INTERNATIONAL CONFERENCE
GROUNDWATER, KEY TO THE SUSTAINABLE DEVELOPMENT GOALS
PARIS - May 18 -20, 2022
ORGANIZED BY IAH-CFH, UNESCO-IHP, THE FRENCH WATER PARTNERSHIP, UNDER THE PATRONAGE OF THE FRENCH NATIONAL COMMISSION FOR UNESCO AND WITH THE SUPPORT OF THE MINISTRY FOR ENVIRONMENT, SEINE-NORMANDY WATER AGENCY, AND SORBONNE UNIVERSITY

# Groundwater, digital twins and artificial intelligence: issues, pitfalls, opportunities and prospects with the ARD Junon Program

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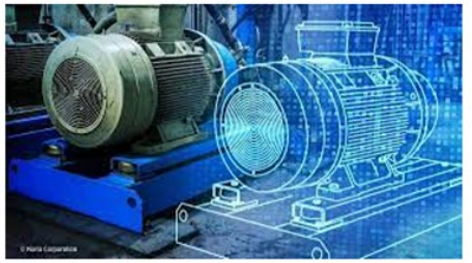
Antea Group

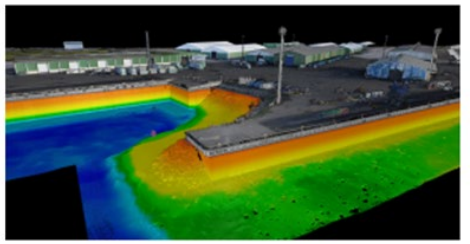
Understanding today.
Improving tomorrow.

# JUNON

« Create a **digital research center** on the **continental environment** (agricultural, urban, forest and fluvial), including each level of the critical zone, and dedicated to research and innovation on all links of the value chain from environmental sensor to plain **digital twins.** »

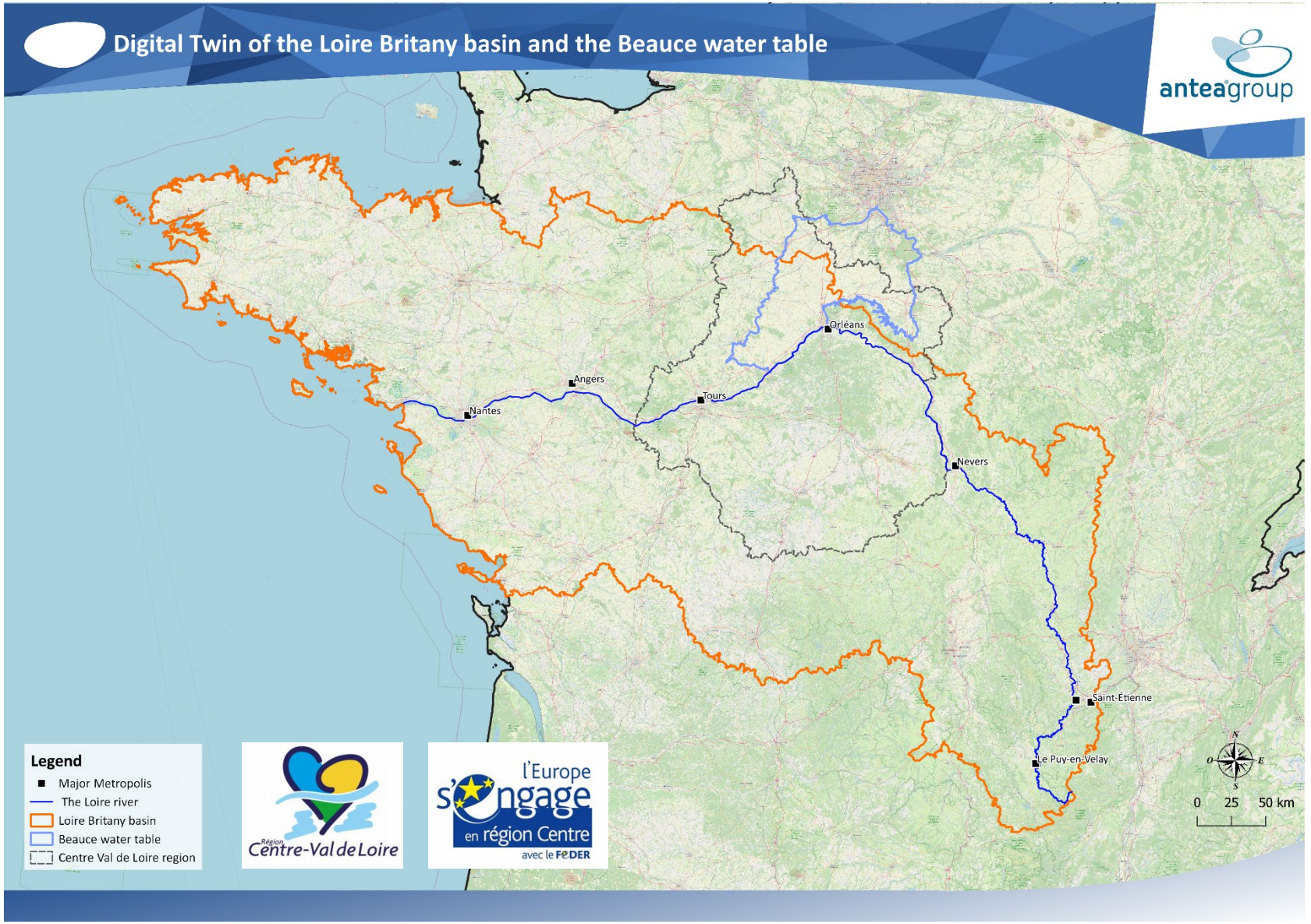
- Improve the **management** of regional **natural resources** (water, air, soil)
- Better **predict** to help the harmonious and **sustainable development** of our territory
- Stimulate **collaboration** and **sharing** to create new applications





- 4 years long regional program starting from 2022
- About 15 millions of euros in investments (ARD, CPER and FEDER)
- Some twenty research teams involved (5 research organisms, 4 private companies)
- Coordinator: BRGM

# Geographic perimeter




- Beauce water table (biggest in EU) and the beauce plain, the leading cereal-producing region in Europe.
- Sologne Natura 2000 site (biggest in EU).
- The orleans forest, the largest french state forest
- Loire Valley UNESCO world heritage and its historical metropolis.
- Loire Britany basin : 30% of France but 50 % of the national agricultural production (in value)

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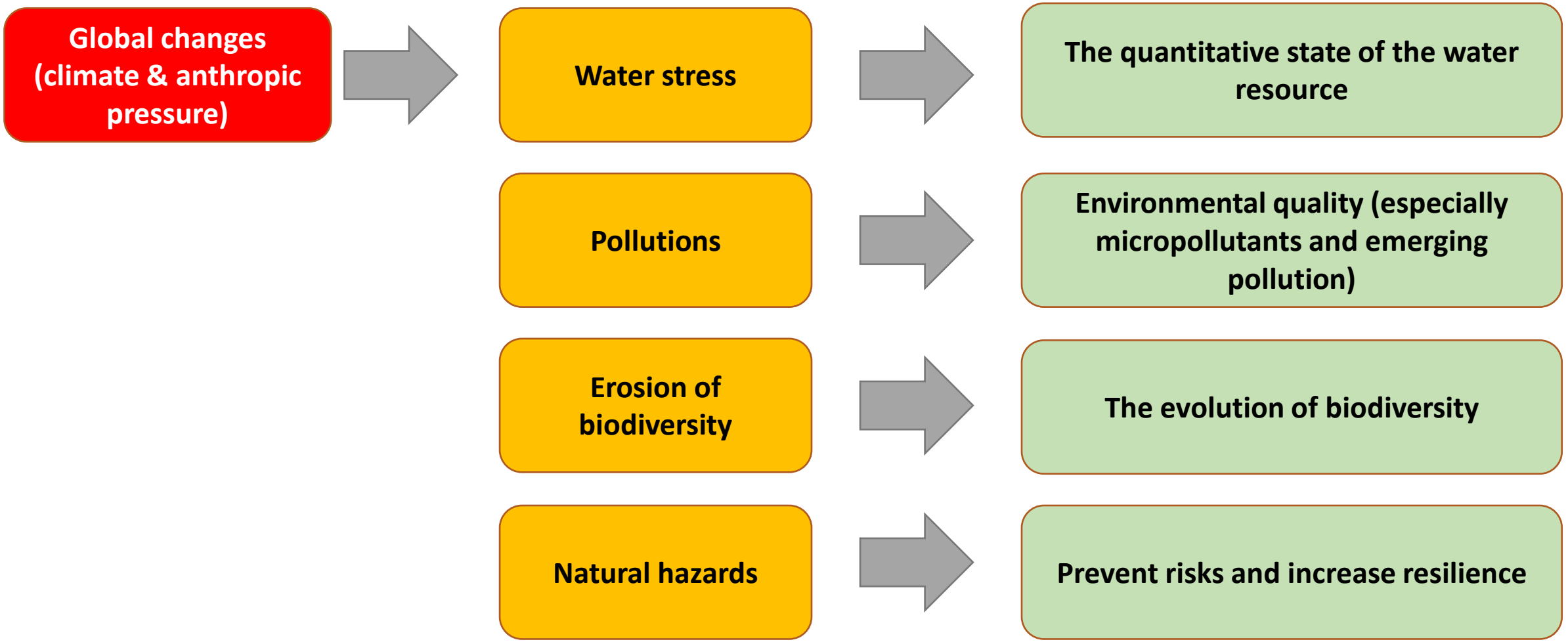
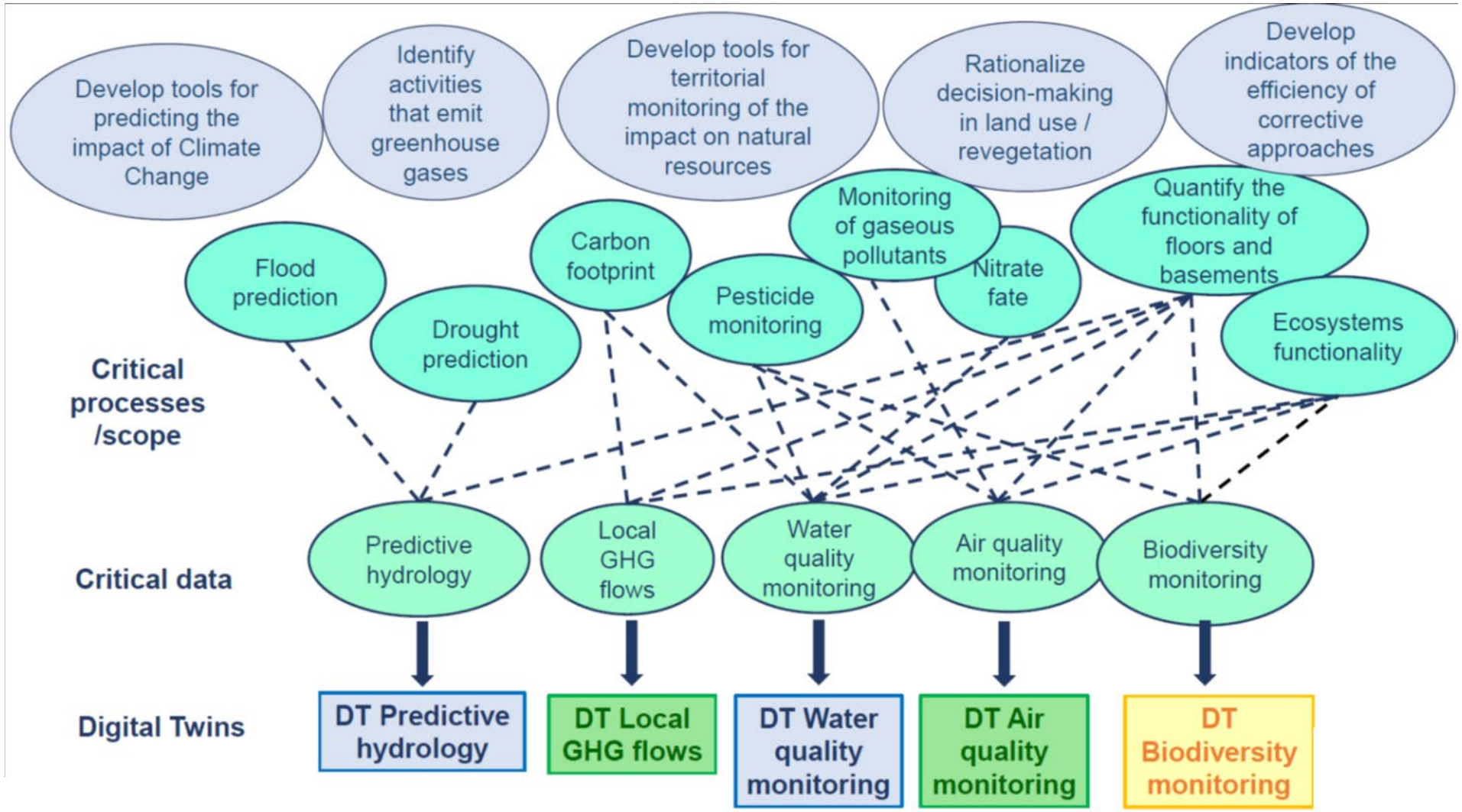
# Junon program ambitions…



# Several Environmental Digital Twins…

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# Environmental Digital Twins pitfalls …

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**Data preprocessing**

- -Clean
- -Sample
- -Aggregate
- -Imperfect data: missing, noise,…
- -Reduce dimension,
- -Accuracy

**Data Processing**

- -Explore data
- -Represent data
- -Link data
- -Learn from data
- -Deliver insight

**Data Analytics**

- -Clustering
- -Classification
- -Regression
- -Network analysis
- -Visual analytics
- -Association
- -Machine learning

**> 70% of the effort!**

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# AI & Environmental data…

## Centre Val de Loire region : hotspot for environmental data!

IT & Env. Engineering

Public Services

Research

+ 100 economic actors working in the field of metrology, engineering and environmental information system

Such as:

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DREAM EAU & MILIEUX

LES PÔLES DE COMPÉTITIVITÉ Éco technologies

SMART SPECIALISATION STRATEGY

GÉORISQUES

IGN INSTITUT NATIONAL DE L'INFORMATION GÉOGRAPHIQUE ET FORESTIÈRE

MINISTÈRE DE LA TRANSITION ÉCOLOGIQUE Liberté Égalité Fraternité

SDES

agence de l'eau Loire-Bretagne

Liberté • Égalité • Fraternité RÉPUBLIQUE FRANÇAISE

DIRECTION RÉGIONALE DE L'ENVIRONNEMENT DE L'AMÉNAGEMENT ET DU LOGEMENT

CENTRE-VAL DE LOIRE BASSIN LOIRE-BRETAGNE

géo CENTRE

OPEN DATA

InfoTerre

InfoSol

ADEME Agence de l'Environnement et de la Maîtrise de l'Énergie

OFB OFFICE FRANÇAIS DE LA BIODIVERSITÉ

recia

Géosciences pour une Terre durable brgm

INRAE

IRD Institut de recherche pour le développement

cnrs

OSUC

UNIVERSITE D'ORLEANS

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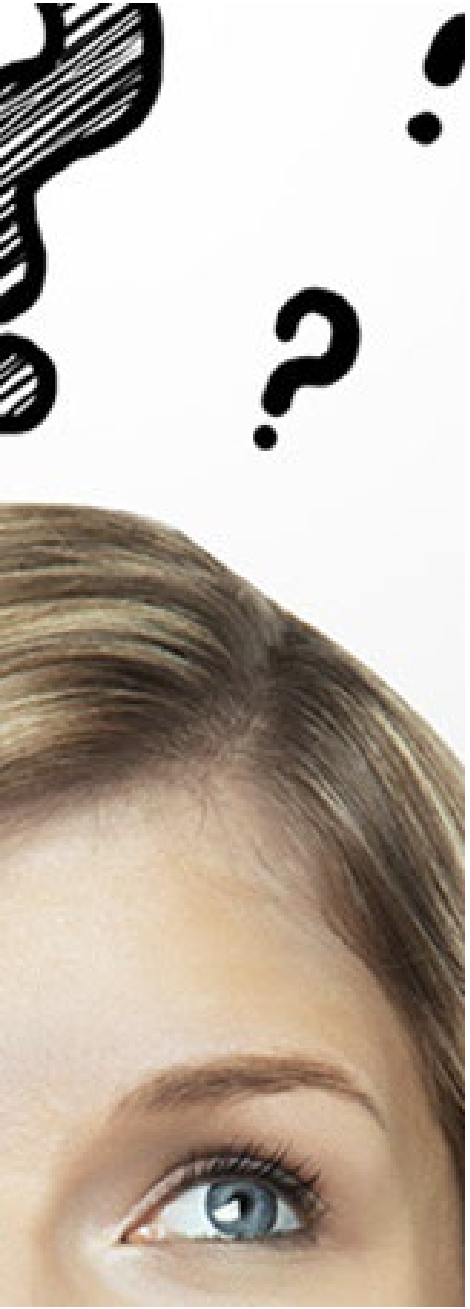
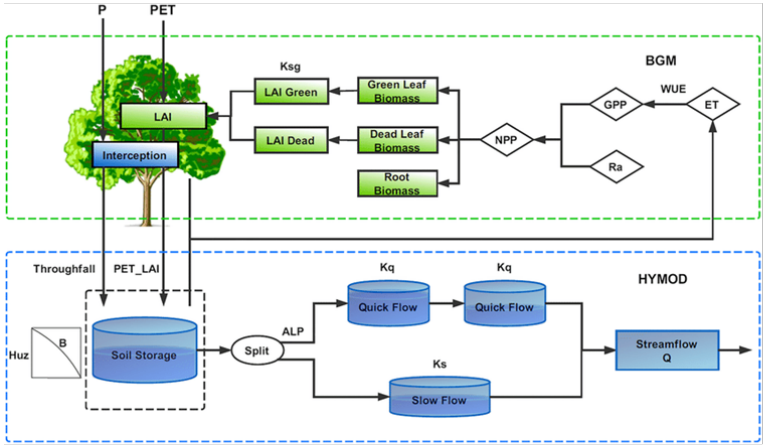
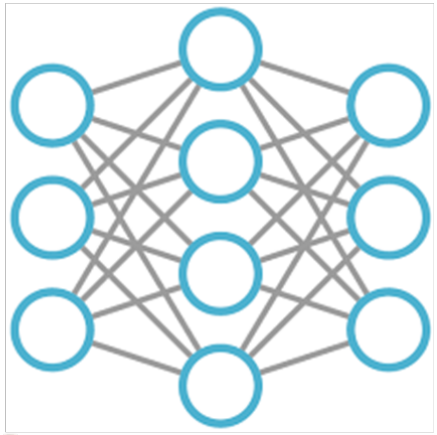
# Environmental Digital Twins pitfalls …



## Conceptual model




## Machin Learning



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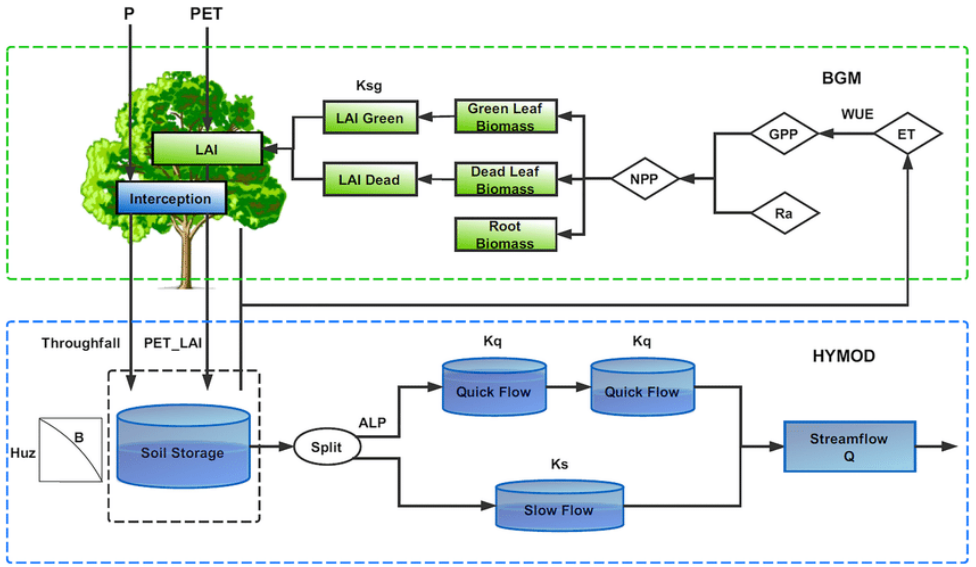
# Environmental Digital Twins solutions …

## Conceptual model

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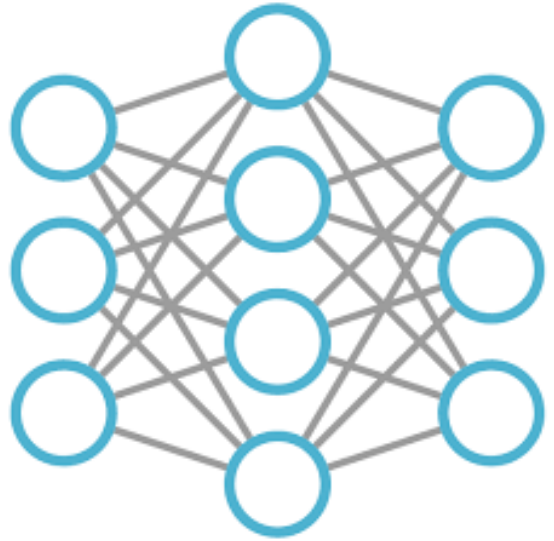
## Machin Learning



## Metamodel AI !

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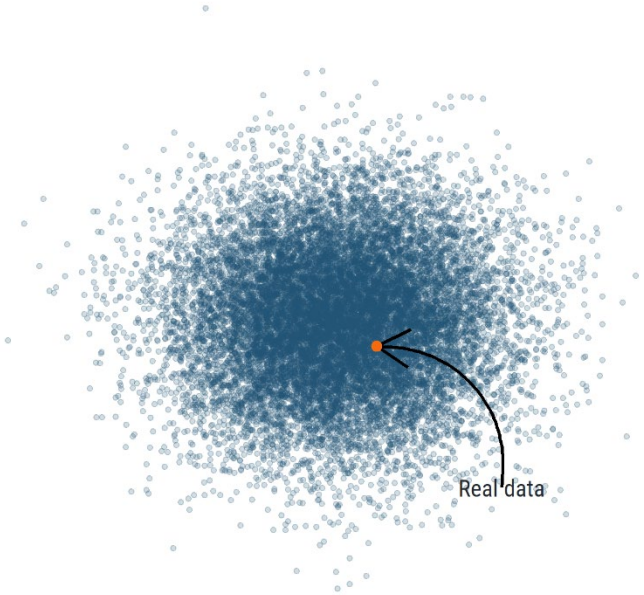
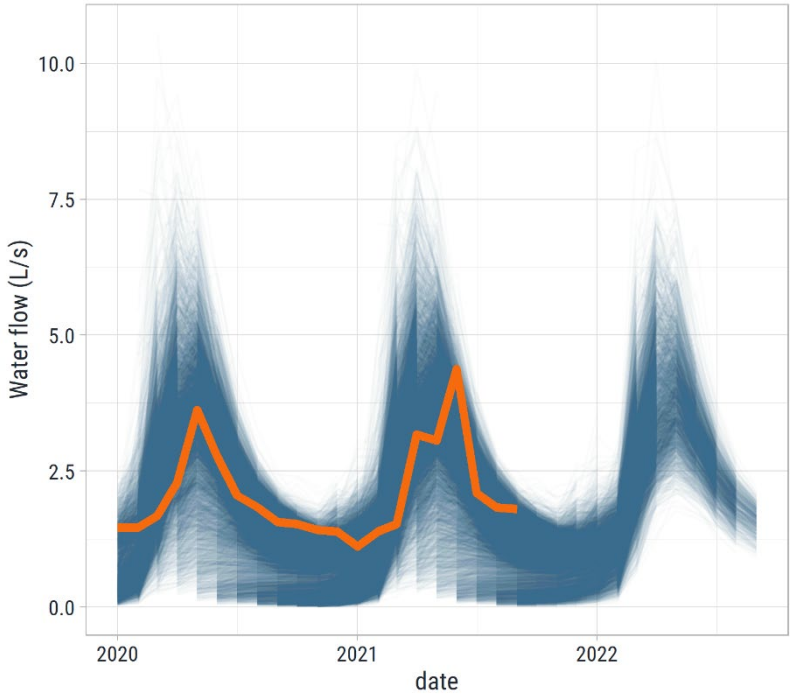
# Extreme dataset projection

## From one « 2 years » time serie to 16 000 yearly times series

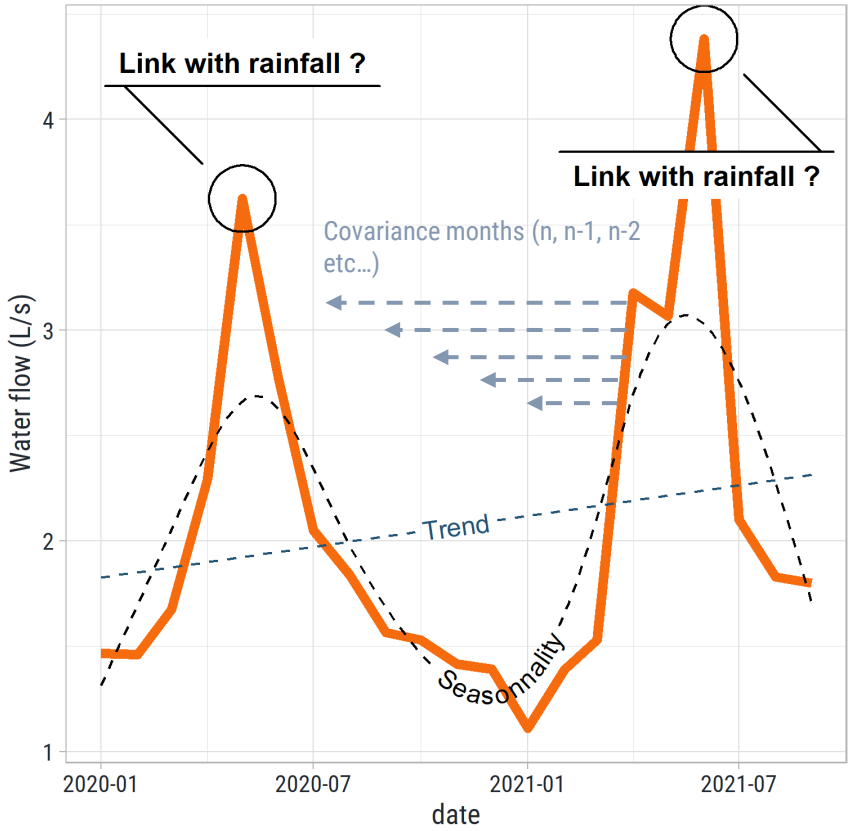



Extreme events condition «statistically» extended



# Features extraction

## From one single signal to multiple derivated metrics

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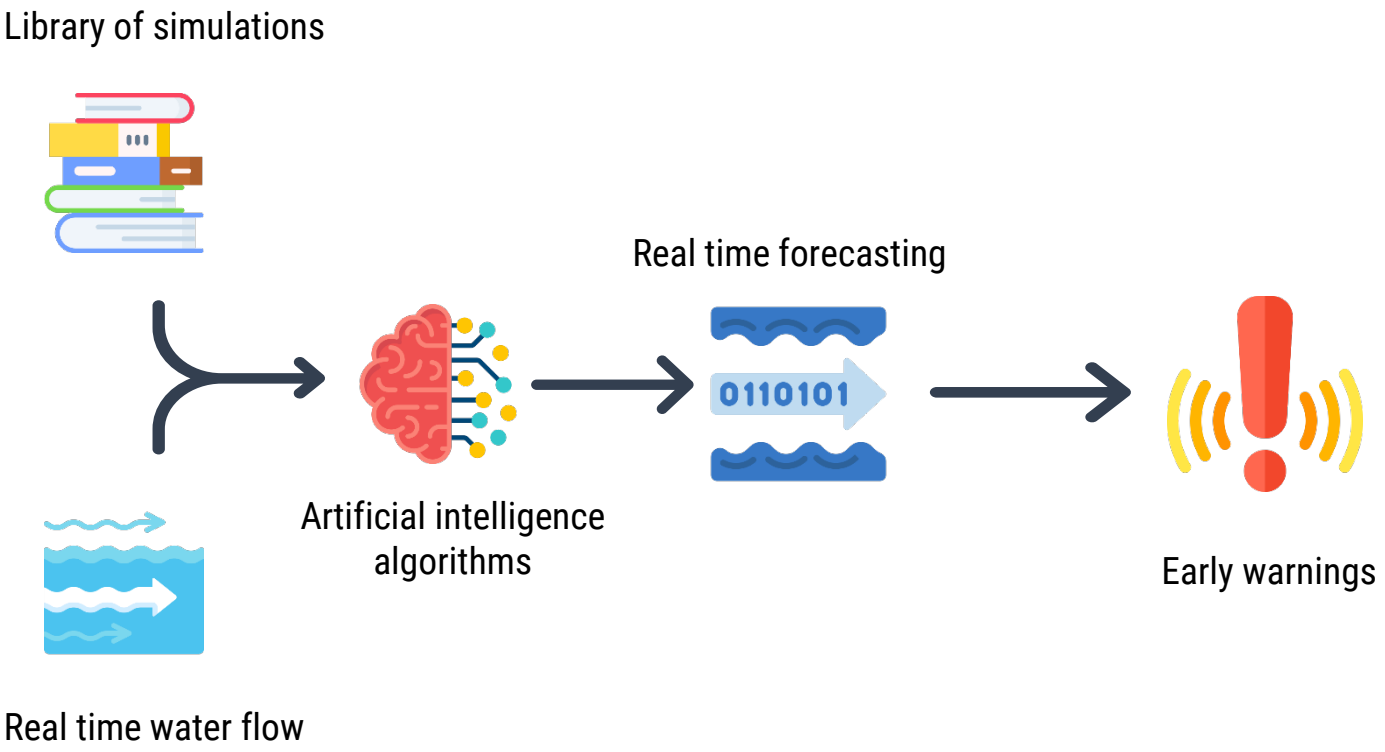
# Building « AI metamodel »

## Crossing real time with trained model for forecast

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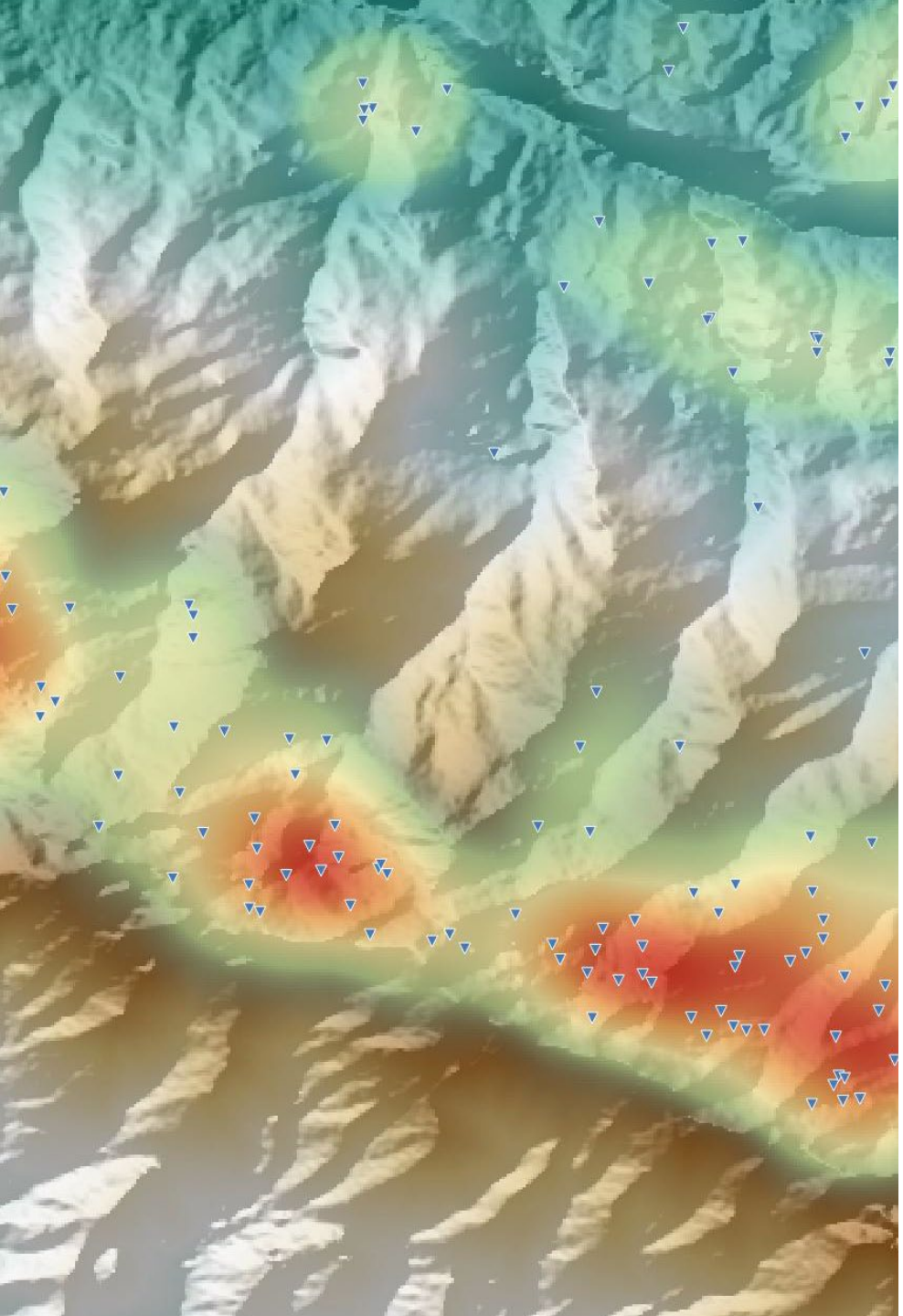
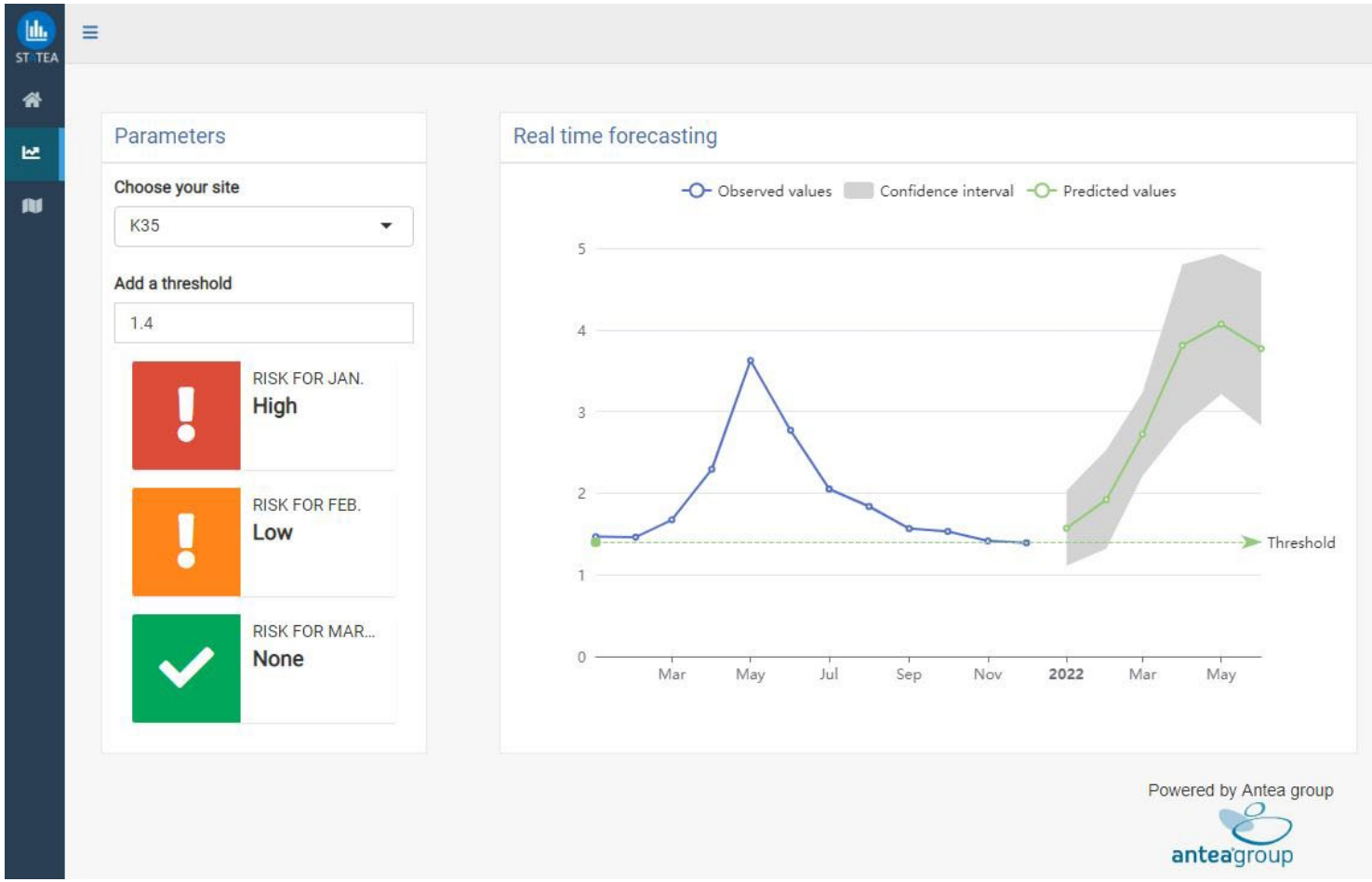


# Sharable decision system

## From model to API

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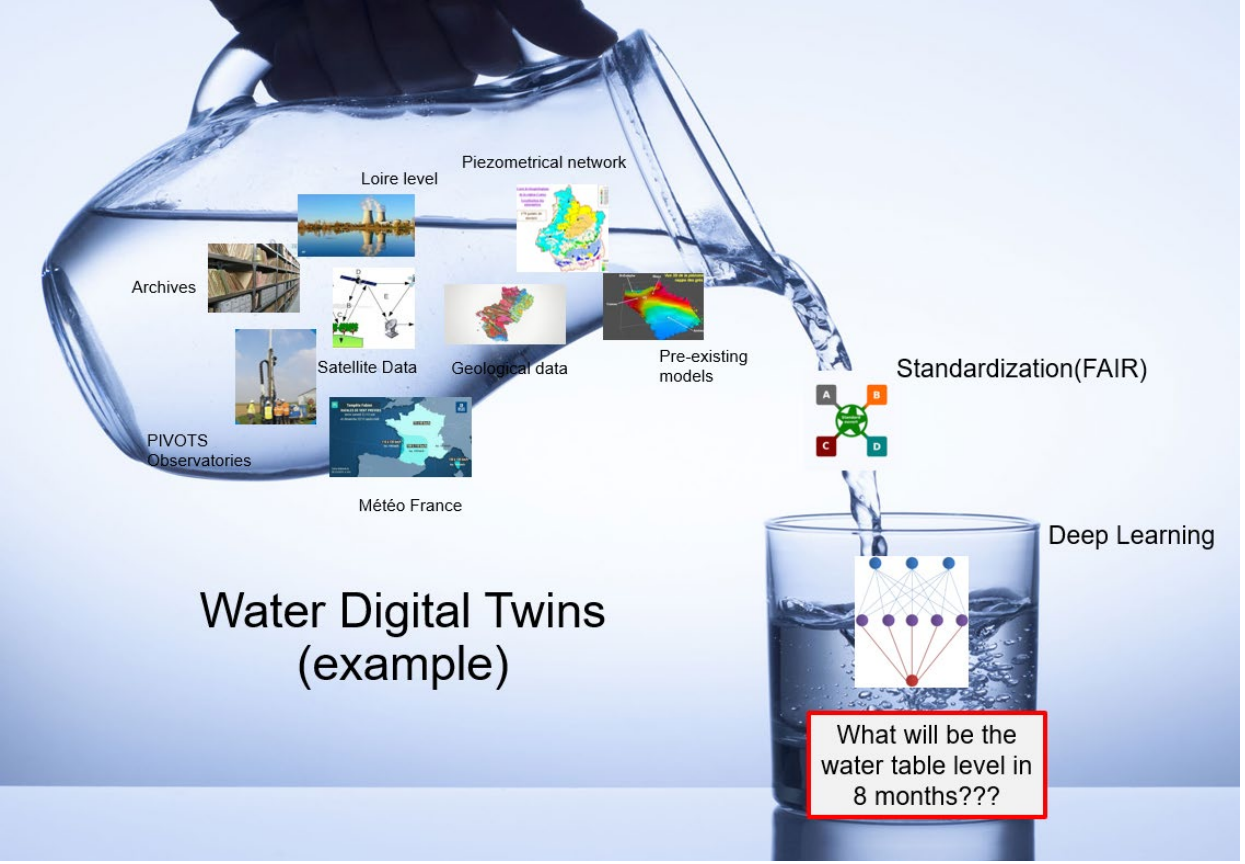


# Water Digital Twins (example)

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## PROVISION OF COMMERCIAL DATA & INTERPRETATIONS

- Monitoring: management of natural resources, in situ validations and tests, deconvolution of complex phenomena
- Prediction: risk prediction, decision support
- Interpretation: basic research

## KNOW-HOW TRANSFER

- Application development of:
  -processing of environmental data
  -data visualization
- AI development and predictive models
- Metrological developments associated with digital
- Access to a test or simulation area on primary or secondary data (sandbox)

## PROVISION OF PUBLIC DATA

- INSPIRE Directive application
- Data related to the Public Twins

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