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Labcom Hydr.IA: a joint Company-Academic laboratory to develop new flood forecasting services. Case Study on the Nîmes Flash-Floods (Southeastern France)

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Labcom Hydr.IA: a joint Company-Academic laboratory to develop new flood forecasting services

Case Study on the Nîmes Flash-Floods (Southeaster France)

Flash-Floods in the city of Nîmes

- Mediterranean climate:
 - High intensity precipitation: e.g. in 1988 (1), > 420 mm in 8 hours
 - High precipitation heterogeneities
- Flood events with response times of less than 1/2 hour
- Damages: e.g. In 1988 (1) 1 billion euros worth of damages, 45,000 victims and 9 casualties
- Small catchments (< 30 km²) with karst terrains
- City crossed by urban rivers (2)

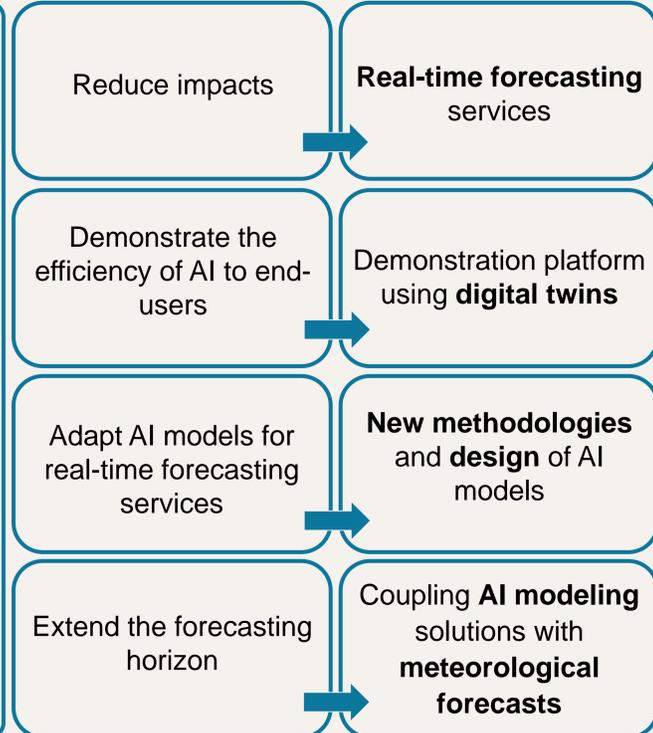


Despite the growing development of AI-related solutions in many complex fields, and the demonstration of their relevance to several hydro(geo)logical issues, there is a **deficit in the transfer of these technologies to end-users.**

Difficulty for **research** to be directly confronted with **real operational conditions**

Limited confidence users have in solutions that are often perceived as opaque, and whose **operational implementation is rare**

Challenges and solutions



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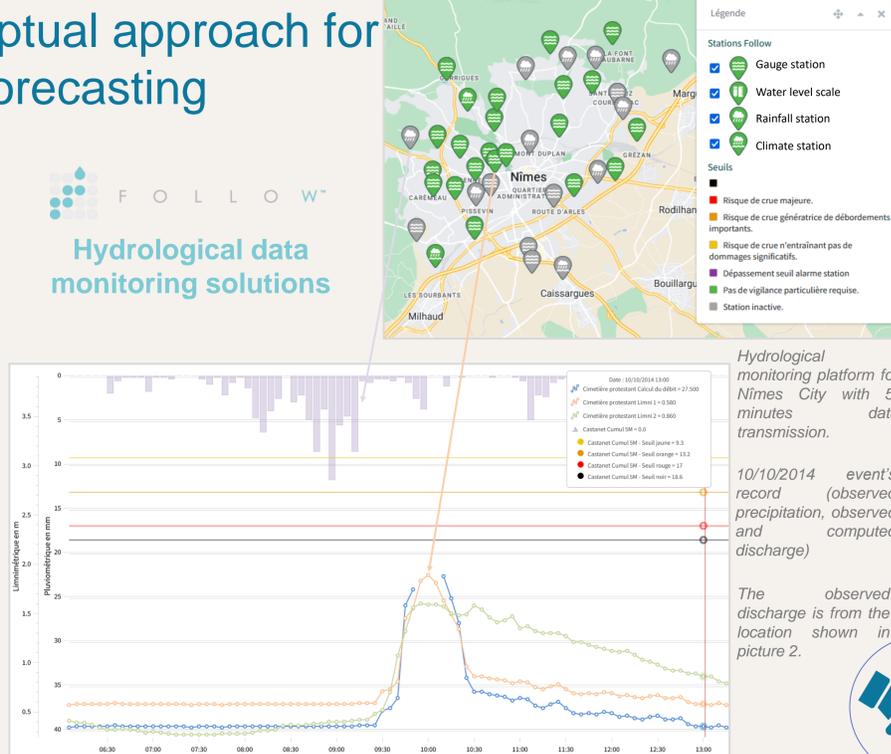
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Conceptual approach for flood forecasting

- Physically based model*
- Input data: corrected radar rain (0,25 km², 5 min)
- Rain/water flow models for non-urban areas and urban areas
- Output: **Continuous discharge forecast** at max 1,5 hour lead time

FOLLOW
Hydrological data monitoring solutions



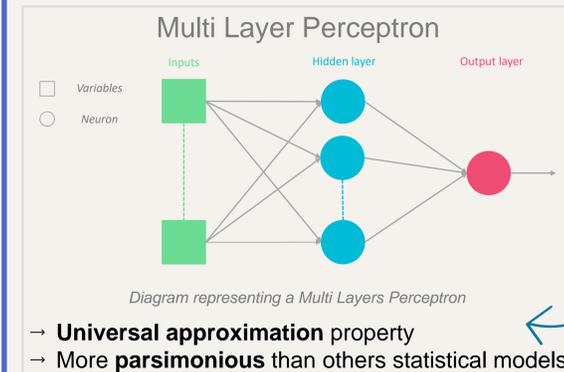
Hydrological monitoring platform for Nîmes City with 5-minutes data transmission.

10/10/2014 event's record (observed precipitation, observed and computed discharge)

The observed discharge is from the location shown in picture 2.



References:
<https://www.follow.solutions/fr/>
 *Pla G, Crippa J, Djerboua A, Dobricean O, Dongar F, Eugene A, Raymond M. 2019. ESPADA : un outil pour la gestion en temps réel des crues éclaircies urbaines en pleine modernisation. La Houille Blanche 3-4: 57-66.



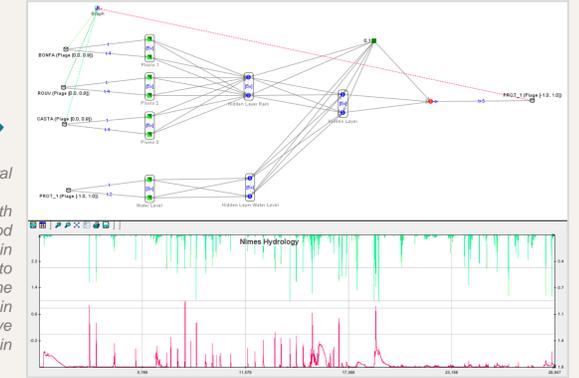
- ### Ongoing studies
- “**Digital twins** of complex hydrosystems for flood forecasting using neural network models”
 - “Flood forecasting using artificial intelligence: **increasing the forecast horizon**”
 - “Modeling of hydrosystems by machine learning: **streamline the use of AI** for flood forecasting”

AI for flood forecasting

In hydrology, the studied systems are **dynamic and non-linear**.

Neural Networks are particularly appropriate for representing these complex natural systems.

RNF Pro ©2016 GEONOSIS
A tool to implement Neural Networks



Example of a Neural Network implemented with RNF Pro. The flood events observed in Nîmes are used to train and test the Neural Network in order to improve flood forecasting in this catchment.

References:
 Hornik K, Stinchcombe M, White H (1989) Multilayer feedforward networks are universal approximators. Neural Netw 2:359-366
 Barron AR (1993) Approximation bounds for superpositions of a sigmoidal function. Proceedings, San Antonio, TX, USA, 17-22 January 1993. 930-945.