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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 km<sup>2</sup>) with karst terrains
- City crossed by urban rivers (2)

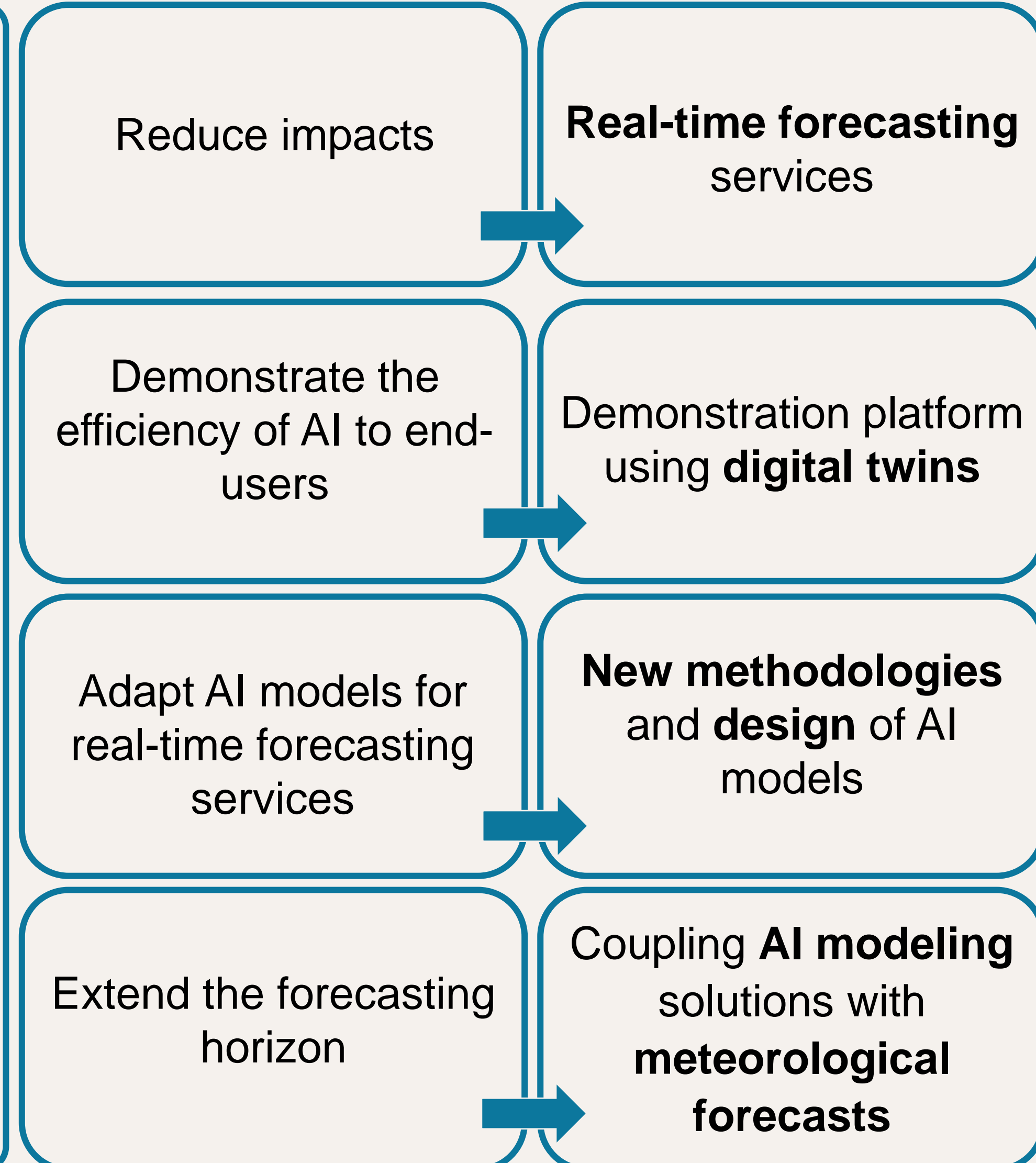


Despite the growing development of AI-related solutions in many complex fields, and the demonstration of their relevance to several hydro(geo)logical issues, there is a **deficit in the transfer of these technologies to end-users.**

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



### Authors

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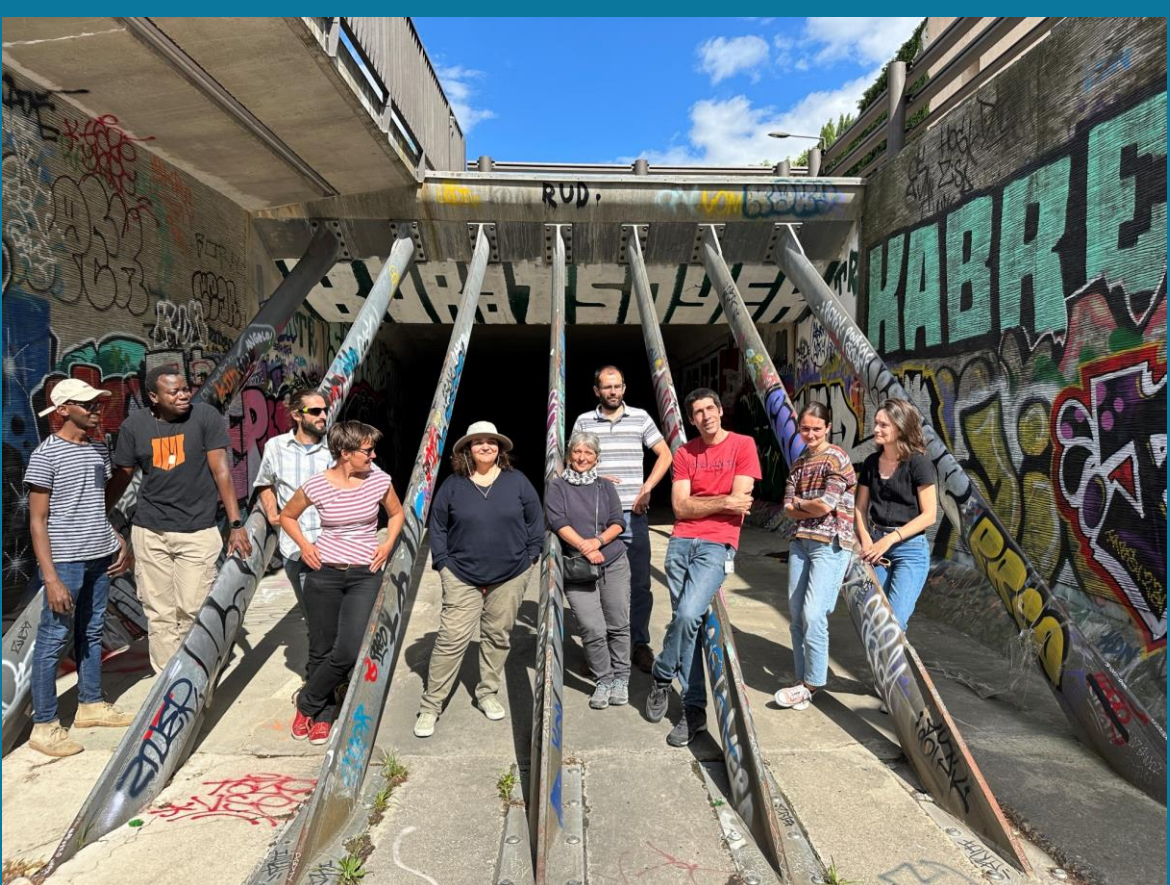
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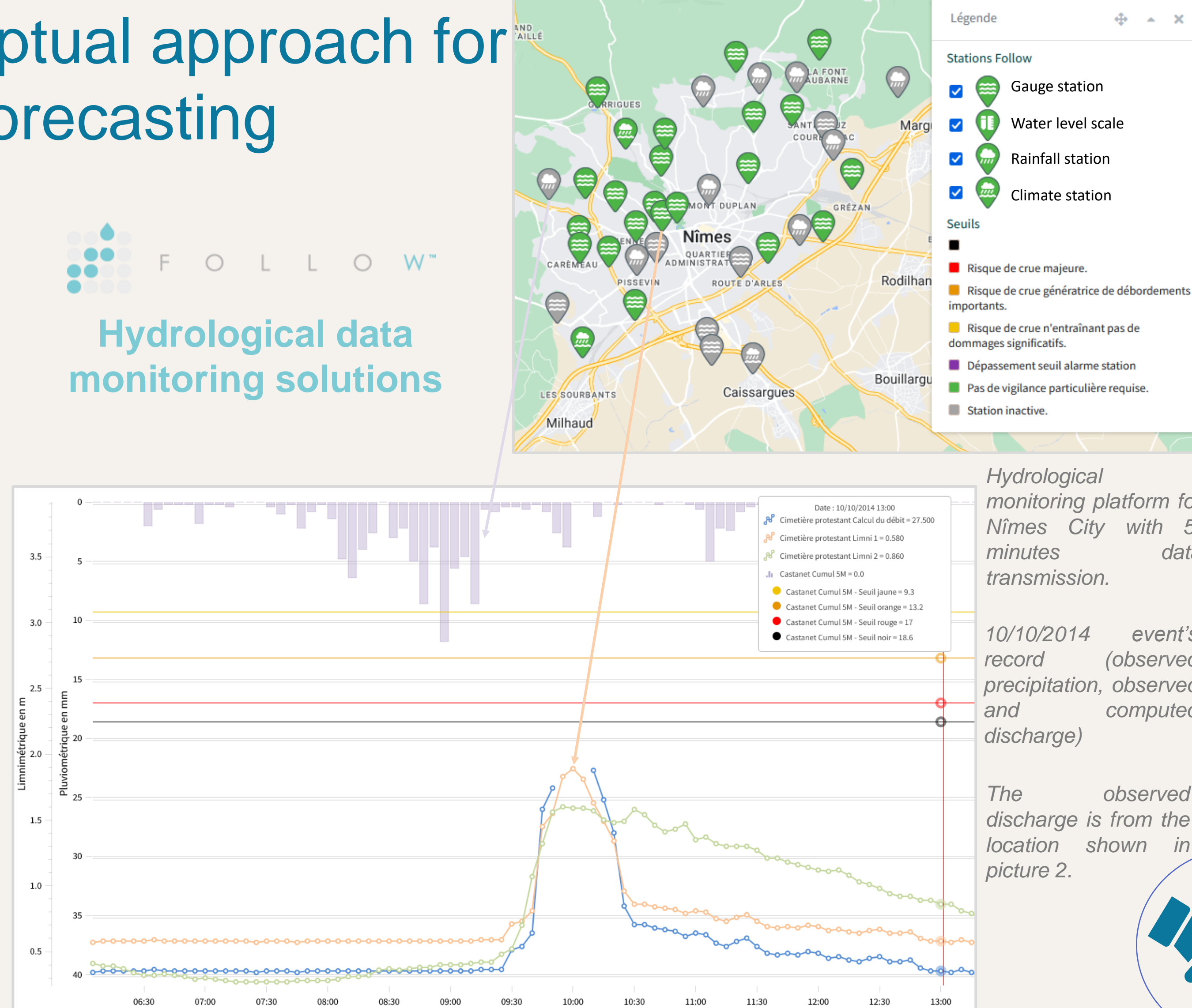
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### Conceptual approach for flood forecasting

- Physically based model\*
- Input data: corrected radar rain (0,25 km<sup>2</sup>, 5 min)
- Rain/water flow models for non-urban areas and urban areas
- Output: **Continuous discharge forecast** at max 1,5 hour lead time

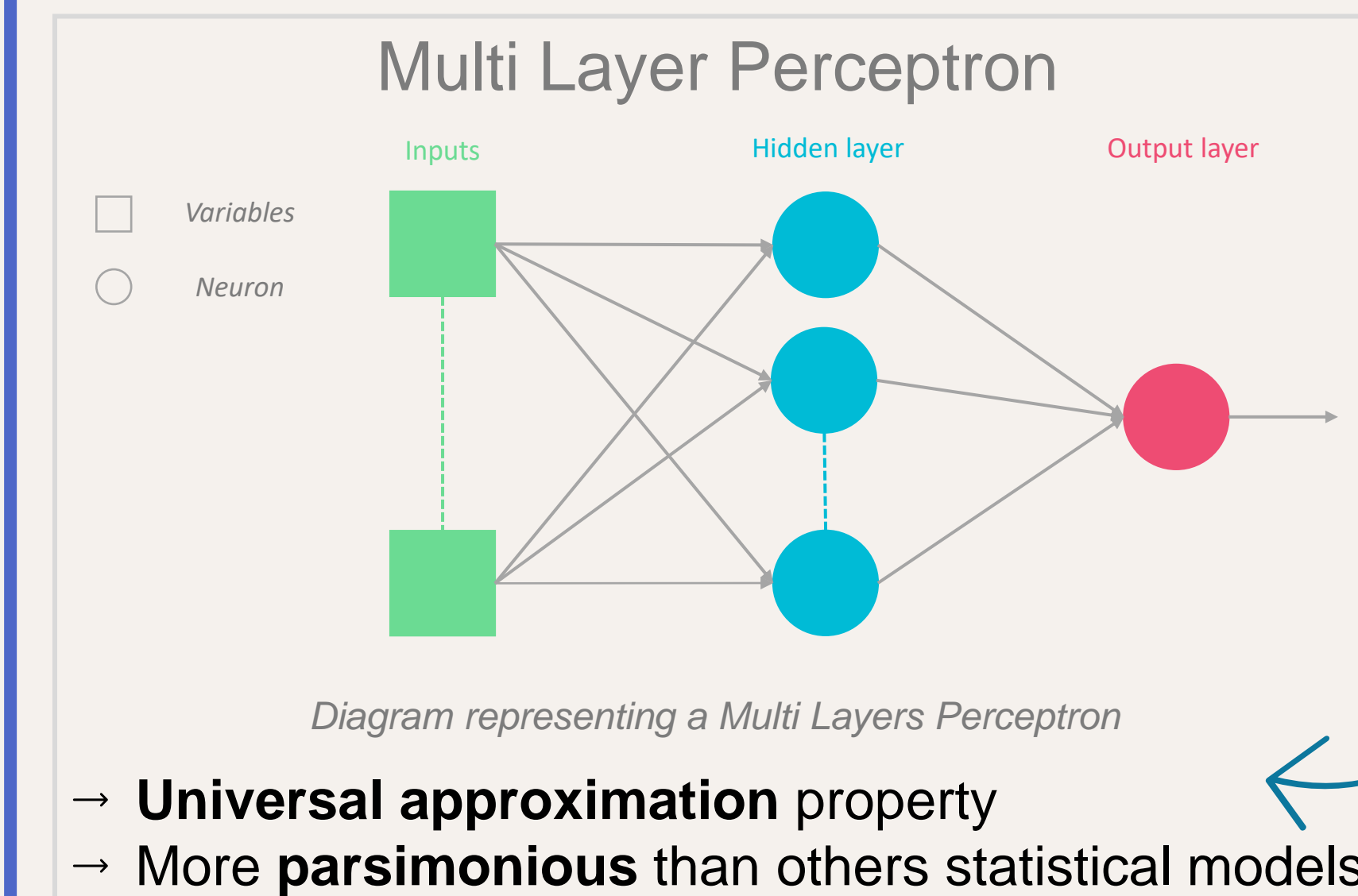
**FOLLOW**  
Hydrological data monitoring solutions



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.

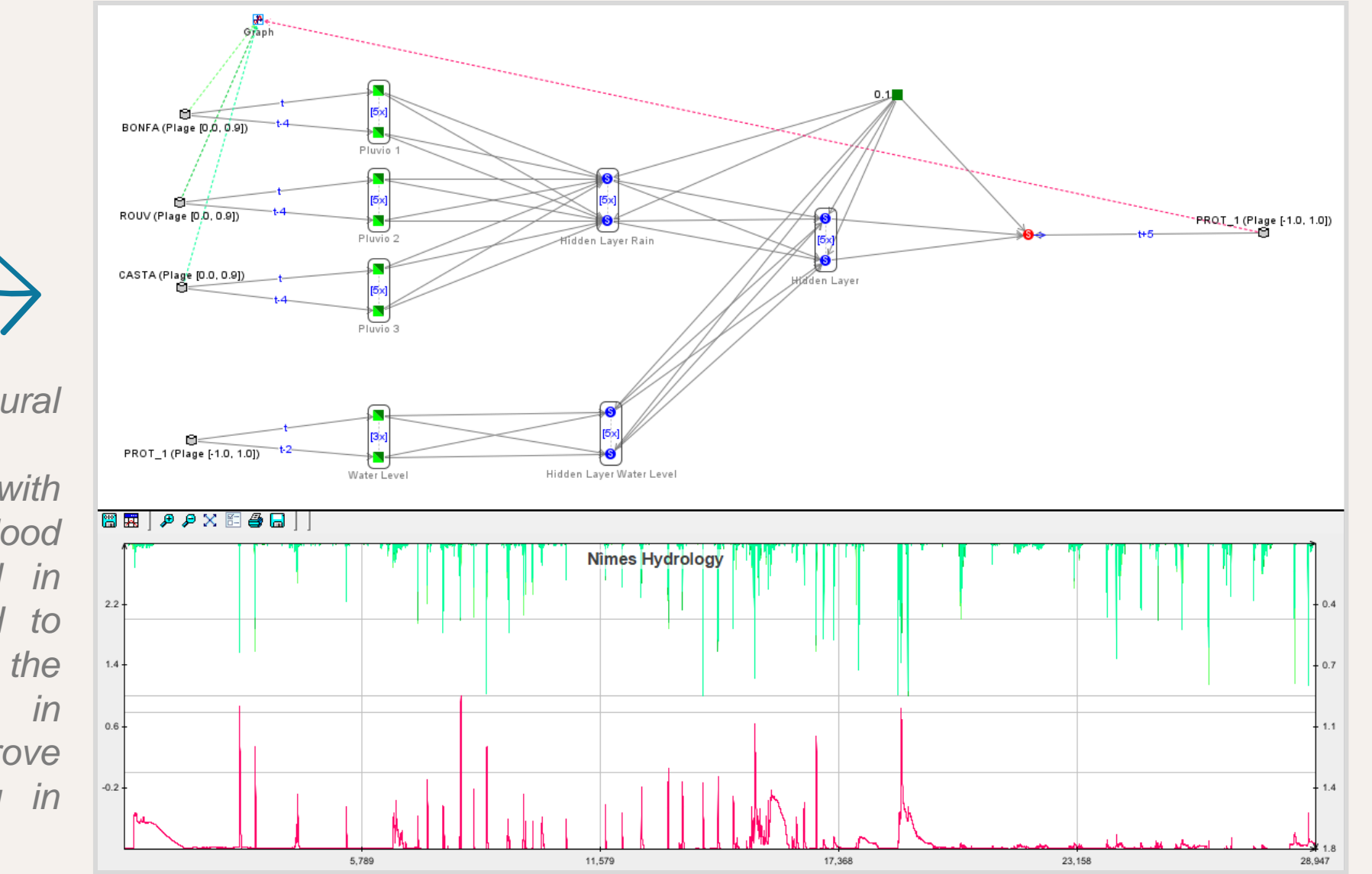


- ### Ongoing studies
- “**Digital twins** of complex hydrosystems for flood forecasting using neural network models”
  - “Flood forecasting using artificial intelligence: **increasing the forecast horizon**”
  - “Modeling of hydrosystems by machine learning: **streamline the use of AI** for flood forecasting”

### 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.

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A tool to implement Neural Networks



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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.