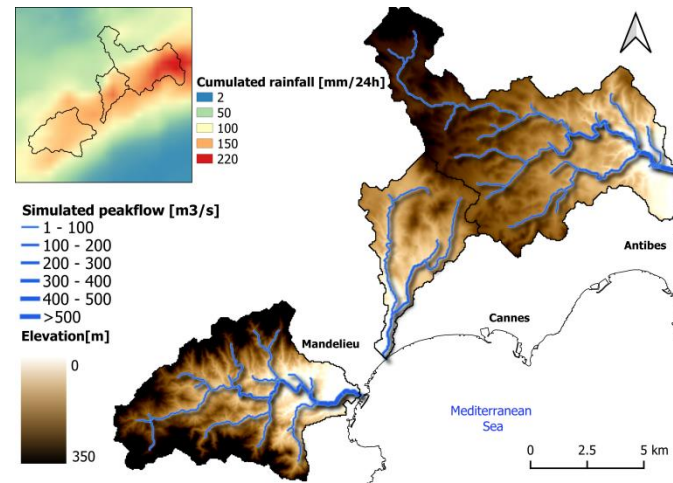
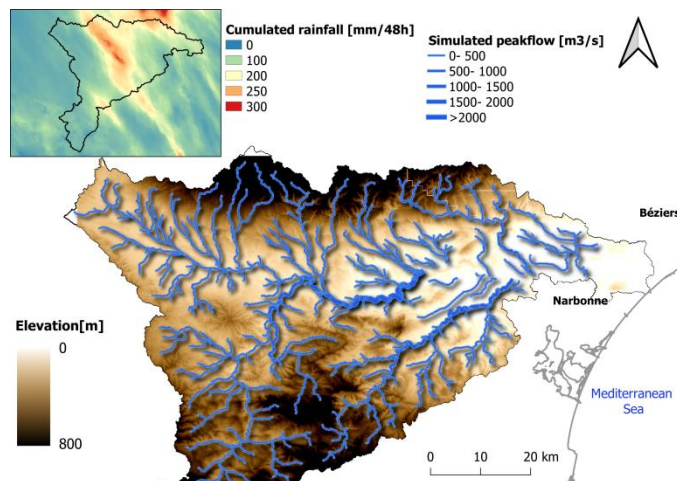
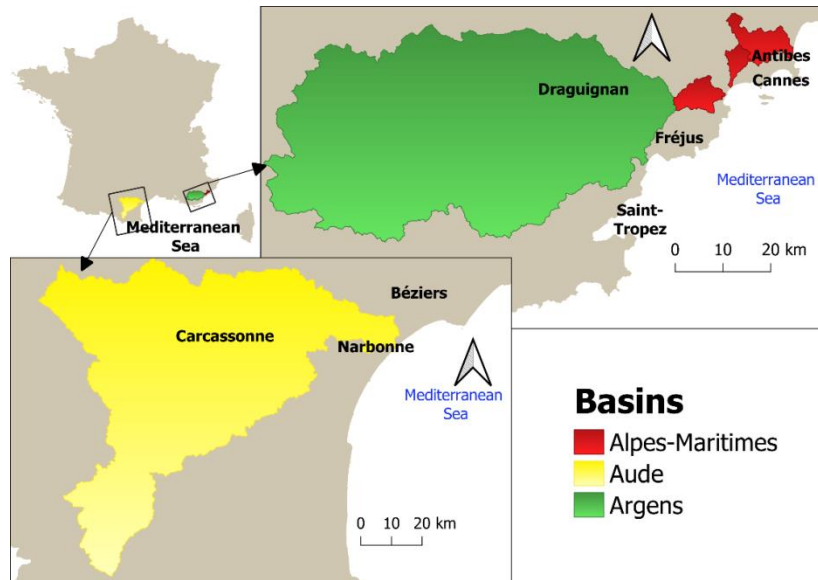
- Performances of automated hydraulic approaches ?
- Identification of main uncertainty sources:
 - DTM resolution and quality (Lidar, ..)
 - No bathymetry
 - Absence of calibration
 - ..



Source: Geosciences



Presentation of case studies



French Riviera, 3rd of October 2015

- 20 deaths,
- 600 million € of direct damage,
- 131 km of rivers simulated
- > 500 high water marks

Argens watershed, 15th of June 2010

- 25 deaths,
- 1 billion € of economic damage,
- 585 km of rivers simulated
- observed limits of the flood area
- high water marks

Aude watershed, 15th of October 2018

- 15 deaths, 1 billion € of economic damage,
- 569 km of rivers simulated
- observed limits of the flood area
- high water marks

3 flood mapping approaches applied

Hand/Manning-Strickler:

Simplified inundation mapping approach based on a HAND raster (height above nearest drainage). (Liu et al., 2016; Reholo et al., 2018)

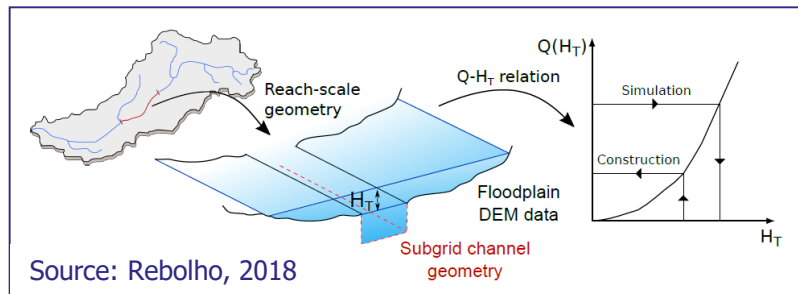
caRtino:

Automated extraction of river cross-sectional profiles from the DTM to run 1D hydraulic models: (Pons et al., 2014)

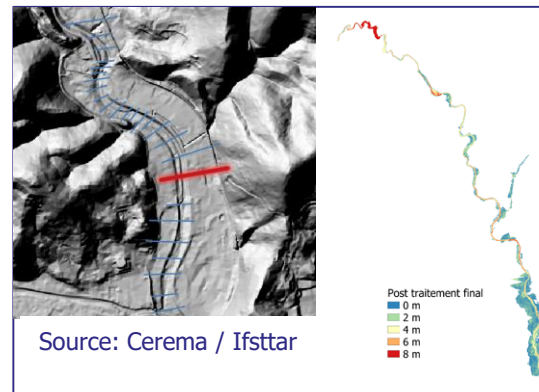
Floodos:

Implementation of the 2D Floodos model (Davy et al., 2017)

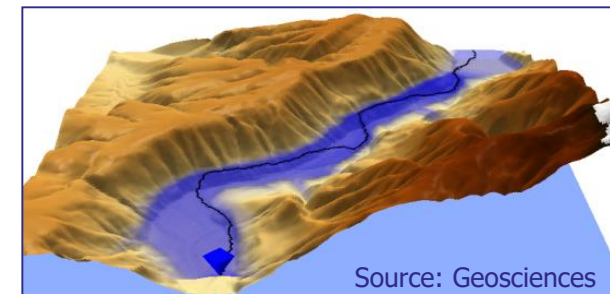
HAND + Man. Strickl.



Cartino: 1D St Venant



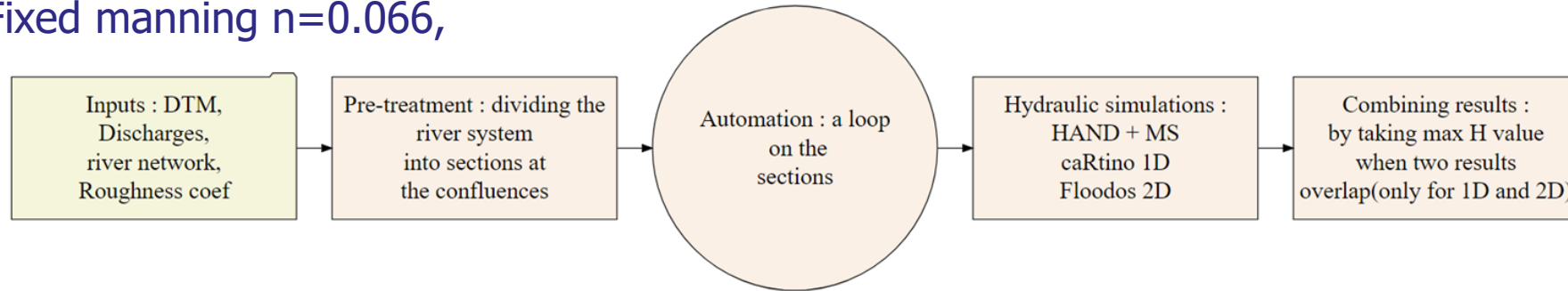
Floodos: 2D St Venant



Evaluation framework

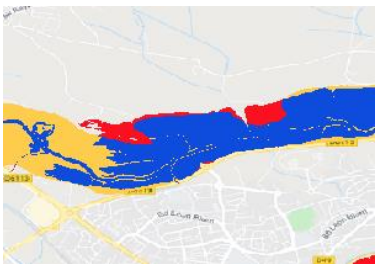
Common flood mapping workflow:

- Estimation of peak discharges on the river network (rainfall-runoff model calibrated on observations)
- Hydraulic computation in steady state regime on each branch of the river network,
- Fixed manning $n=0.066$,



Evaluation:

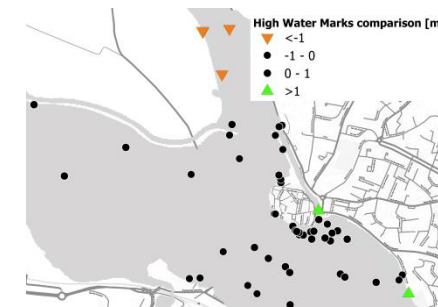
Comparison with actual observed flood extent



		Reference	
		Flooded	Dry
Simulated	Flooded	Hits {a}	False alarm {b}
	Dry	Misses {c}	Correct negative {d}

Critical success index $CSI = \frac{a}{a + b + c}$

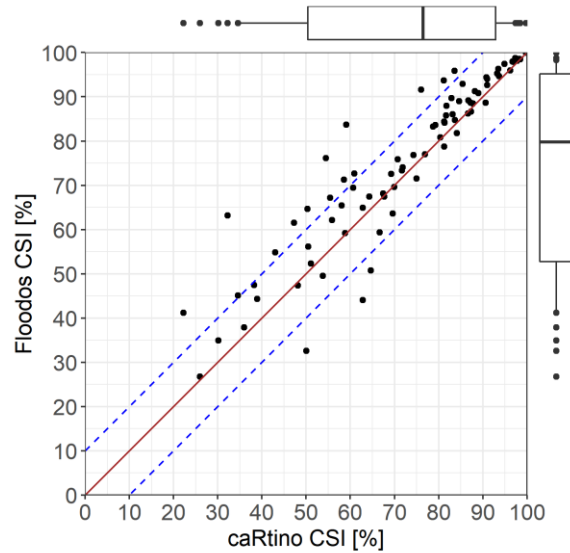
Comparison with high water marks



Simulated surface – high water marks elevations

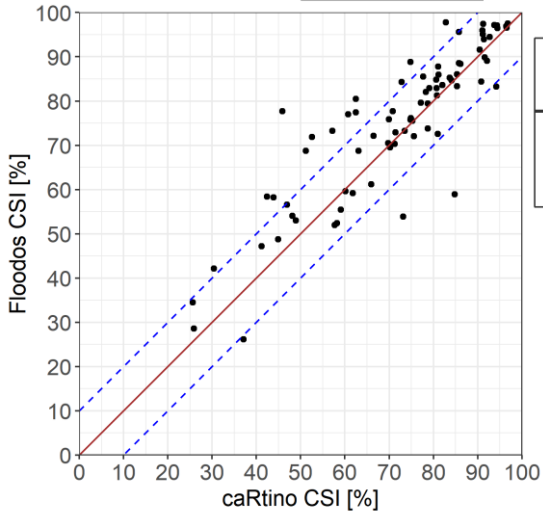
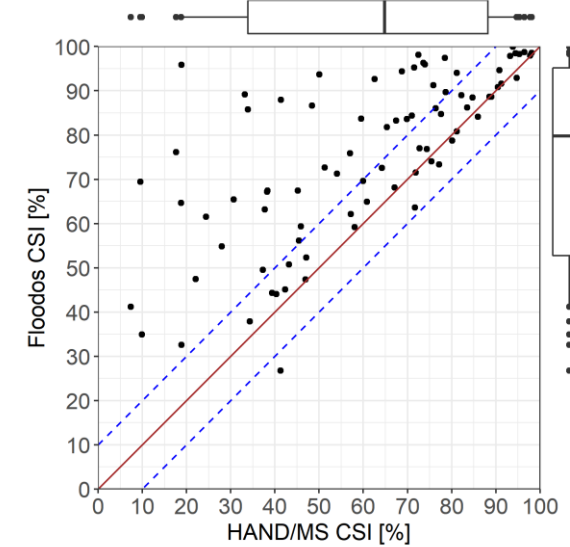
Results (1): critical success index

caRtino vs Floodos

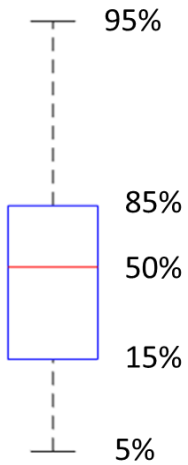
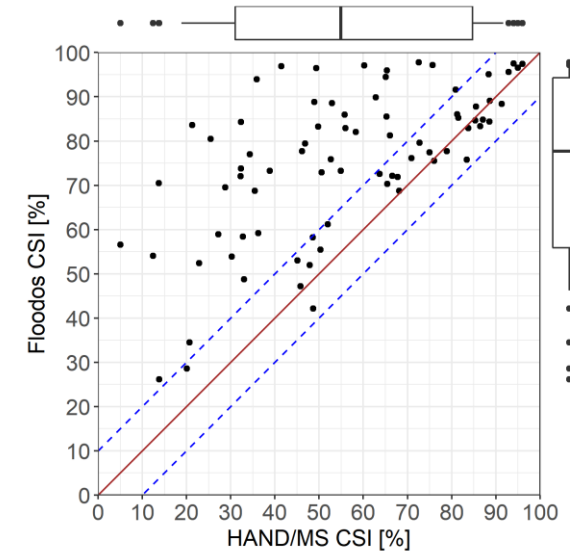


Argens 2010

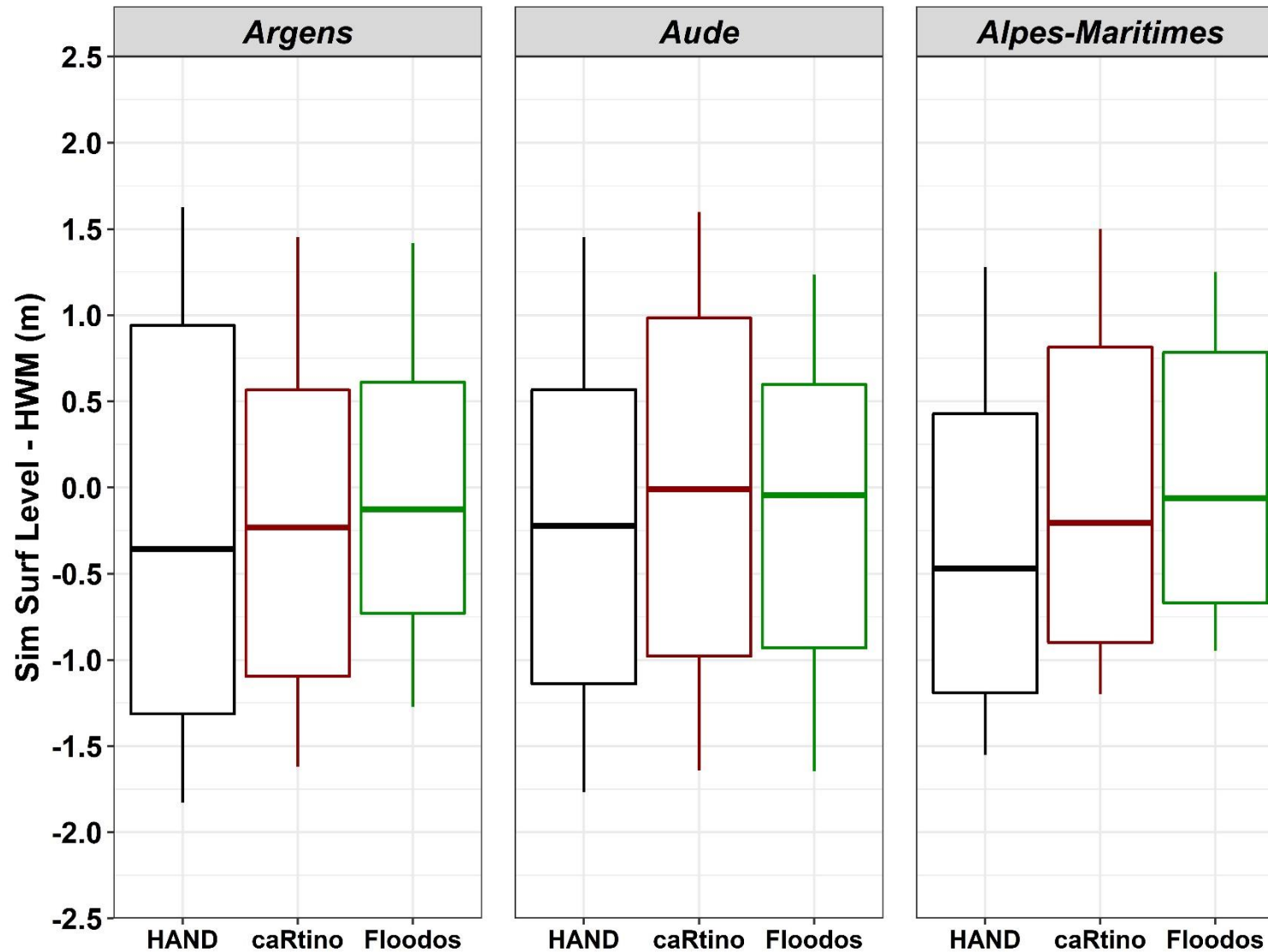
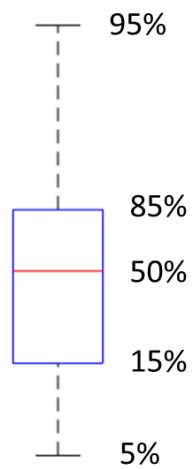
HAND/MS vs Floodos



Aude 2018



Results (2): water surface levels



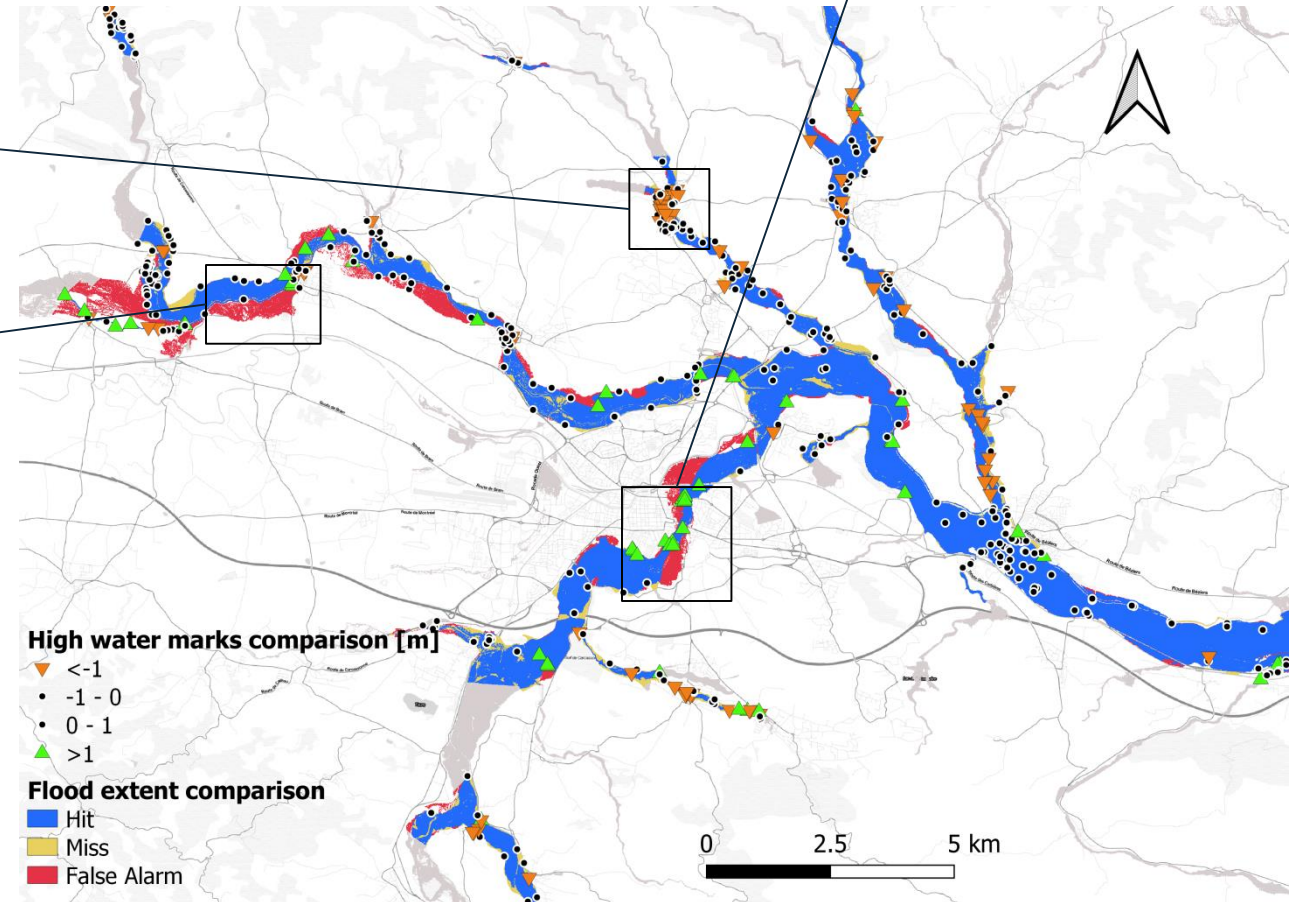
Results (3): main error sources

Examples of clusters of large errors
(exceeding 1m on water level)

Absence of bathymetry in the DTM

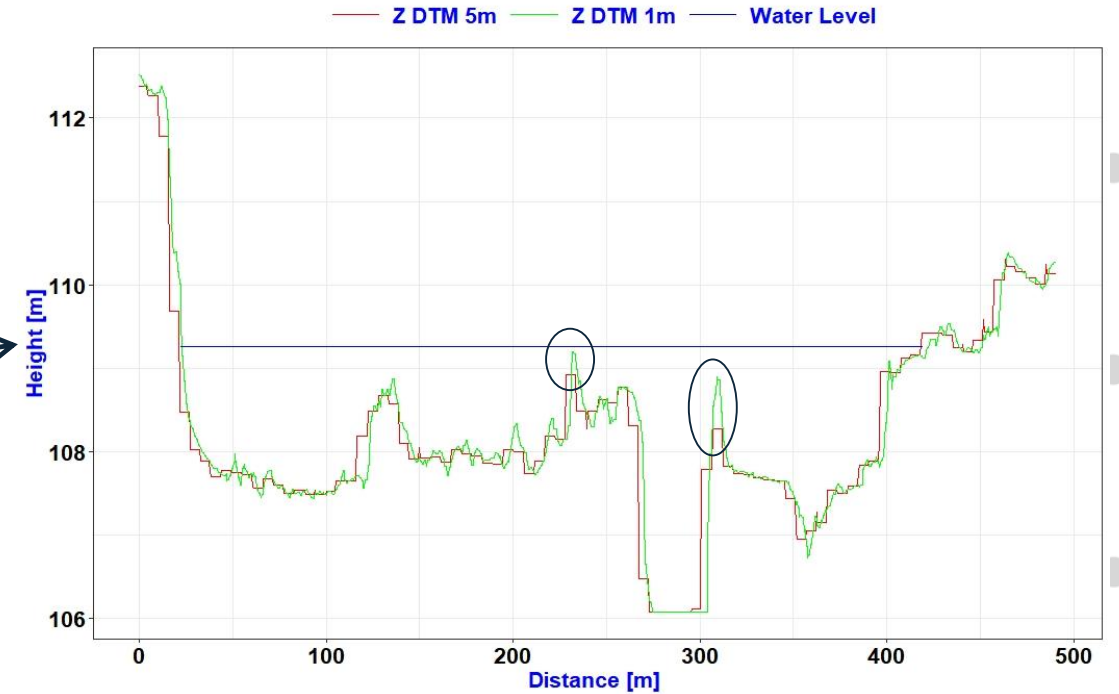
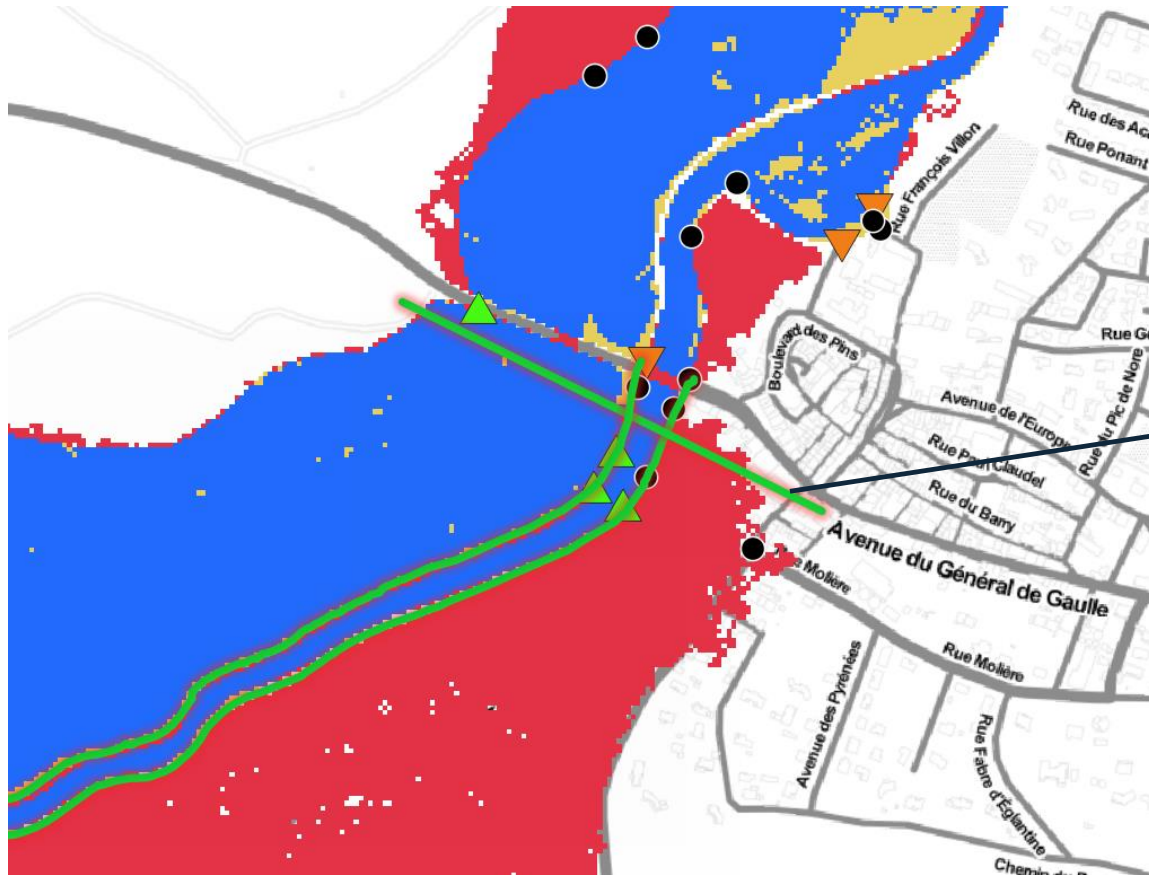
Bridge overflooded

Representation of dikes in 5 m DTM



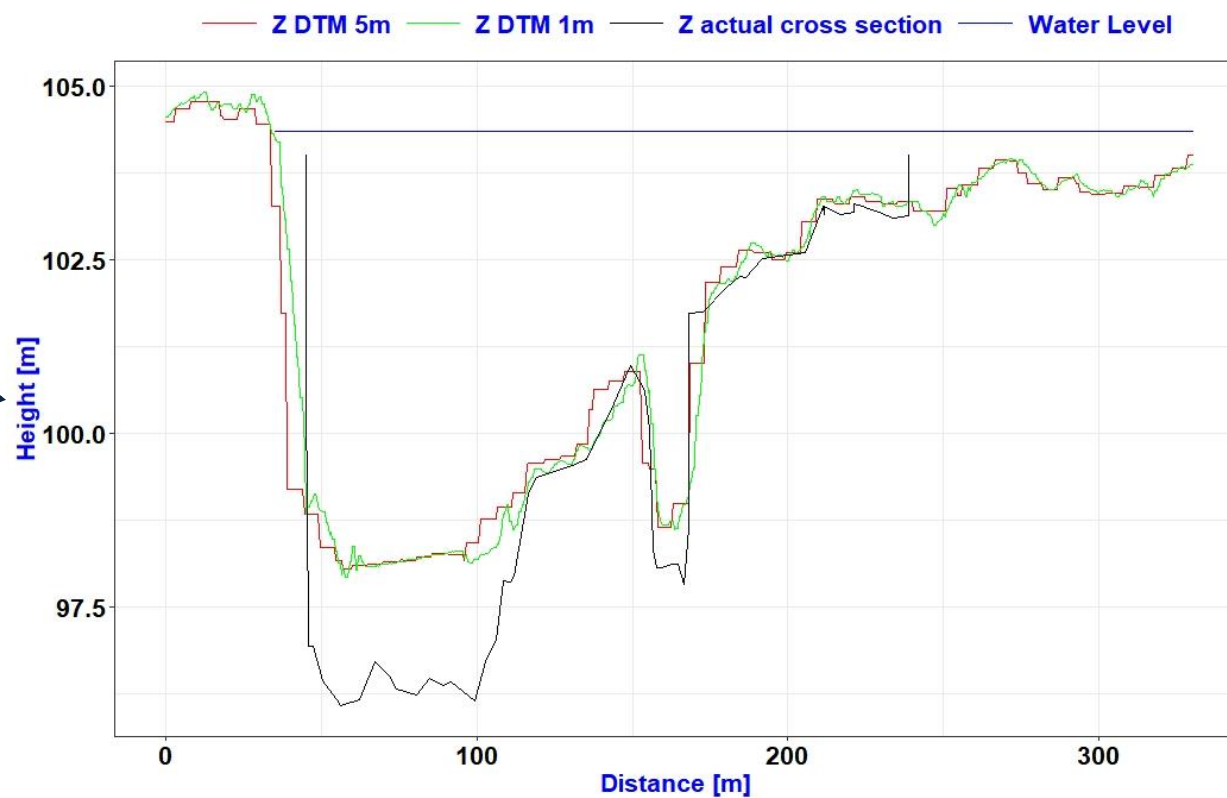
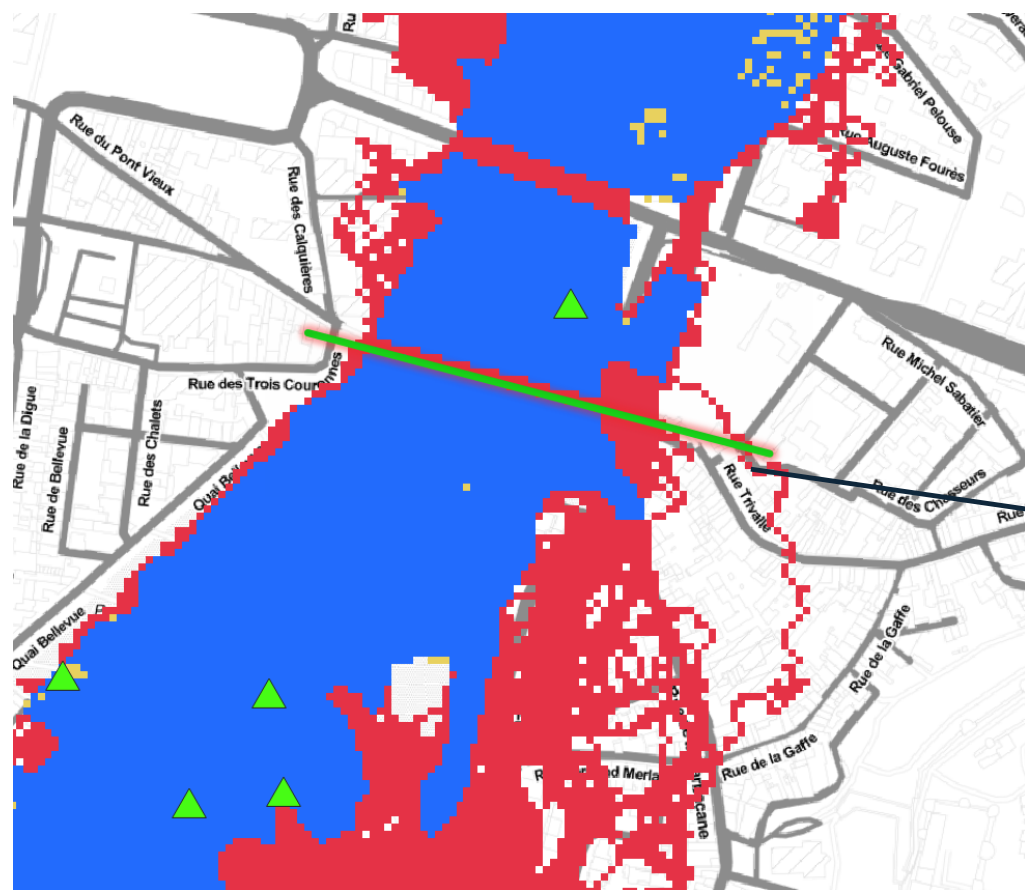
Results (4): Representation of dikes in 5 m DTM

Fresquel River at Pezens



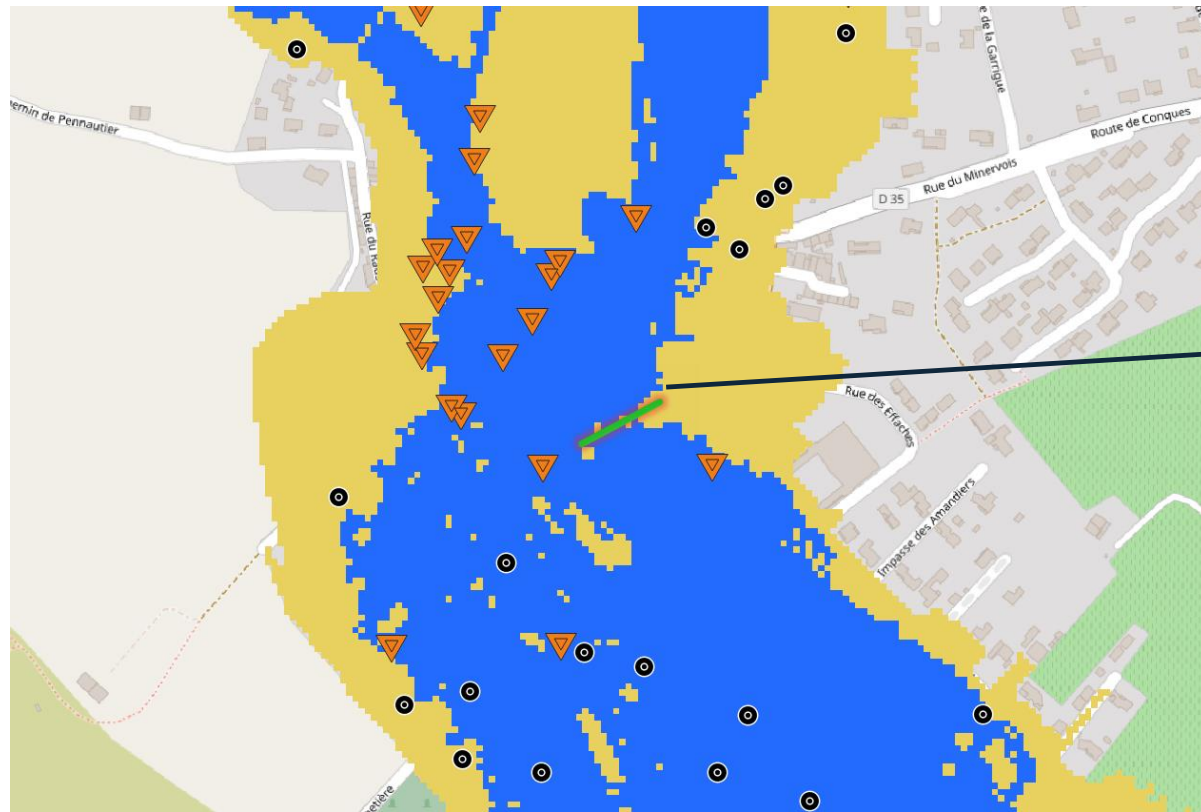
Results (5): Absence of bathymetry in DTM

Aude River at Carcassonne



Results (6): Bridge overflooded

Trapel river at Villegailhenc :
a bridge was overflooded and destroyed,
causing a large backwater effect



L'Aude en alerte rouge, les inondations ont fait treize morts

Le département de l'Aude était placé en vigilance rouge pluie-inondation lundi 15 octobre jusqu'à 11 heures. La préfecture a demandé aux habitants de ne pas sortir de chez eux.

La Croix, le 15/10/2018 à 07:42 Modifié le 15/10/2018 à 10:18

🗒 Lecture en 2 min.



Nabil HOCINI

nabil.hocini@univ-eiffel.fr

