AquaVar DSS for water resource management in a Mediterranean watershed

PROSPECTS AFTER FIVE YEARS OF EXPLOITATION BY THE WATER UTILITY: R&D PROGRAM FOR THE UPCOMING YEARS

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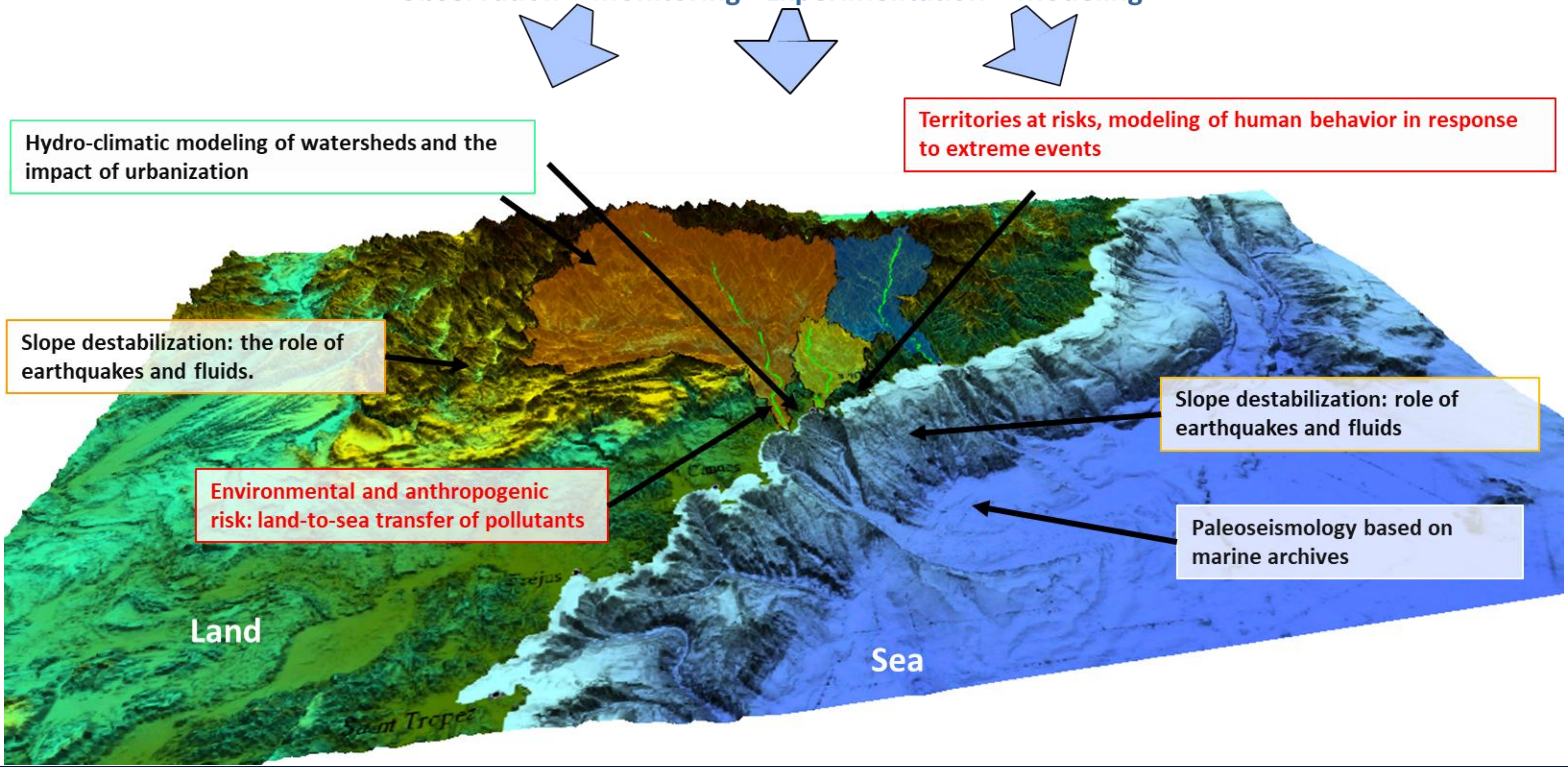
MÉTROPOLE NICE CÔTE D’AZUR

Multi-disciplinary Research Unit in the field of Earth and Universe Sciences with **199 persons:** *116 permanents : 72 Researchers/Pr et 44 Engineers/Technicians*

83 non-permanents : 36 PhD et 34 Post-Doc + contract.

Team : RISKS ON A CHANGING PLANET

Observation – Monitoring– Experimentation – Modeling



Outline

1. Nice Metropolitan area: the Var watershed context

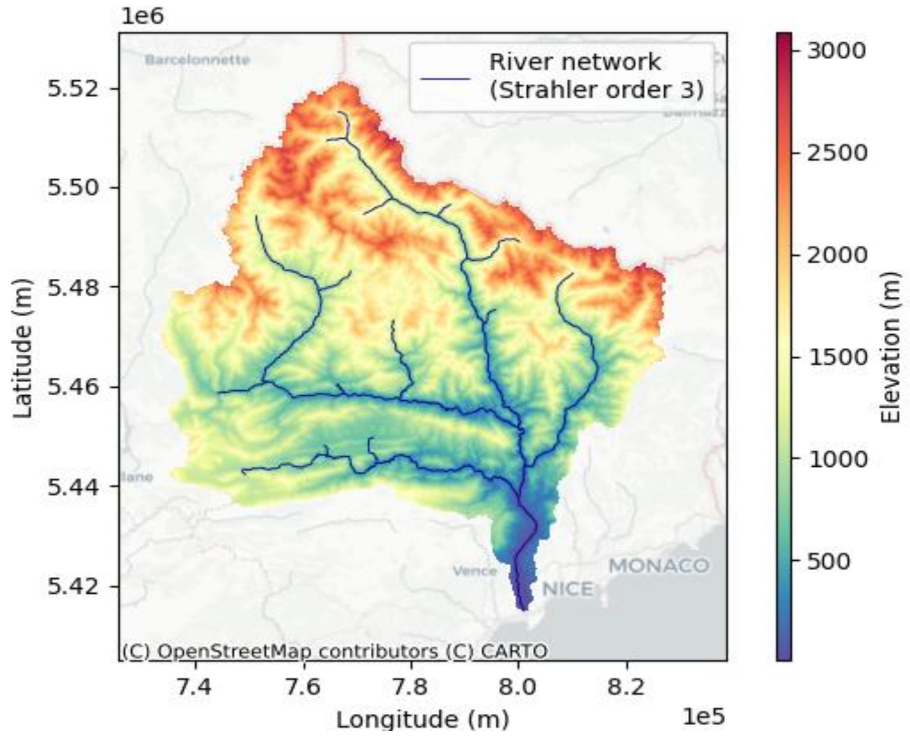
2. AquaVar: an initiative for the sustainable development and exploitation of a DSS for operators

3. AquaVar : interface and functionalities at a glance (…& more detailed by F. Billaud)

4. DSS development through collaboration: feedback and perspectives

Is the final TRL of a DSS a Moving Target?

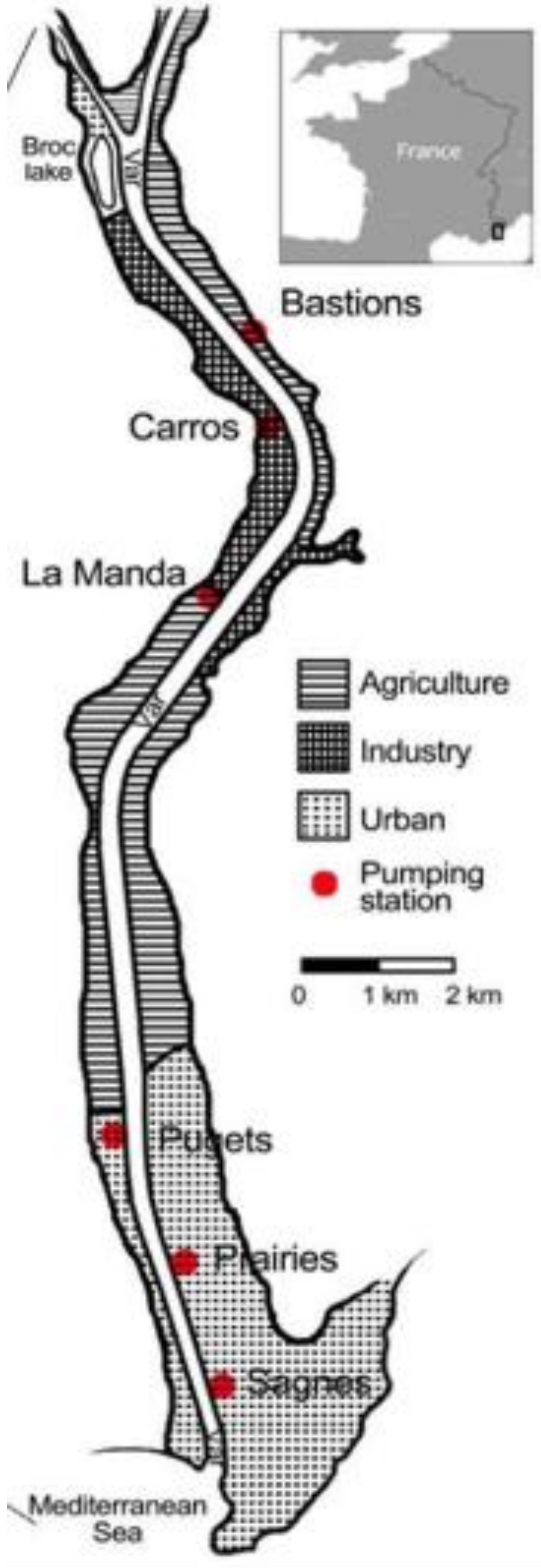
1- Nice Metropolitan area: the Var watershed



The yypical post card…Sunshine, palm-trees, mountains …

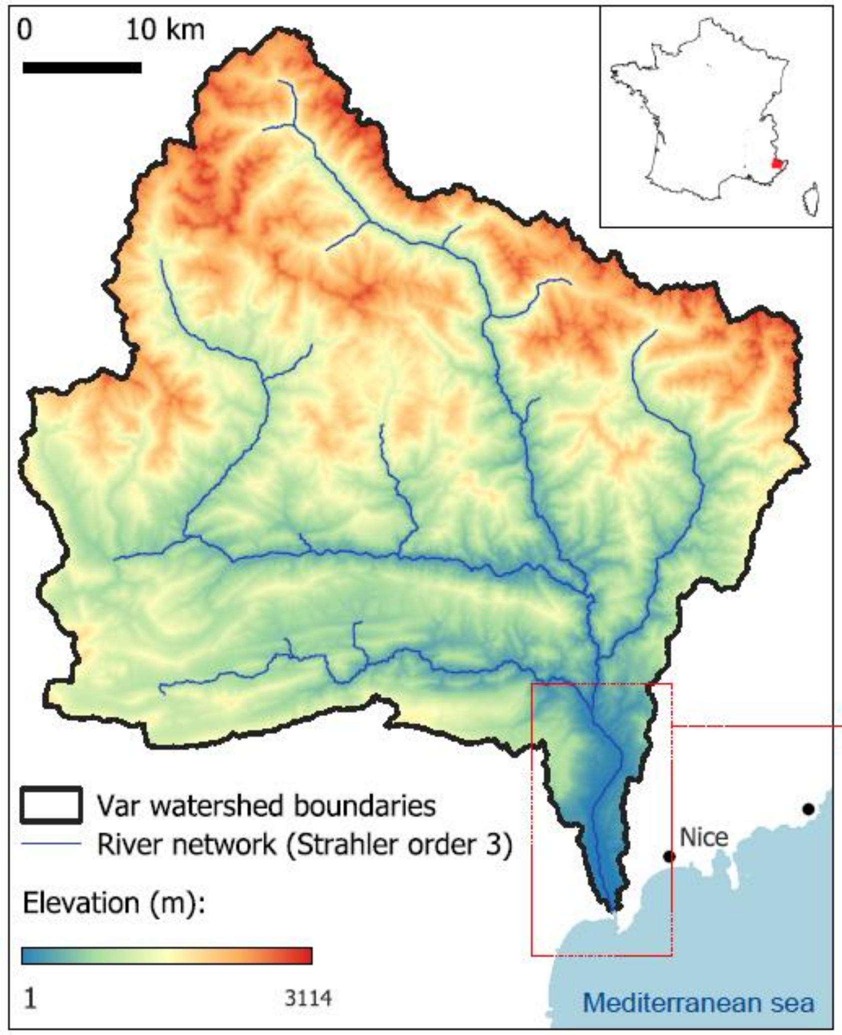
… a bit of human activity …

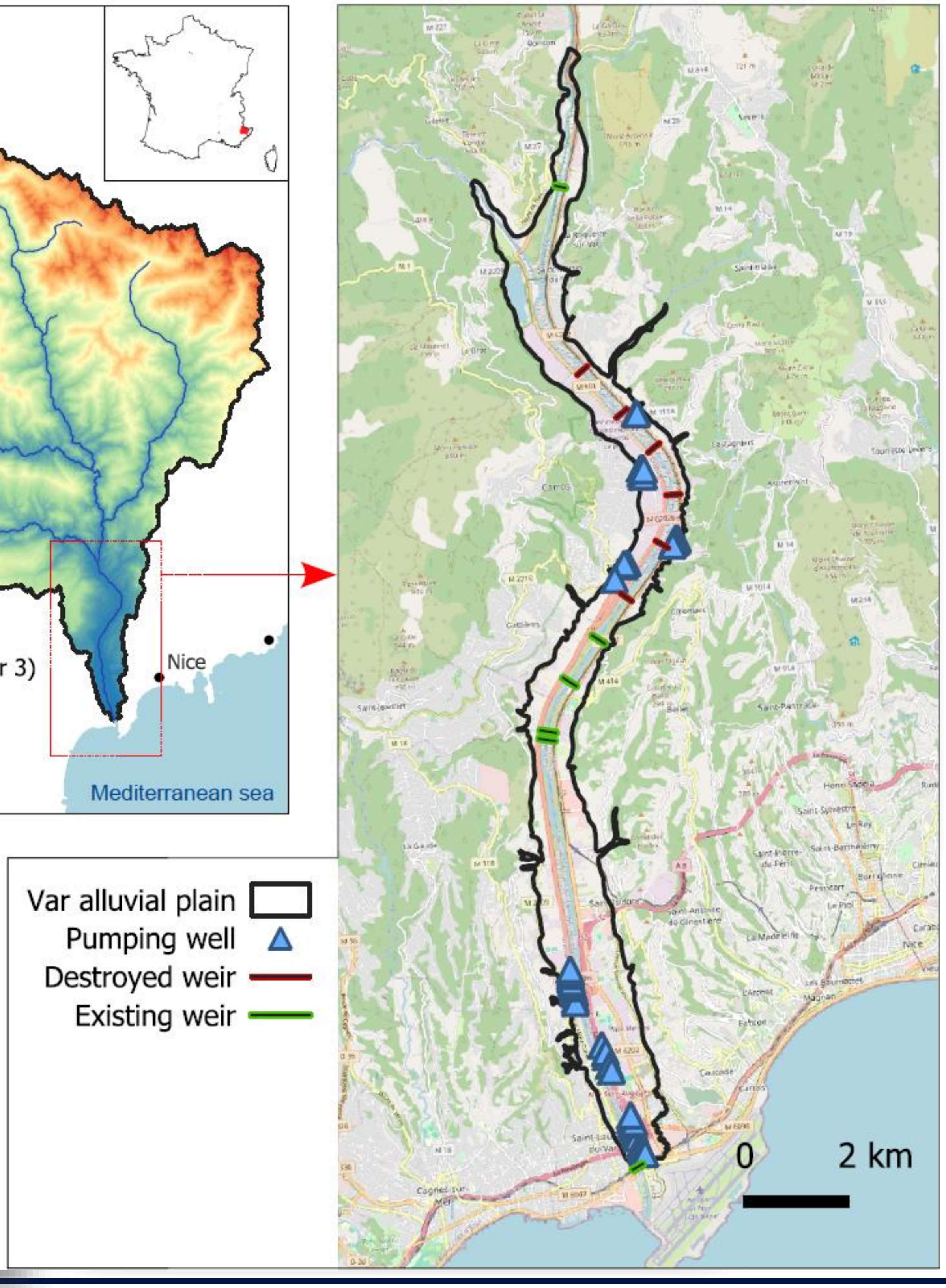
1- Nice Metropolitan area: the Var watershed



(Ma et al, 2020)

… in the river-bed …

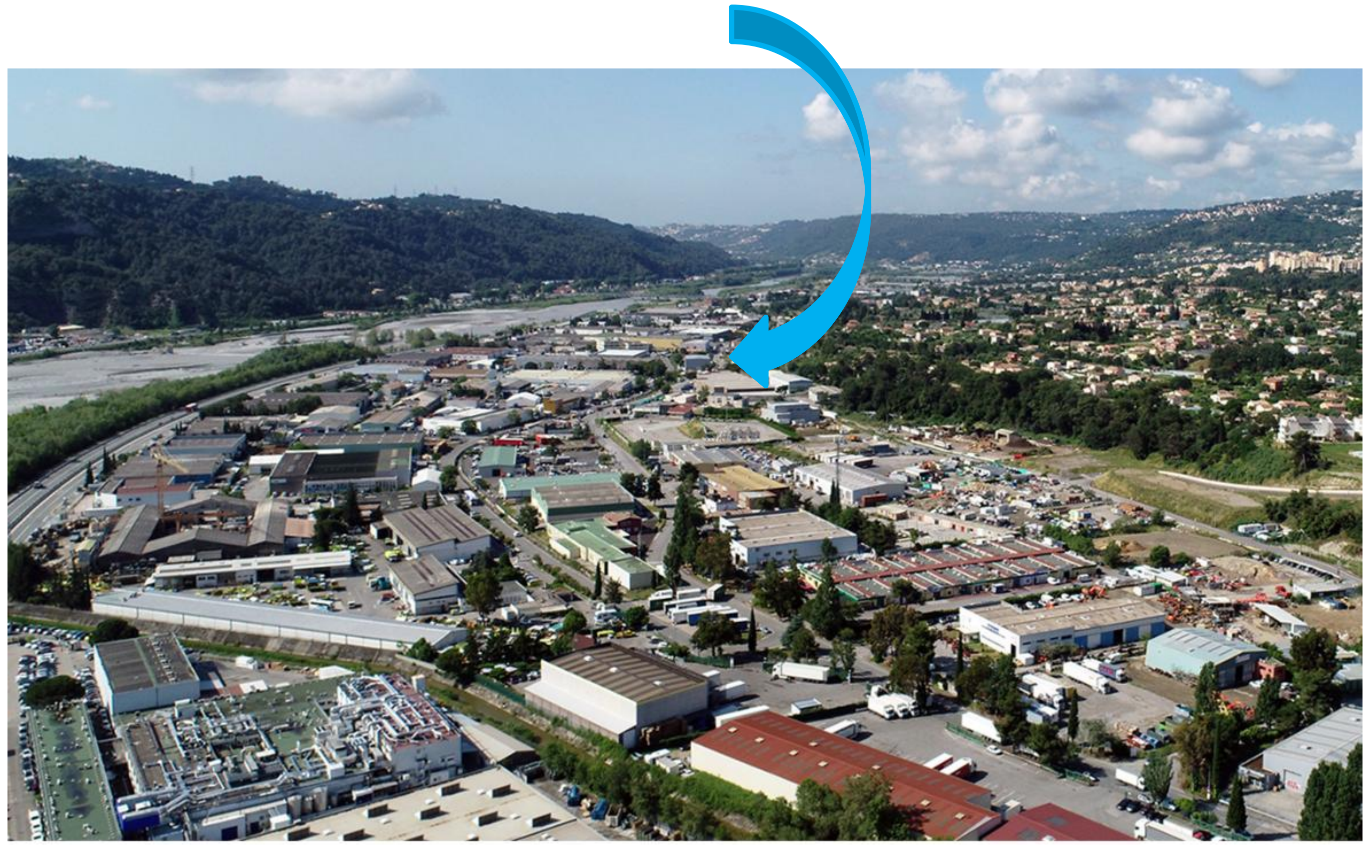




… still growing

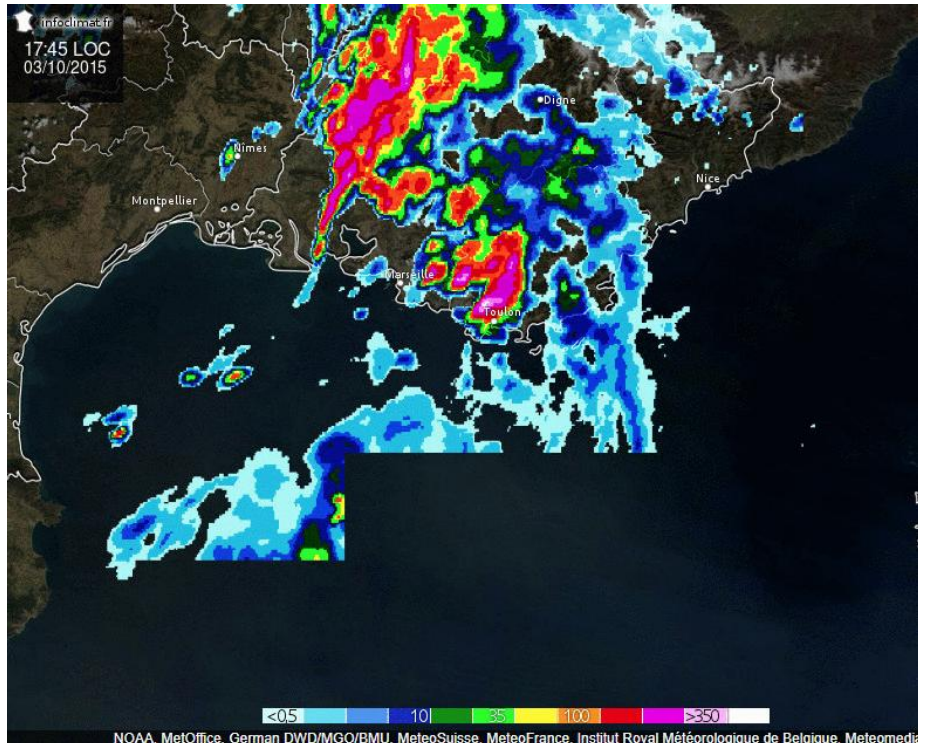
Eco-Valley &
Carros industrial area :

- ✓ 567 companies
- ✓ 11,750 jobs
- ✓ 188 hectares
- ✓ 2.4 billion EUR in annual turnover



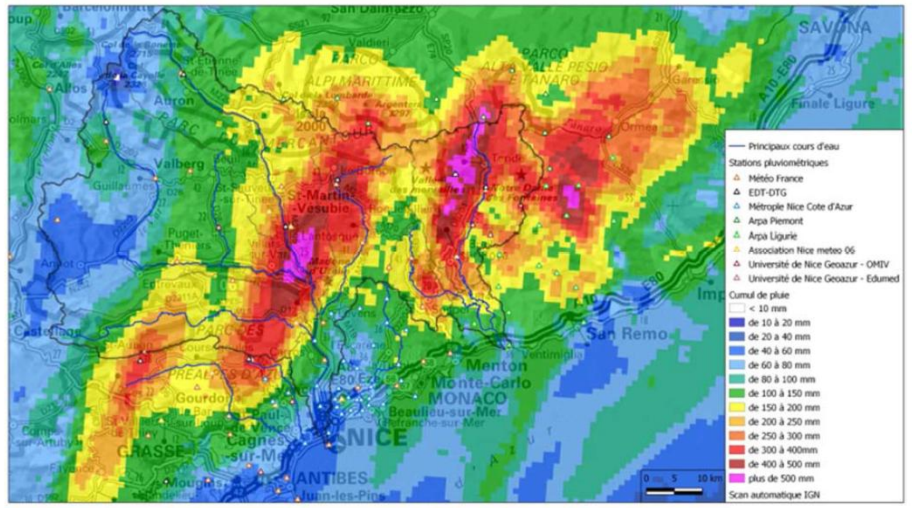
2- AquaVar: An initiative for the sustainable dev. and exploitation of a DSS for operators

2015 Oct.03 (Cannes)



Source: Météo-France

2020 Oct.02 Alex Storm



Source: Météo-France

2022–2023 : Drought in France

Major water issues to manage:

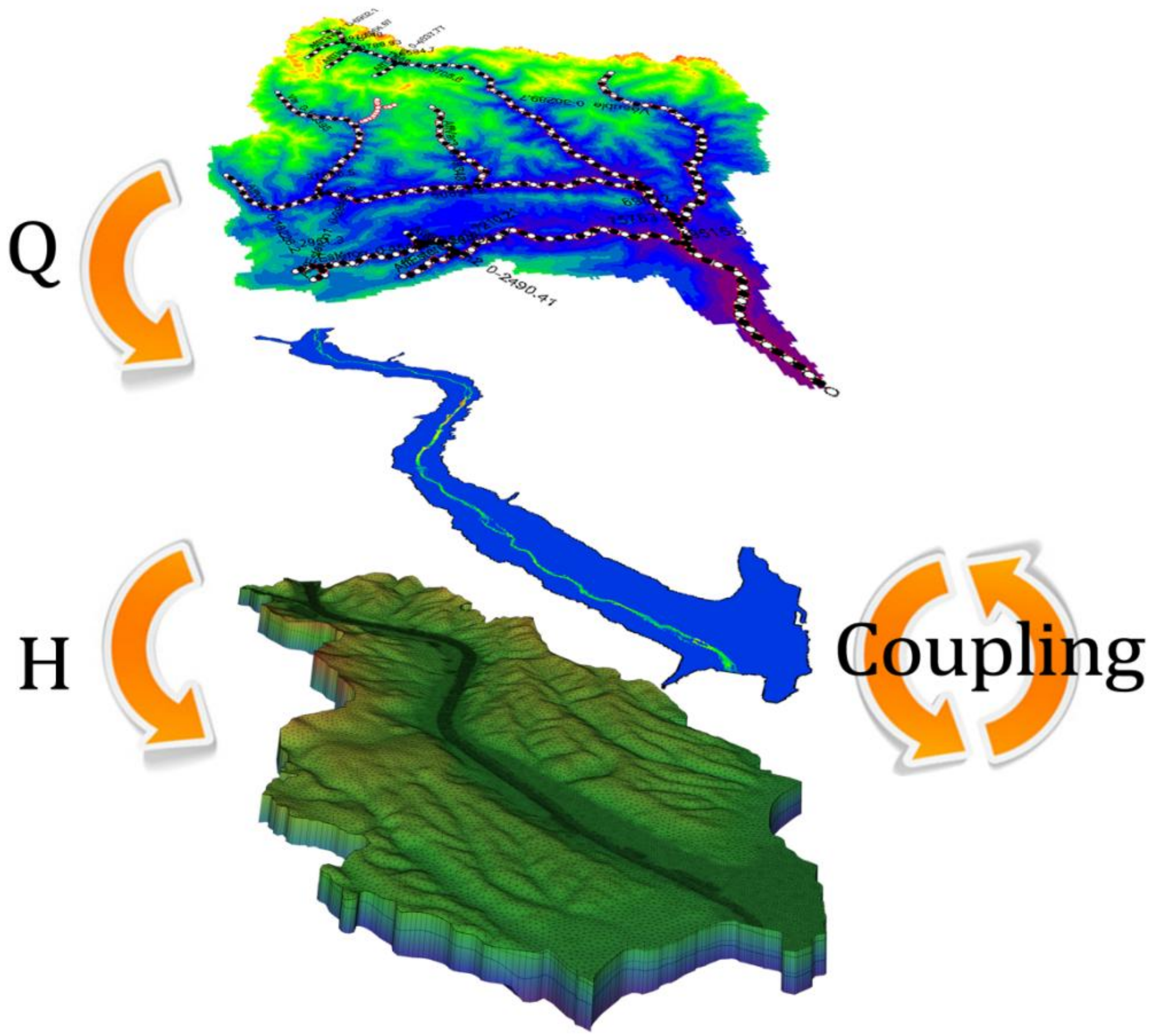
- ✓*Competition among water uses and increase of the water demand*
- ✓*Growing **vulnerability regarding floods***
- ✓*Major droughts associated to high consumption periods*
- ✓*Major **droughts** repeated over several consecutive years*
- ✓*Vulnerability of resources regarding **accidental pollutions***
- ✓*Need **to anticipate** difficult situations and to establish strategy for a sustainable drinking water supply to users*

2- AquaVar: An initiative for the sustainable dev. and exploitation of a DSS for operators

DEPG
DPGR
APE

Develop a simulation tool to manage:

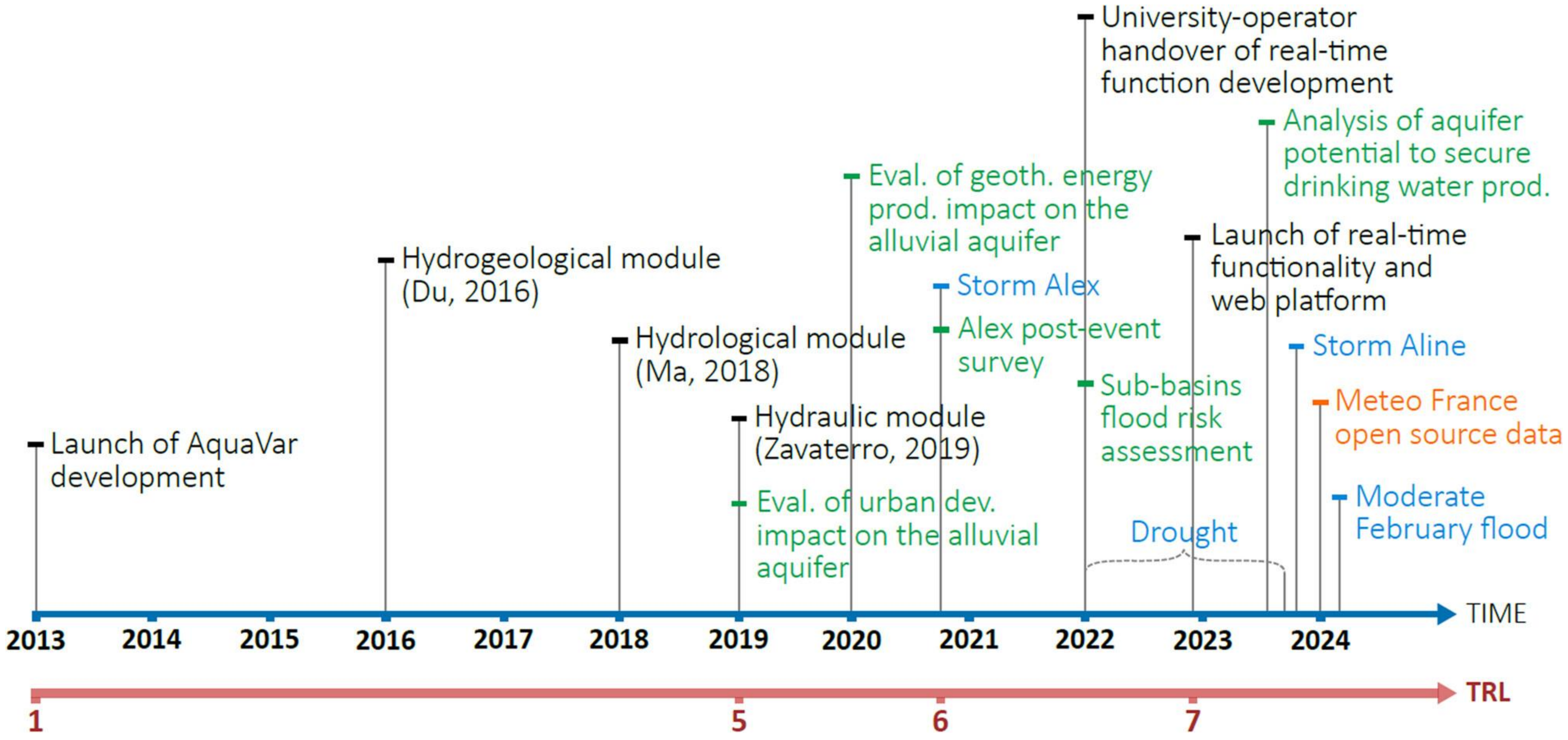
1. Integration of existing sensors for **real-time monitoring**
2. **Optimization of pumping** protocols and identification of new resources
3. **Saltwater Intrusion monitoring** and simulation
4. **Pollutant** Impact Assessment
5. Geothermal Impact Assessment
6. **Flood Extent**
7. Impact of New **Urban Developments**
8. Development of the tool and integration with the Nice Information System



2- AquaVar: An initiative for the sustainable dev. and exploitation of a DSS for operators

- **Development steps and launch of main features (2013-2019);**
- **Selection of one–off applications (2019-ongoing);**
- **Hydrological notable events (2021-ongoing);**
- **Change in access to DSS input data (2024-ongoing).**

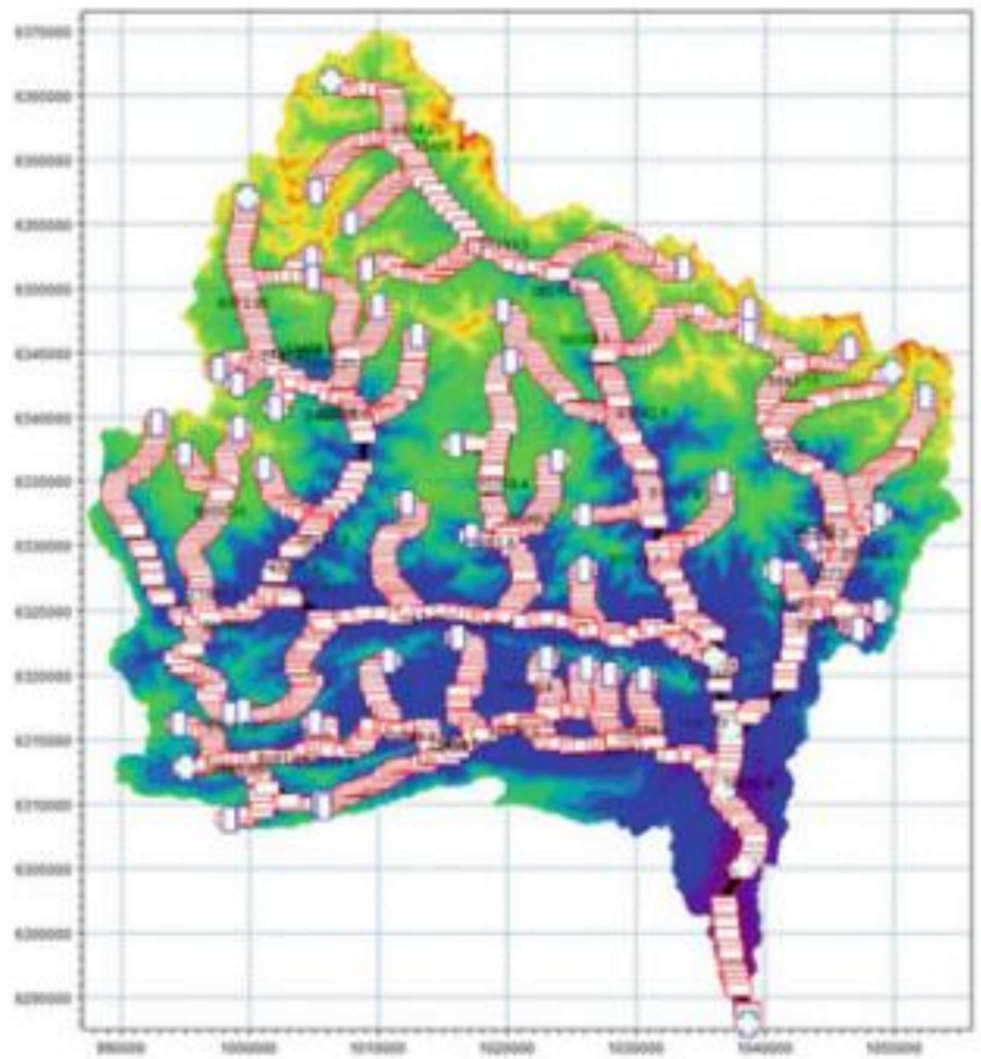
AquaVar development and operation timeline:



Picourlat, F. et al. (2025). AquaVar decision support system for water resource management: Lessons learned from the first five years of operation. *River*.

2- AquaVar: An initiative for the sustainable dev. and exploitation of a DSS for operators

2D Hydrological model + **2D Hydraulic** model + 3D **Hydrogeological** model



MIKE SHE

- **Full Var catchment (3,000 km²)**
- **100 m resolution**
- **Production of boundary conditions the 2 downstream models**

MIKE 21FM

- **High resolution**
- **From 25 m to 5 m**
- **25 km long**
- **Floodplain + all infrastructures**

FeFlow

- **High resolution**
- **From 75 m to 5 m**
- **7 layers**
- **Up to 600 m deep**

3- AquaVar : Interface and functionalities at a glance

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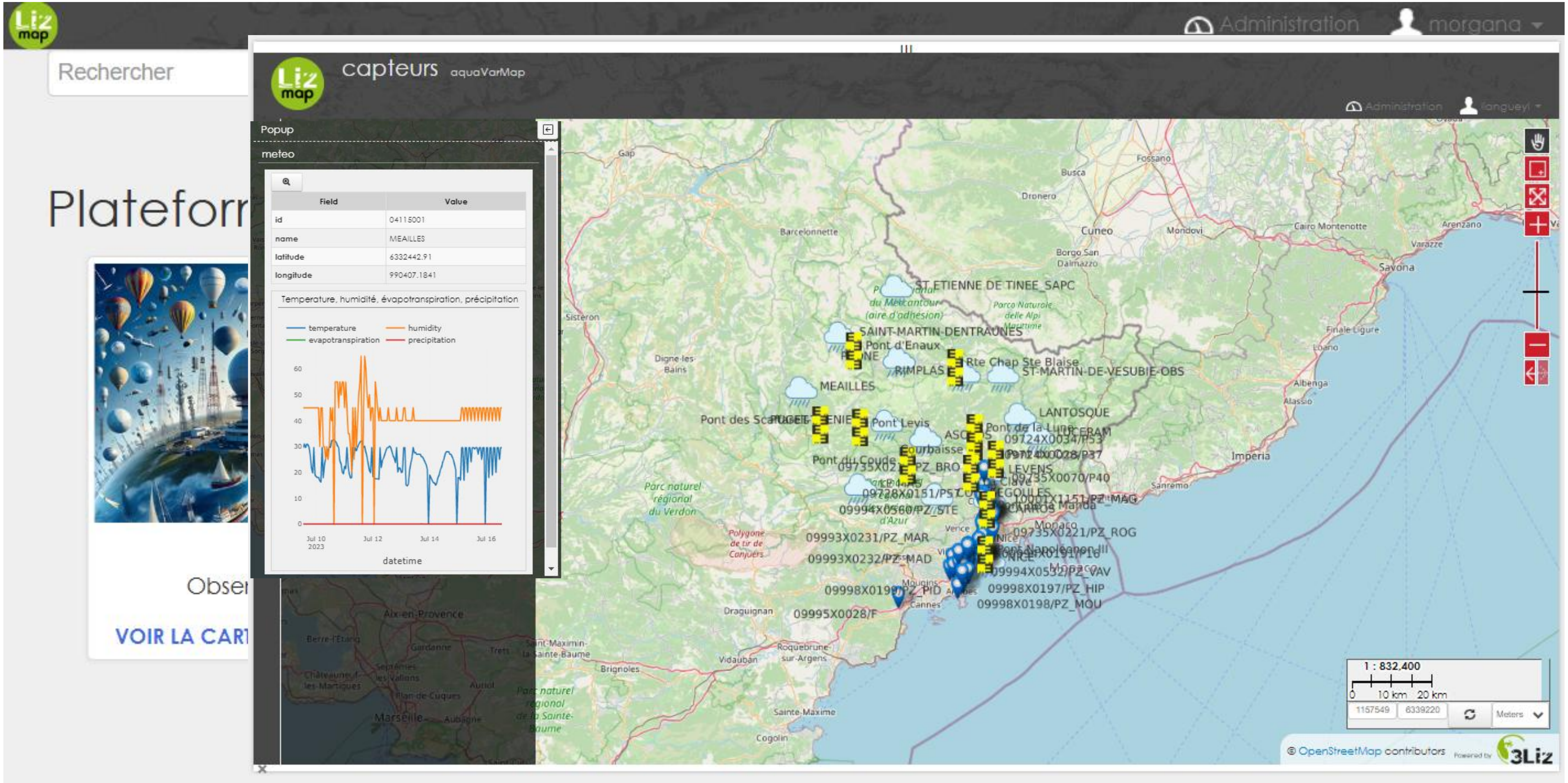

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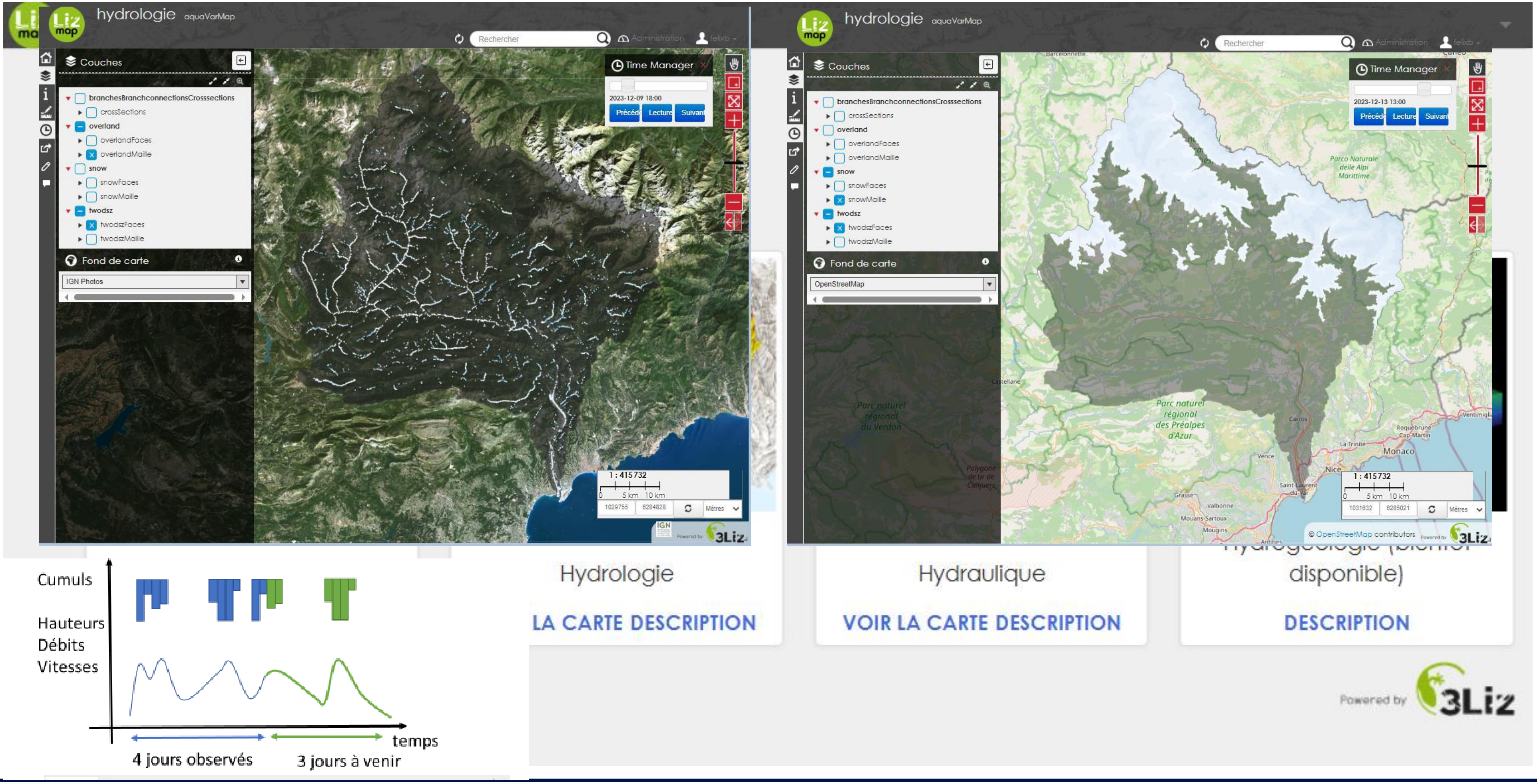

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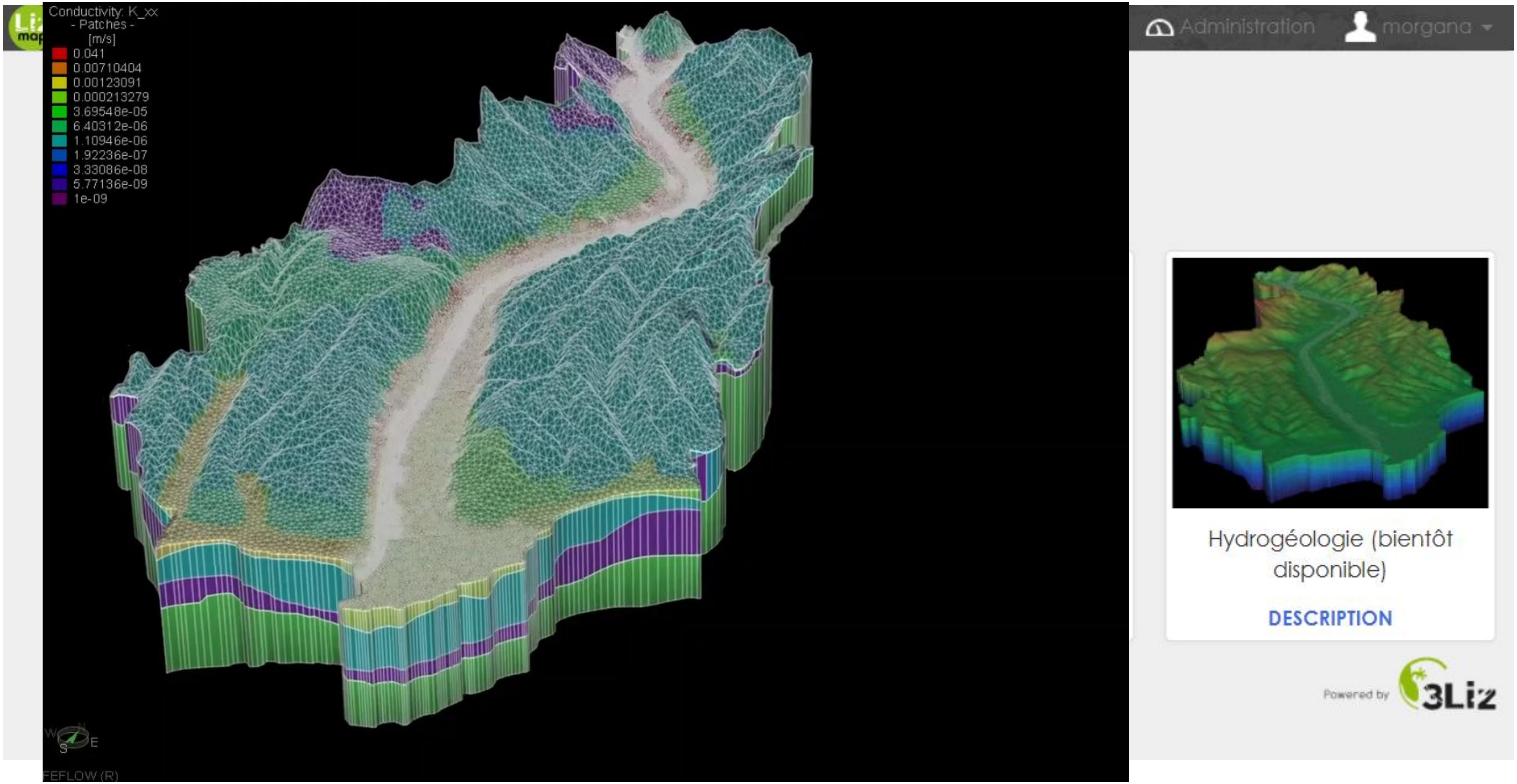

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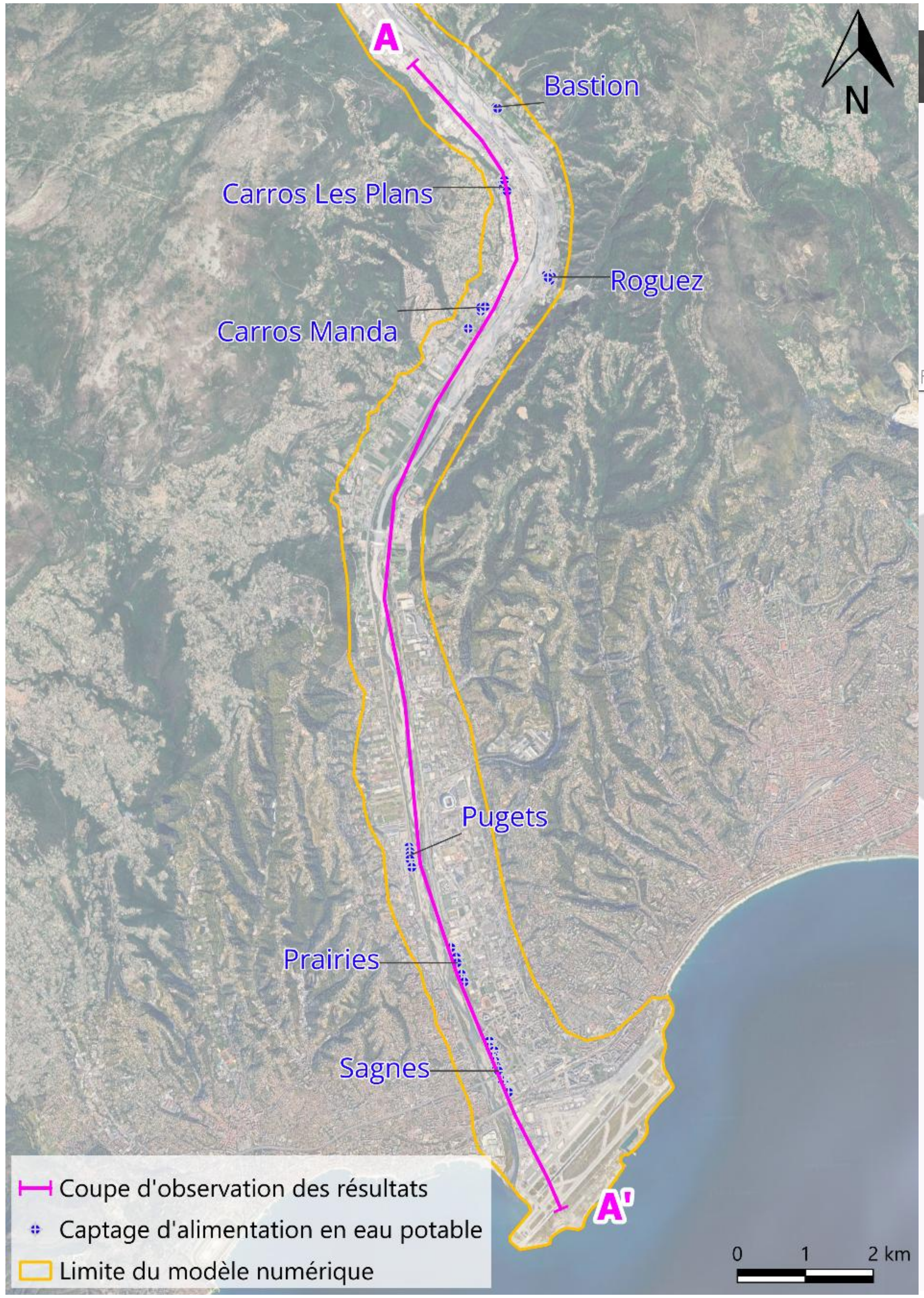

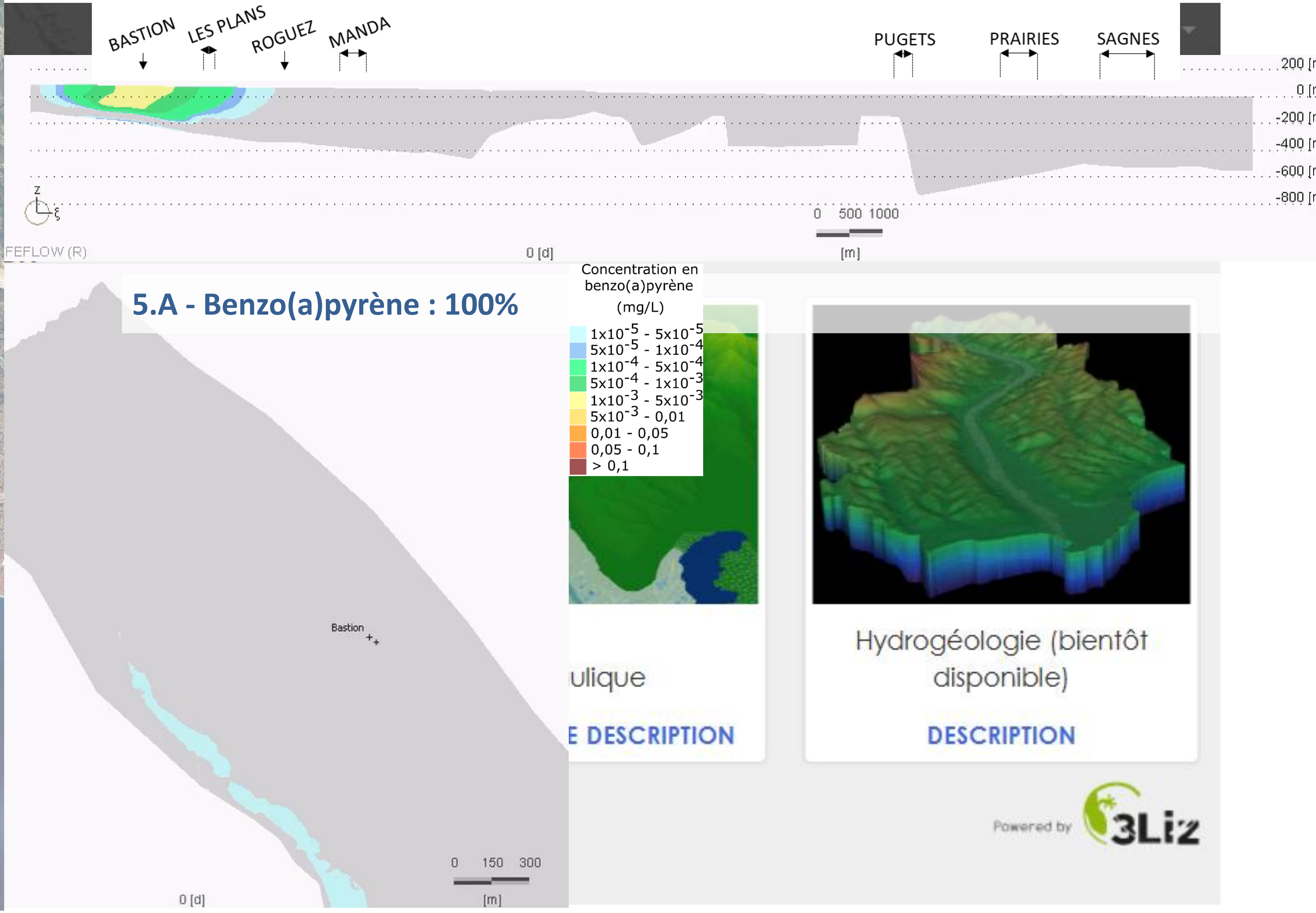

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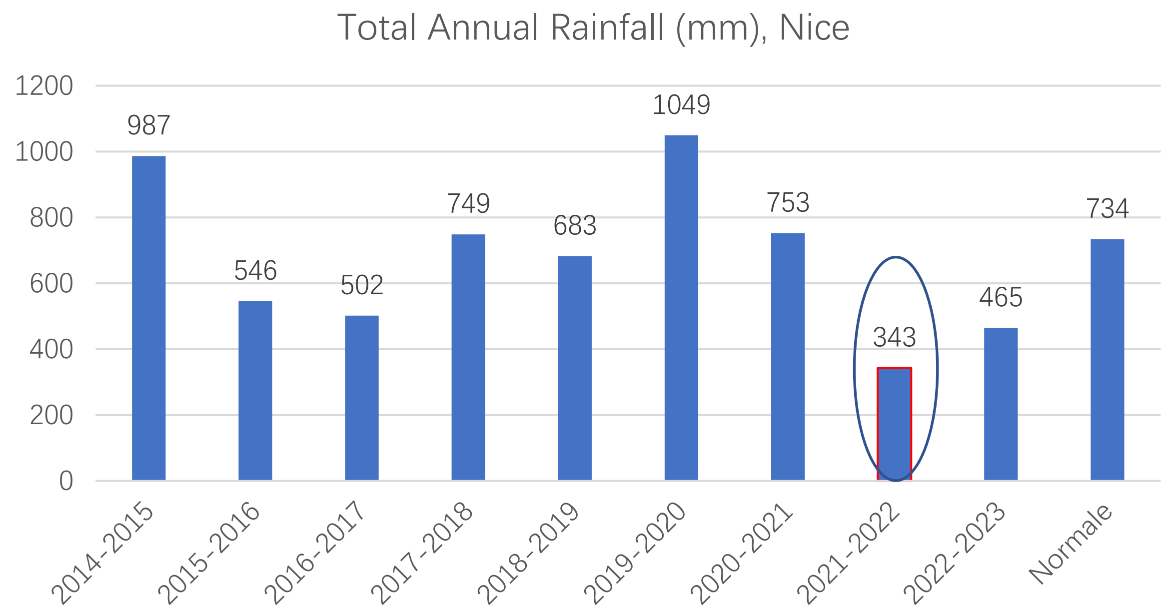
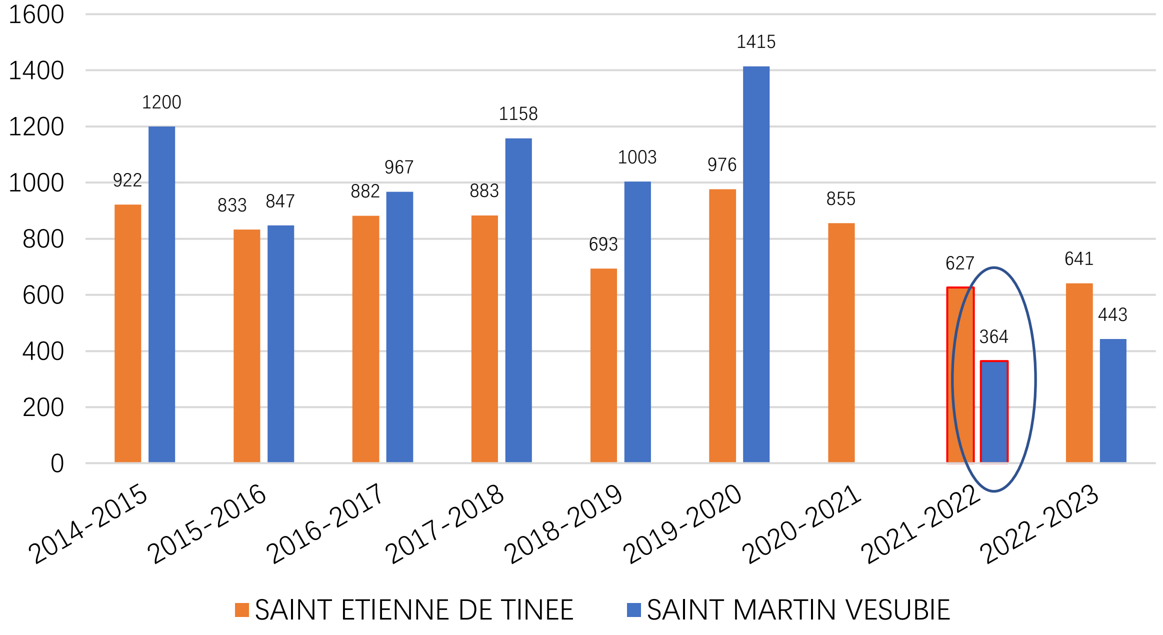
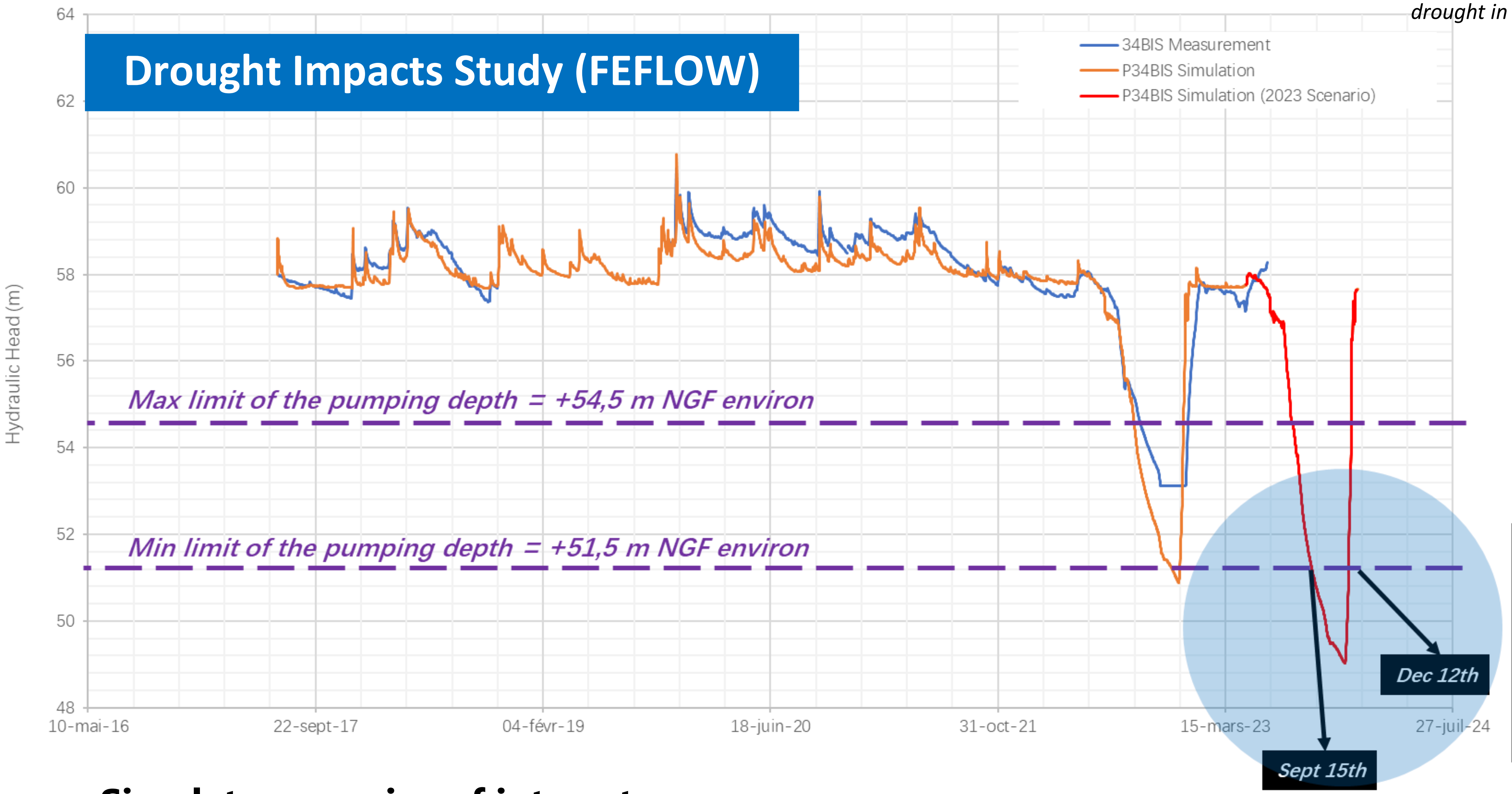




Lake Broc (top) and the Var River (bottom) during the drought in 2022



There is risk of low water for pumping for 2 months (Sept 15th – Dec 12th)

Simulate scenarios of interest:
e.g. what if 2022 drought occurs a second time?

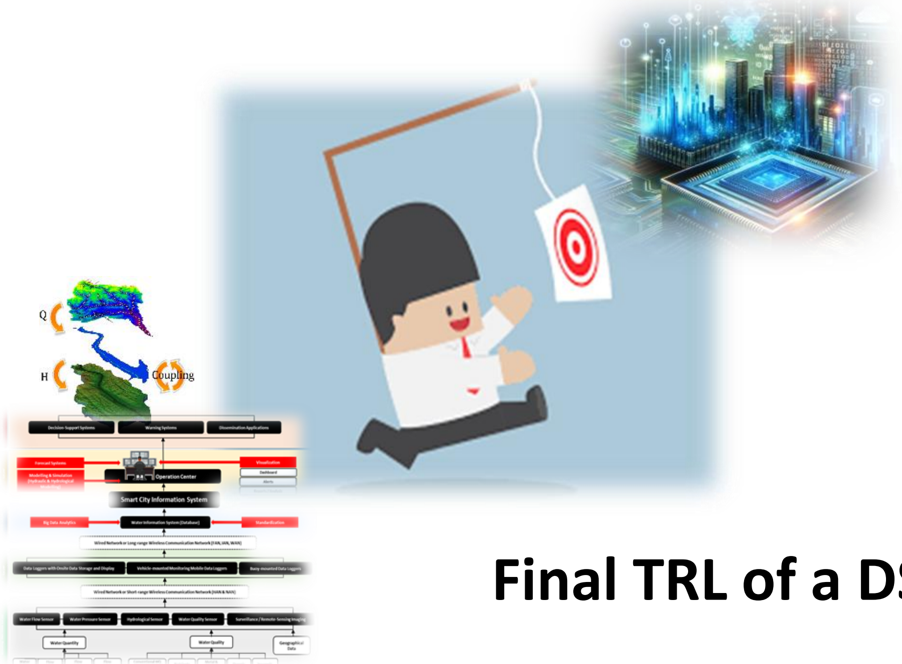
4- DSS development through collaboration: Feedback

The strengths of this DSS development and scheme

1. **Joint** research and development
2. **Unlocking** administrative boundaries
3. **Maximizing** the use of **public money**
4. Learning and **replication** of the solution (two **DSS in development**)
5. Collaboration resiliency
6. **Long-term investment** and **slow** development
7. Allows for **evolution and innovation** (new Post-docs (4) and Ph.Ds (2))

Challenges to overcome

1. Three different administrations: Failure to **act quickly**
2. Long-term investment and slow development: maintain the **commitment of the partners**
3. **Cost** of maintaining the DSS due to some functionalities (real-time)



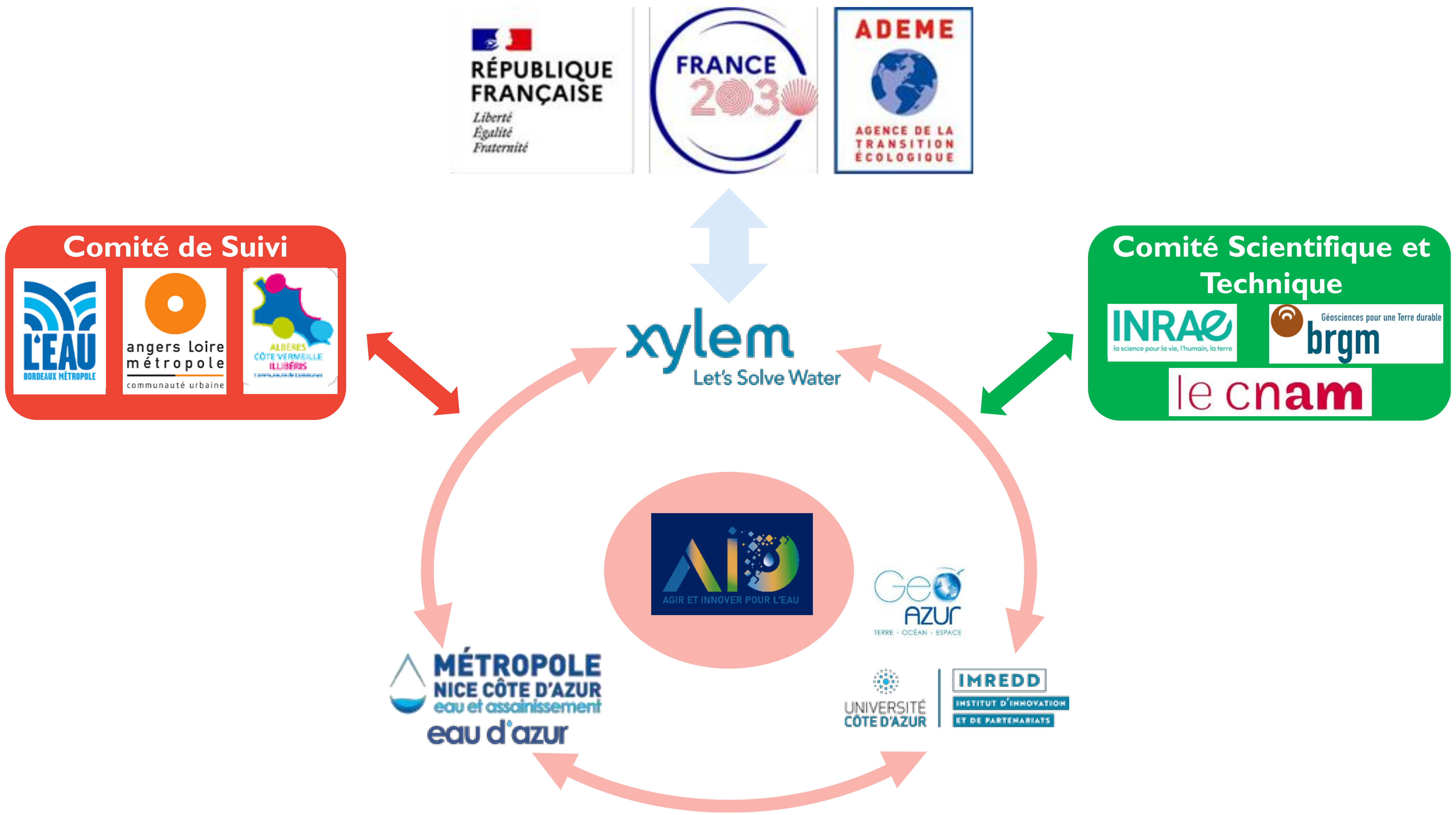
Final TRL of a DSS, in that configuration, is a moving target

4- DSS development through collaboration: R&D perspectives

Objective: AquaVar Digital Twin Enhancement and integration in Hypervision

2025 2026 2027

AGIR ET INNOVER POUR L'EAU



Ambitious project to developpe Hypervision for the metropolitan area

For the AquaVar part, started in 2025 @ University Côte d'Azur:

- 4 Postdoctoral Researcher➔ Ongoing enhancement
- 2 Junior researcher (Ph.D. Candidates)➔ Future functionalities development
- 2 Engineers➔ replicability and development

4- DSS development through collaboration: R&D perspectives

AGIR ET INNOVER POUR L'EAU

Objective: AquaVar Digital Twin Enhancement and integration in Hypervision

OBJECTIVES:

Methodological development

•Maximize the use of open-access climatological, meteorological, and hydro(geo)logical data

•Integrate remote-sensing data into real-time hydrological models

Acquire new knowledge on resources

•Geological modeling of karstic and alluvial aquifers

•Morphological and sedimentary evolution of the Lower Var Valley

•Recharge modeling: groundwater–river interactions

Anticipate the use of water reuse (REUT) and non-conventional resources

•Strategic planning using hydroinformatics tools

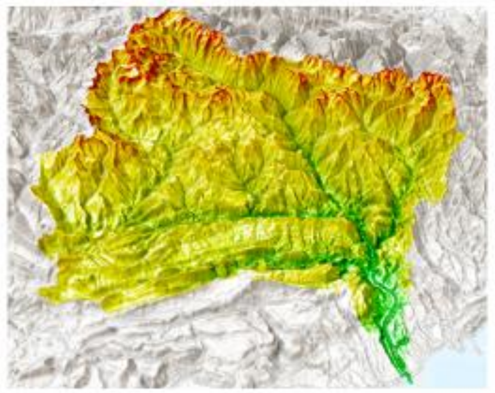
•Water reuse (REUT) and de-impermeabilization (reducing soil sealing)

4- DSS development through collaboration: R&D perspectives

Objective: AquaVar Digital Twin Enhancement and integration in Hypervision

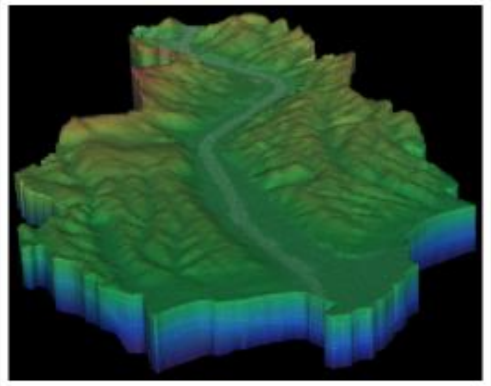
Observations

✓ **Ontology**



Hydrologie

Hydraulique



Hydrogéologie (bientôt disponible)

✓ **Integrating Remote sensing data**

- **Rainfall/ET/SM products**
- **Snow cover maps**
- **DEMs (monthly/seasonal maps)**

✓ **River hydro-sedimentary assessment**

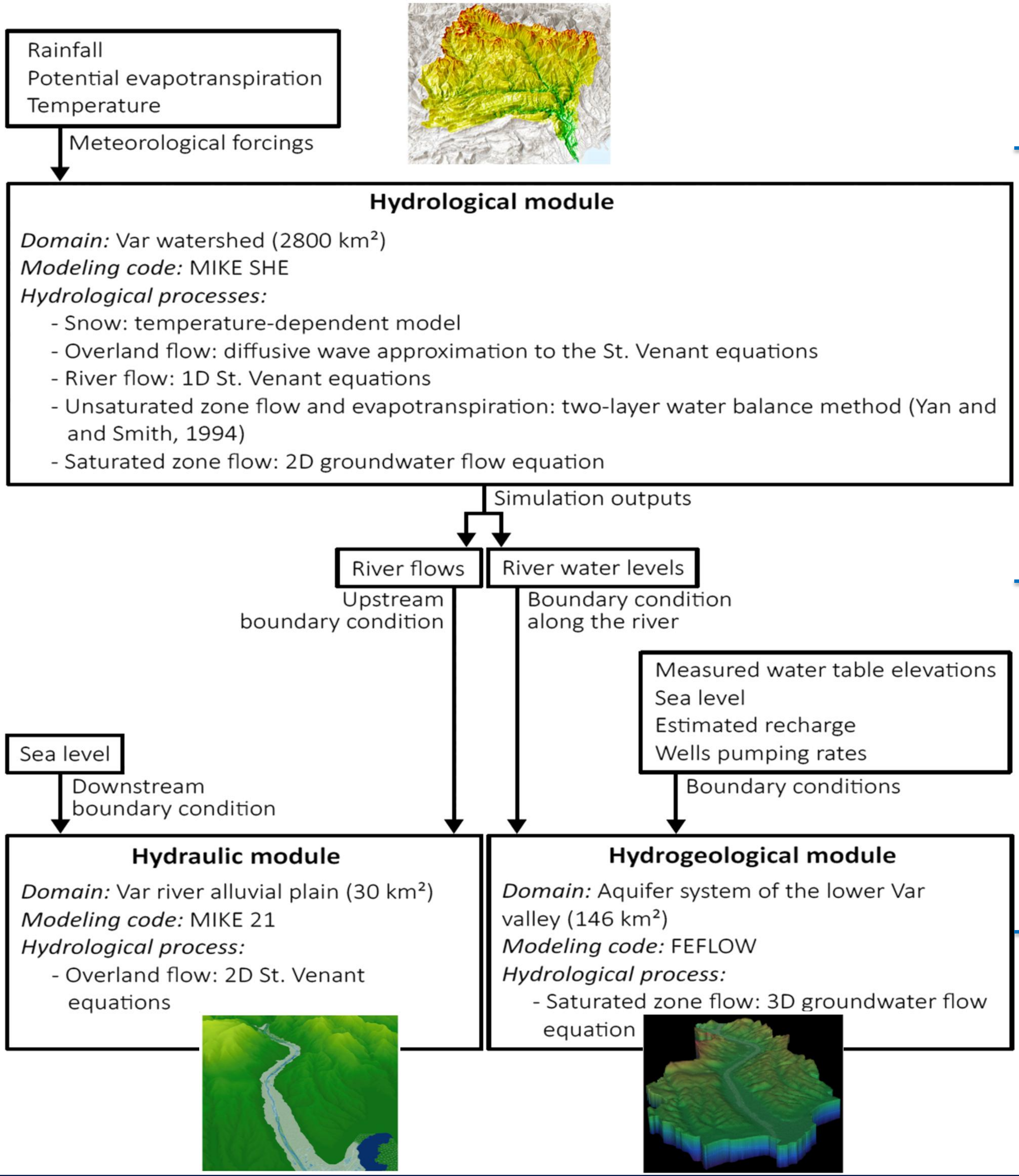
- **Hydro-morphological evolution of the Var valley**
- **Integration of debris-flow risk assessment**

✓ **River-Aquifer Interaction**

✓ **Hydrogeo-chemistry & Hydrogeo-physics**

✓ **Non-Conventional water (REUT & SUDS) and hydroinformatics**

4- DSS development through collaboration: R&D perspectives



AIO Project (Agir et Innover pour l'eau, 2025-2028)

AquaVar Digital Twin Enhancement and integration in Hypervision

✓ Integrating Remote sensing data

- Rainfall/ET/SM products
- Snow cover maps
- DEMs (monthly/seasonal maps)

✓ River hydro-sedimentary assessment

- Hydro-morphological evolution of the Var valley
- Integration of debris-flow risk assessment

✓ River-Aquifer Interaction

✓ Hydrogeo-chemistry & Hydrogeo-physics

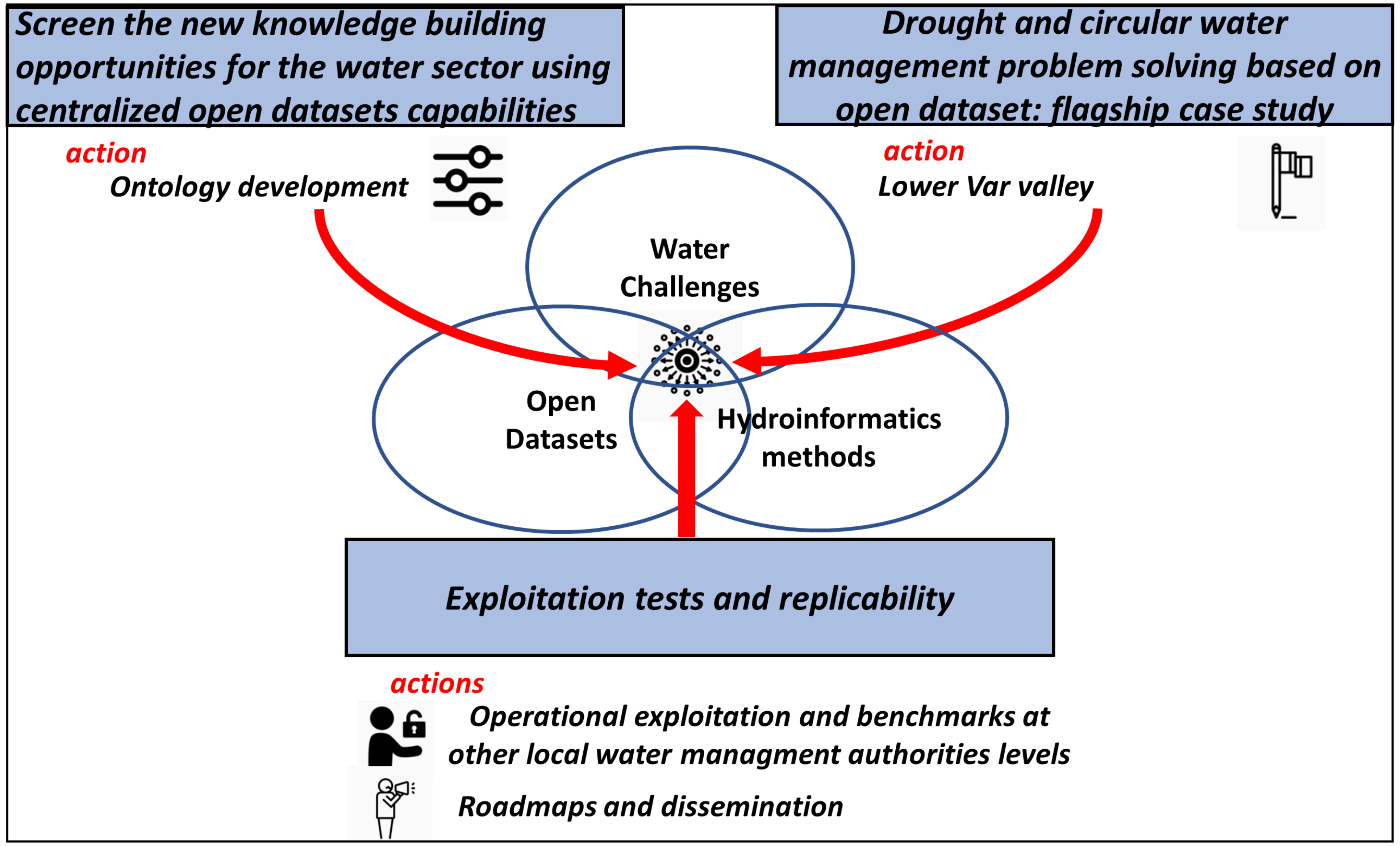
✓ Non-Conventional water (REUT & SUDS) and hydroinformatics

4- DSS development through collaboration: R&D perspectives *(by AMRAOUI Allaedine)*

OBJECTIVE: Map the interdependencies between water-management challenges, open data sets from European/national agencies, and hydroinformatics modelling tools

Brief description – will allow to:

1. assess data sets and methods to optimize reproducibility;
2. improve the adaptability and scalability of the resource-management module;
3. ensure efficient operation under varying data/knowledge conditions (create routing methods to reproduce approaches at different levels of maturity);
4. integrate advancements to ensure the long-term sustainability of the resource-management module.



- ➤ Create and implement ontology frameworks using languages such as OWL, RDFS, and SPARQL.
- ➤ Develop a flagship case study on combating water scarcity in the Var River basin (France)

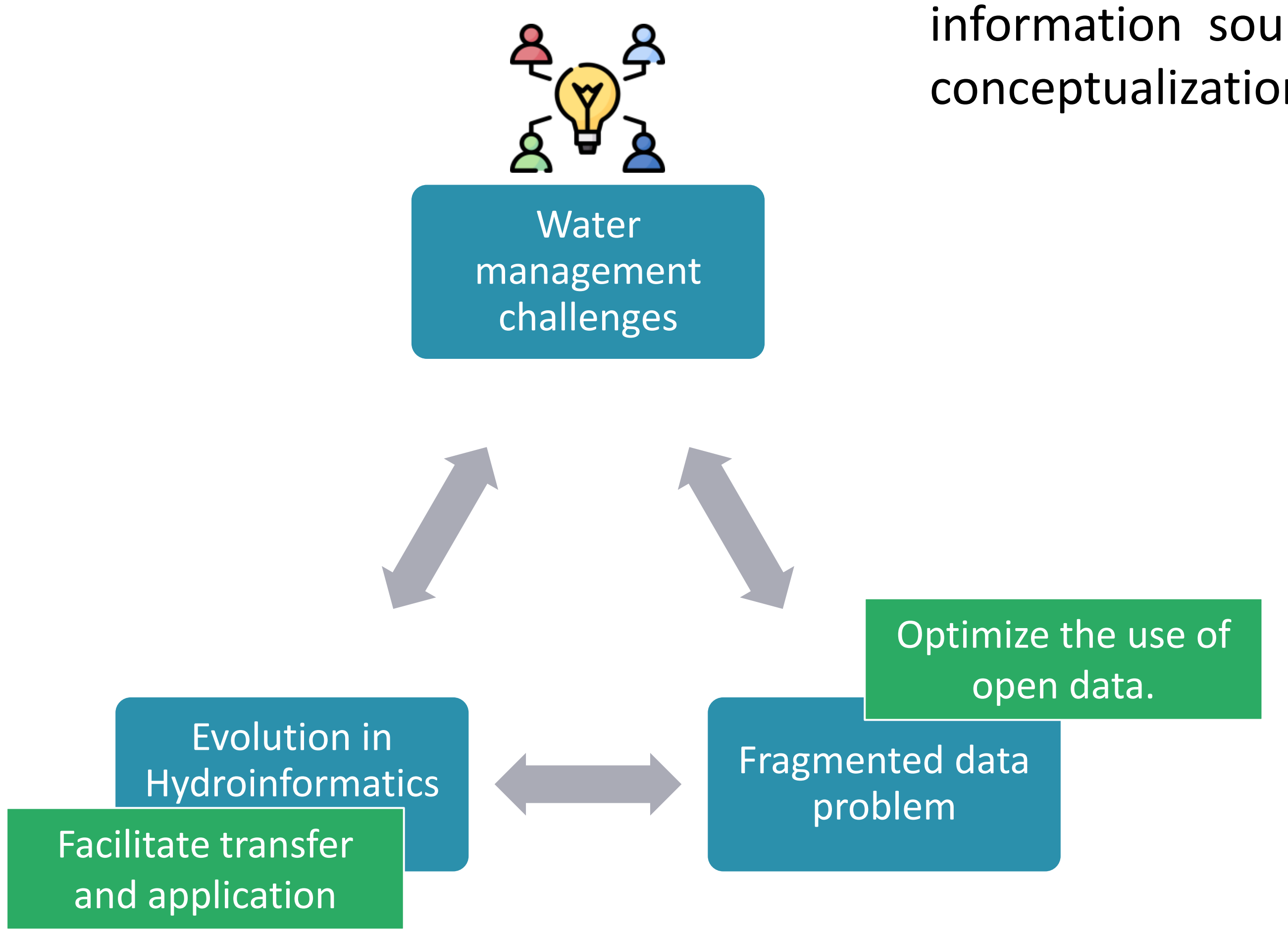
4- DSS development through collaboration: R&D perspectives *(by AMRAOUI Allaedine)*

OBJECTIVE: Map the interdependencies between water-management challenges, open data sets from European/national agencies, and hydroinformatics modelling tools

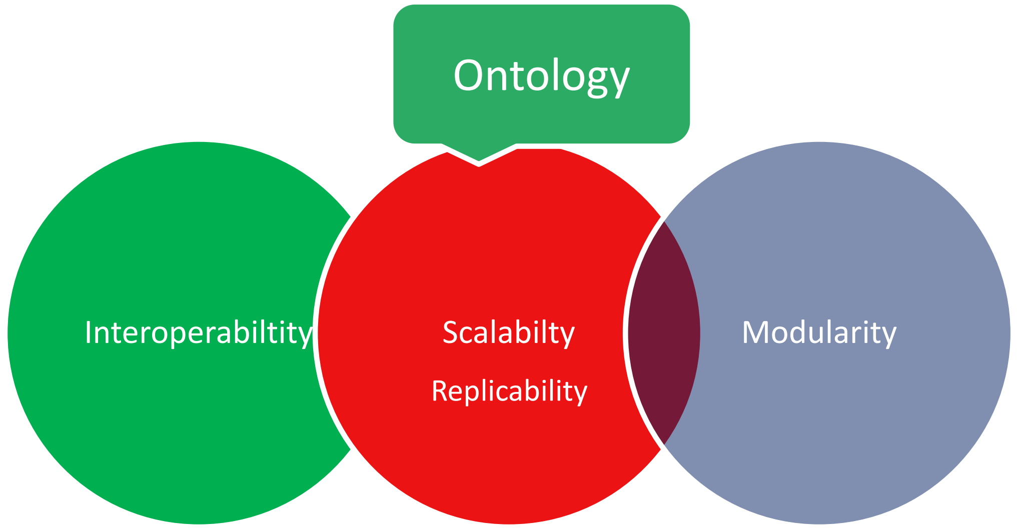
Context: Why an Ontology for Water Management DSS?

*"In computer science and information science, an ontology encompasses a representation, formal naming and definition of categories, properties and relations between the concepts, data and entities that substantiate one, many or all domains of discourse."**

*Gray, J., Rumpe, B. On the relationship between models and ontologies. Softw Syst Model 21, 1271–1272 (2022).



What we need is to **aggregate**, **structure** and **organize** these information sources and techniques under a standardized conceptualization.

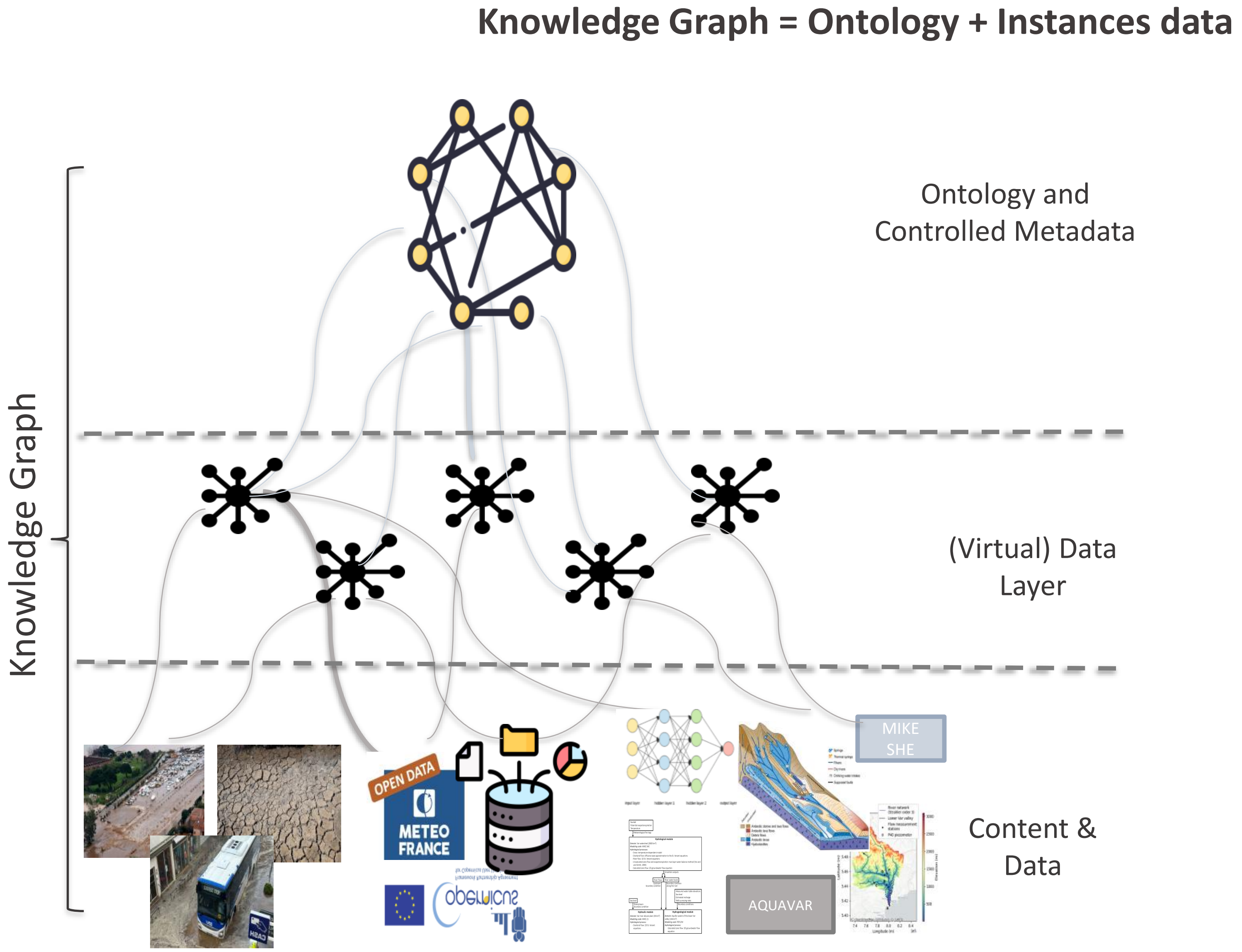


In most use cases, an organization uses ontologies to describe what it knows and it wants to know and to connect concepts to data/content for knowledge management and information retrieval.

Typically represented in **OWL (Web Ontology Language)** or **RDFS**, following W3C standard.

4- DSS development through collaboration: R&D perspectives *(by AMRAOUI Allaedine)*

OBJECTIVE: Map the interdependencies between water-management challenges, open data sets from European/national agencies, and hydroinformatics modelling tools



"A knowledge graph acquires and integrates information into an ontology and applies a reasoner to derive new knowledge." Ehrlinger, L., & Wöß, W. (2016). Towards a definition of knowledge graphs. SEMANTiCS (Posters,Demos, SuCCESS), 48(1-4), 2.

- Databases remain essential for **storing** and **managing** raw data.
- Many **heterogeneous databases**: different formats, schemas, and vocabularies.

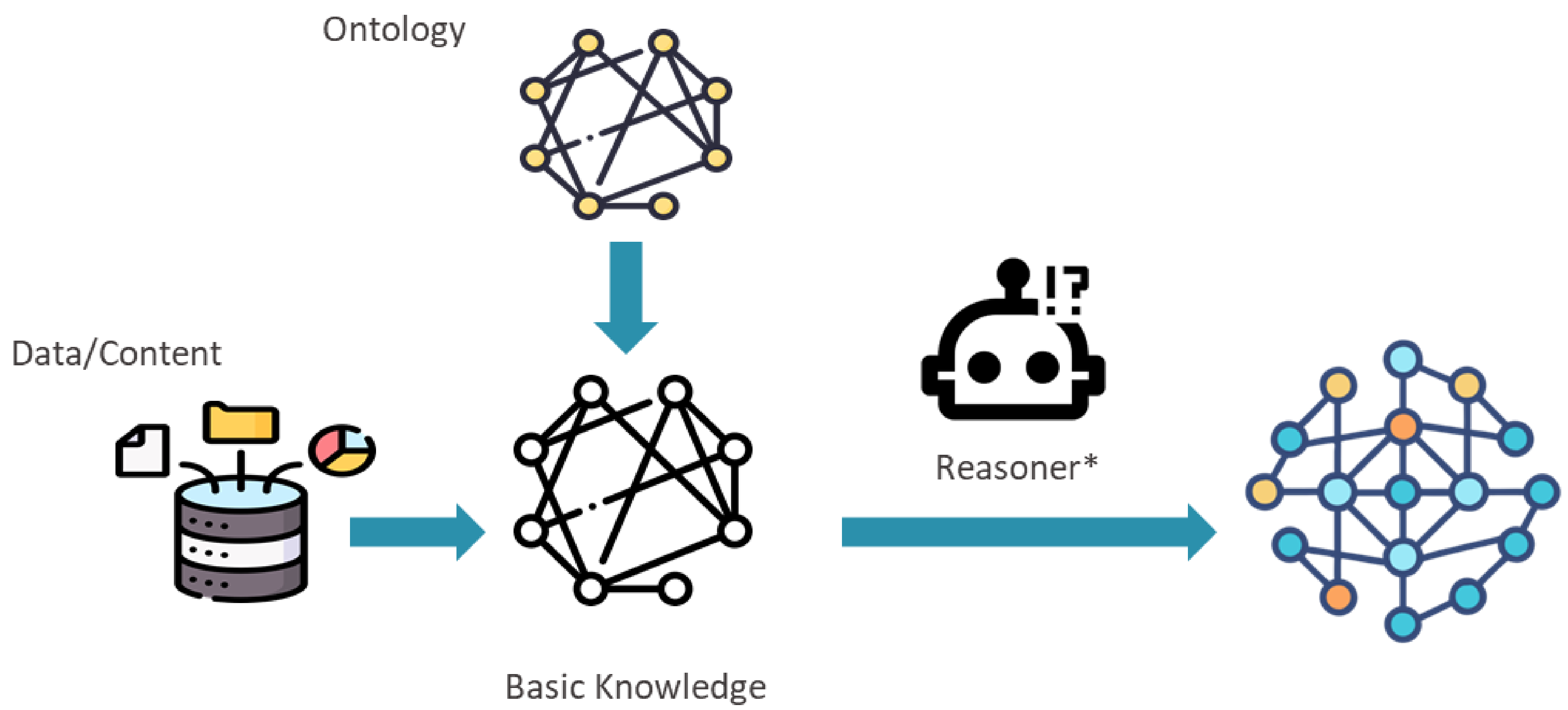
- Ontology sits on top of these databases as a **semantic layer.**
- Providing a **shared vocabulary** and defining how concepts in one dataset **relate** to concepts in another.

And together, they allow us to **reason**, **query**, and **analyze** information in an integrated way.

4- DSS development through collaboration: R&D perspectives *(by AMRAOUI Allaedine)*

OBJECTIVE: Map the interdependencies between water-management challenges, open data sets from European/national agencies, and hydroinformatics modelling tools

Knowledge Graph = Ontology + Instances data



*Infer connections between objects/concepts that are not explicitly described to supportnew information building based on the logic of the knowledge graph. It use axioms/rules which describe conditions that are generally true about the specific domain(s). Vergara, I. V., & Lee, L. C. (2023). A schematic review of knowledge reasoning approaches based on the knowledge graph. Journal of Enterprise and Business Intelligence, 3(3), 179-189.

What can you do with a Knowledge Graph ?

- **Integrated search across sources:**
Explore data from hydrological models (MIKE SHE, FEFLOW), monitoring databases (Aquavar, Météo-France, EEA), and scientific repositories in a unified way.

- **Discovery across heterogeneous content:**
Connect structured (time series, indicators) and unstructured (reports, publications, policy documents) information to support decision-making.

- **Enhanced decision support:**
Enable more targeted recommendations for water allocation, drought mitigation, or flood risk management.

- **Visualization of interlinked water data:**
Provide clear, interactive maps and graphs linking events (e.g., *Drought 2022*), indicators (groundwater levels, runoff), and management policies.

- **Foundation for AI-based applications:**
Power predictive models, anomaly detection, and scenario simulations by leveraging the structured relationships in the KG.

4- DSS development through collaboration: R&D perspectives *(by Dr. OUASSANOUAN Youness)*

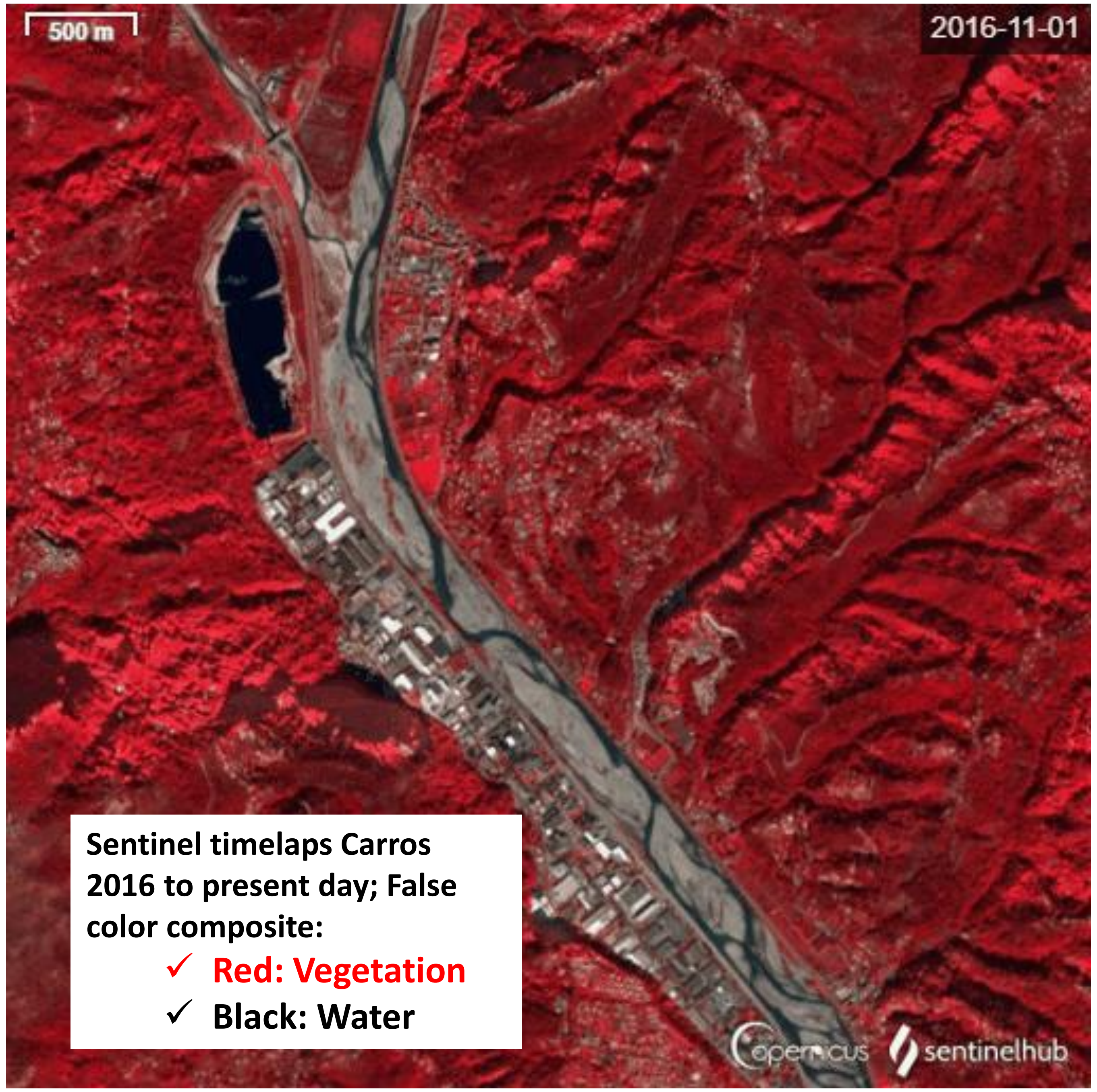
OBJECTIVE: develop an operational methodology for integrating remote-sensing data on spatio-temporal hydromorphological evolution, snowpack dynamics, etc., into physically based numerical models of the AquaVar decision-support tool.

Brief description – will allow to:

Produce scripts for processing satellite data to generate numerical indicators and dedicated cartographic products, including in particular:

1. a snow-covered area computed from satellite observations over the Var watershed;
2. quantification of sediment transport and assessment of channel migration in a braided river (time-evolving DEMs);
3. “snow” and “morphology” indicators derived from satellite images of a territory.

→ Creation of new monitoring indicators



Sentinel timelaps Carros 2016 to present day; False color composite:

- ✓ Red: Vegetation
- ✓ Black: Water

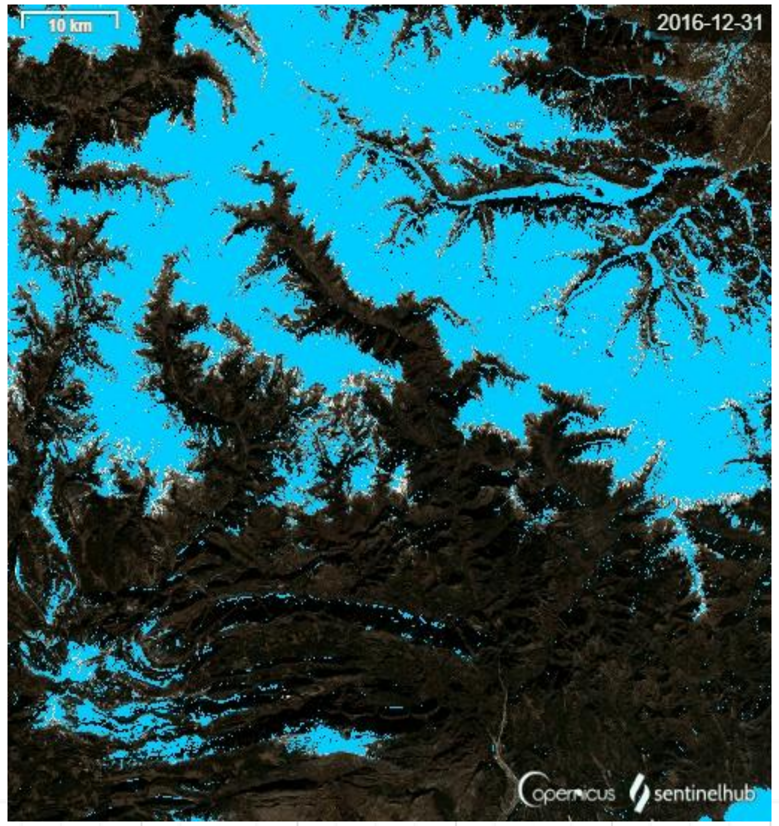
4- DSS development through collaboration: R&D perspectives *(by Dr. OUASSANOUAN Youness)*

OBJECTIVE: Integrating remote-sensing data on spatio-temporal hydromorphological evolution, snowpack dynamics, etc., into physically based numerical models of the AquaVar decision-support tool.

Time-laps Snow cover 2016 to 2025 (Sentinel-2)

Natural color composites

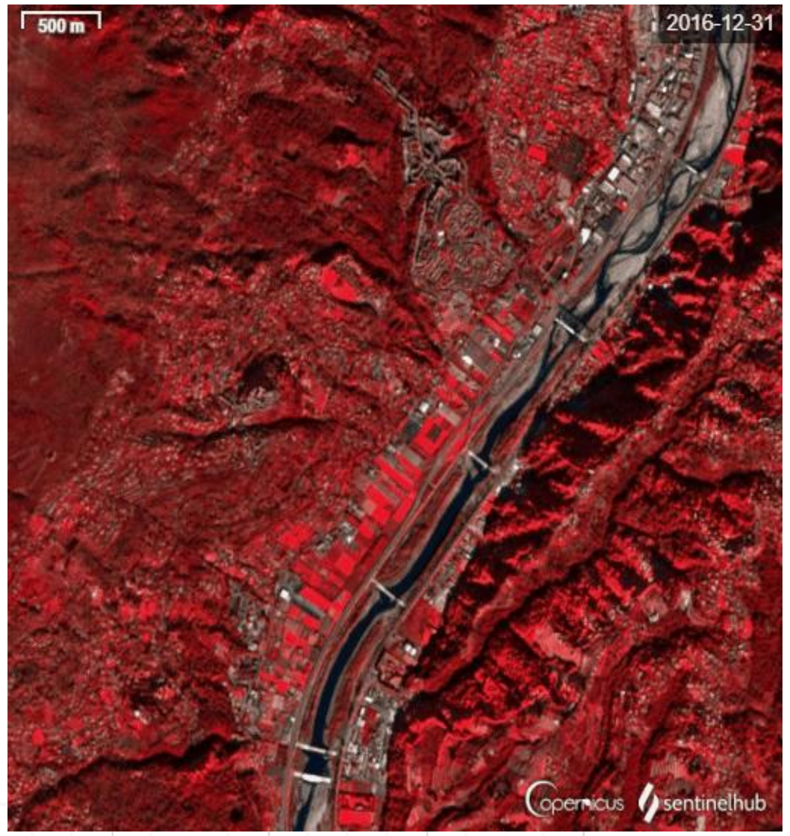
- Snow: Blue cian
- Clouds: White

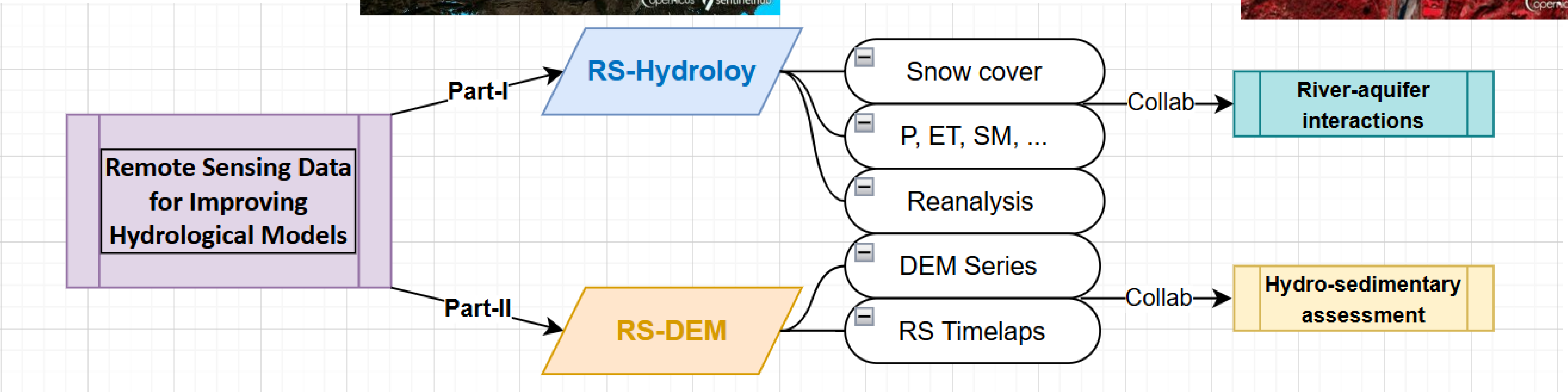


Time-laps 2016 to 2025

False Color Composites:

- ✓ Red: Vegetation
- ✓ Black: Water





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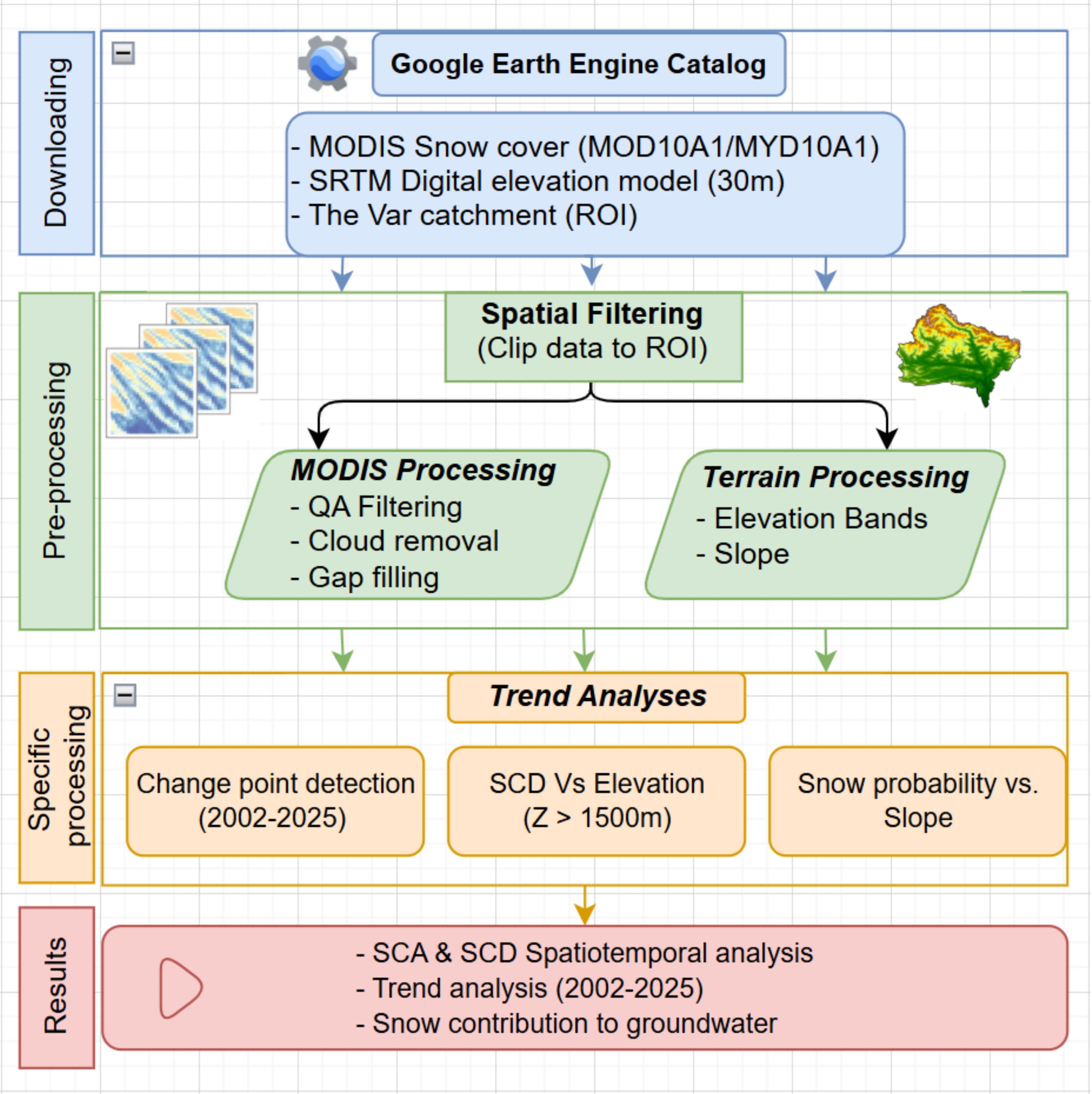
Script overview



Pipeline-Python script

- Downloading
- Pre-processing
- Specific processing
- Results

Product: Snow Perimeter calculated based on satelite observations over the Var cachment

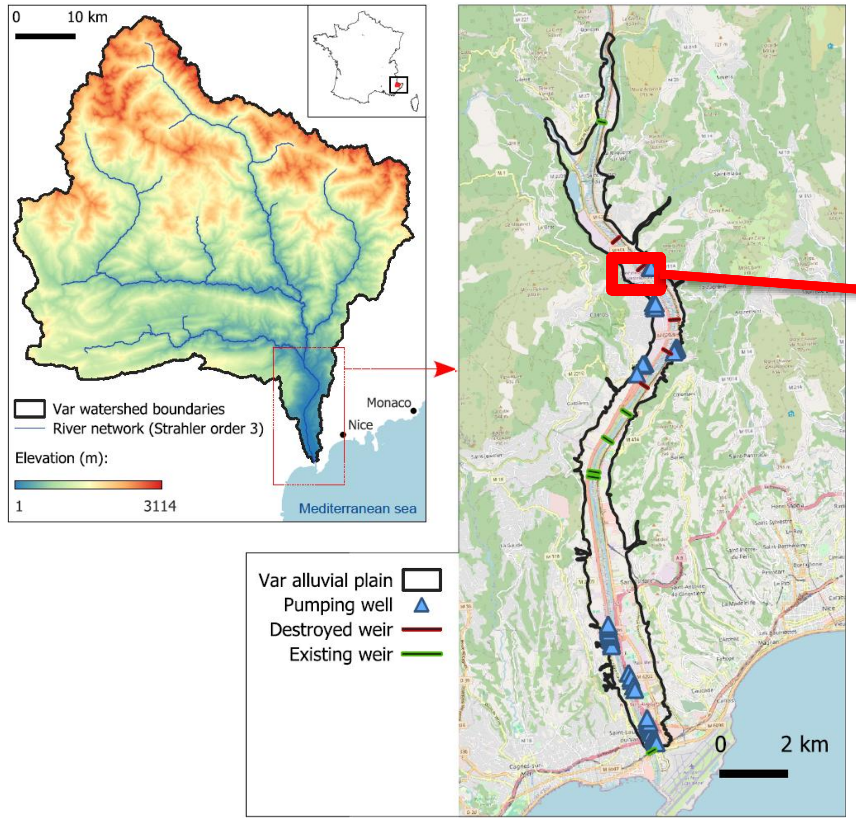
4- DSS development through collaboration: R&D perspectives *(by Dr. PICOURLAT Fanny)*

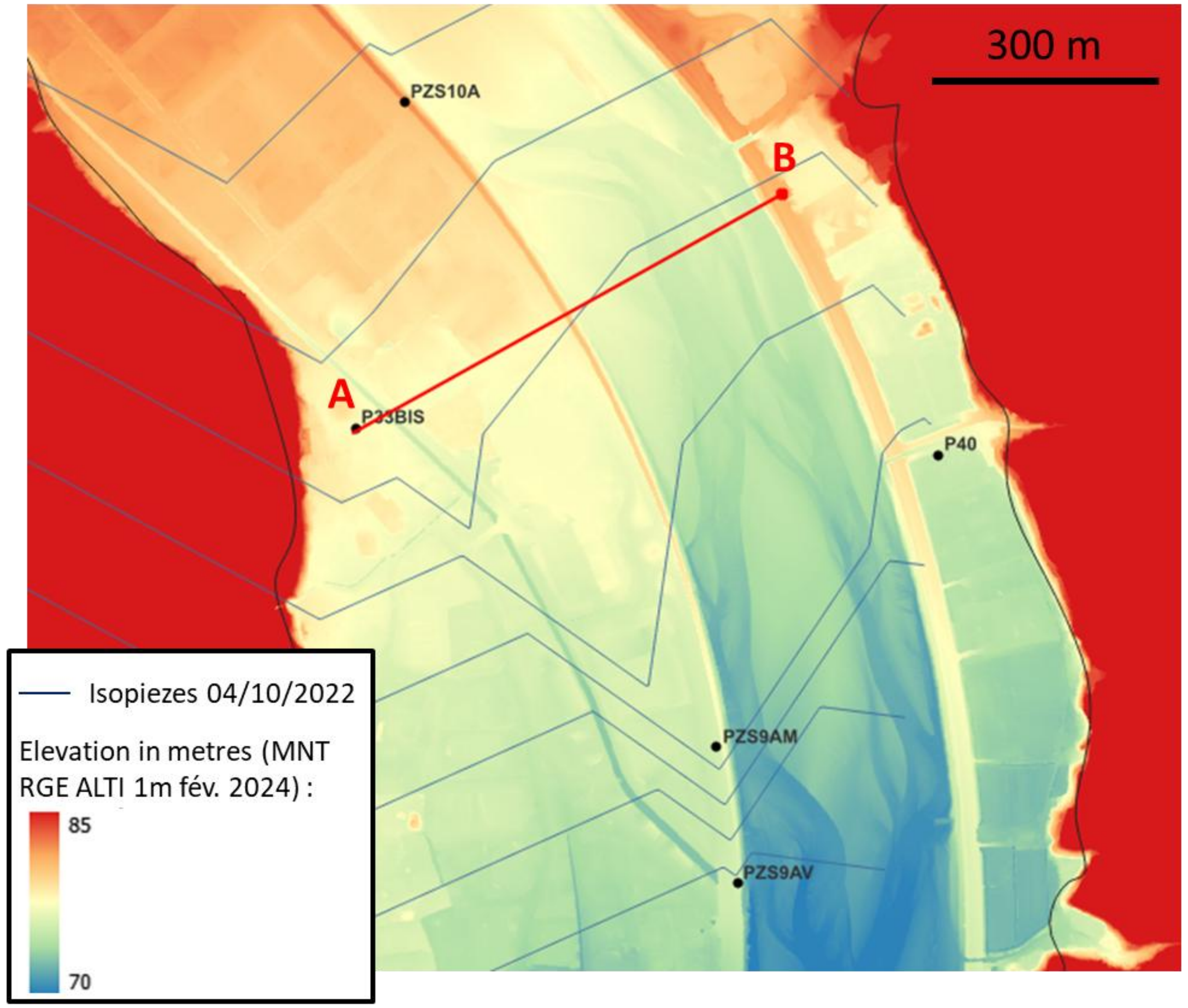
Objective: Improve knowledge of groundwater/river interactions in order to:

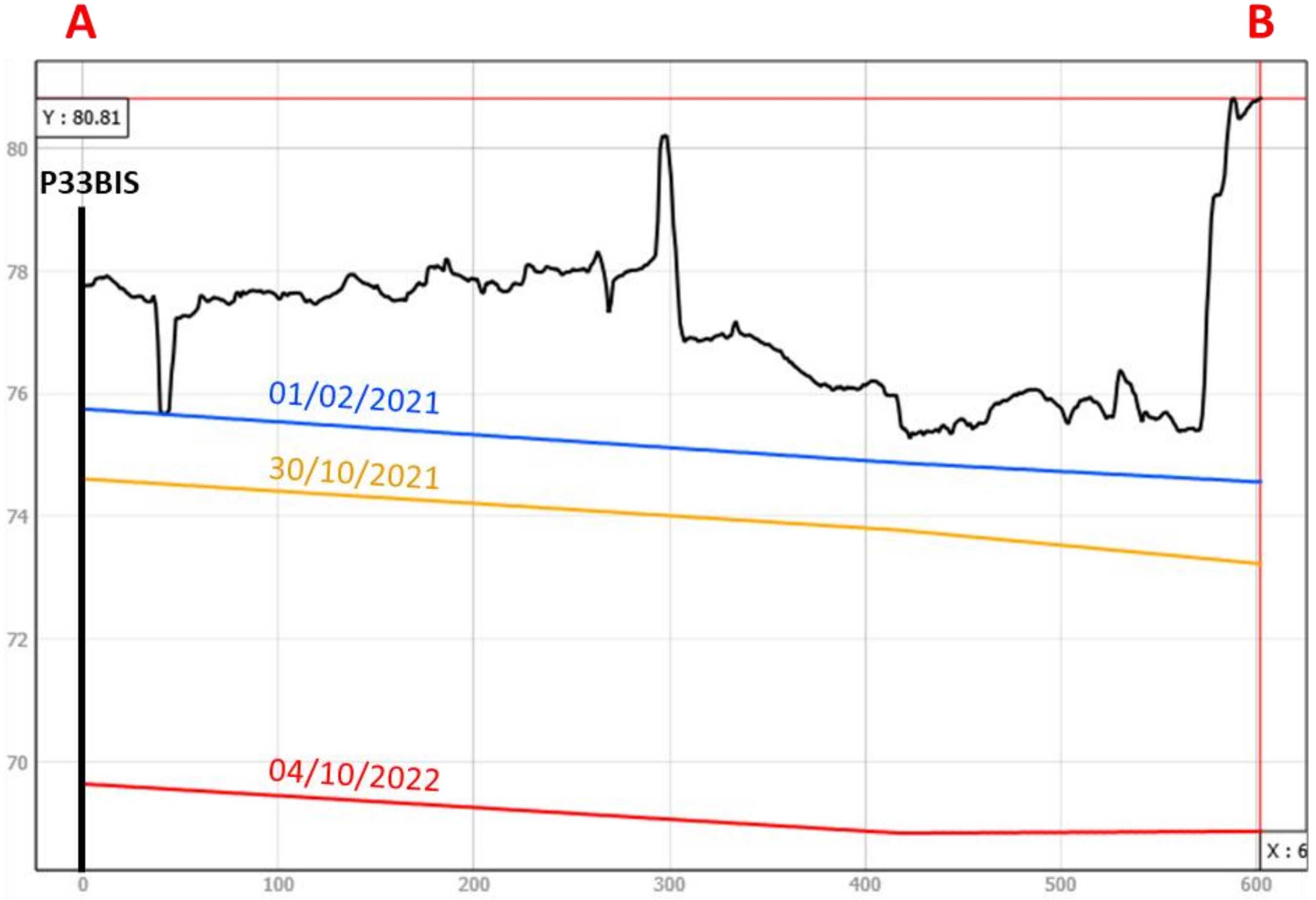
(i) understand in detail the recharge phenomena in the lower valley and their spatial distribution (for optimizing water-reuse scenarios — see PhD theses);

(ii) strengthen the numerical modelling of the water resource in the lower valley.

River-Ground Water interactions – A look back at the 2022-2023- drought



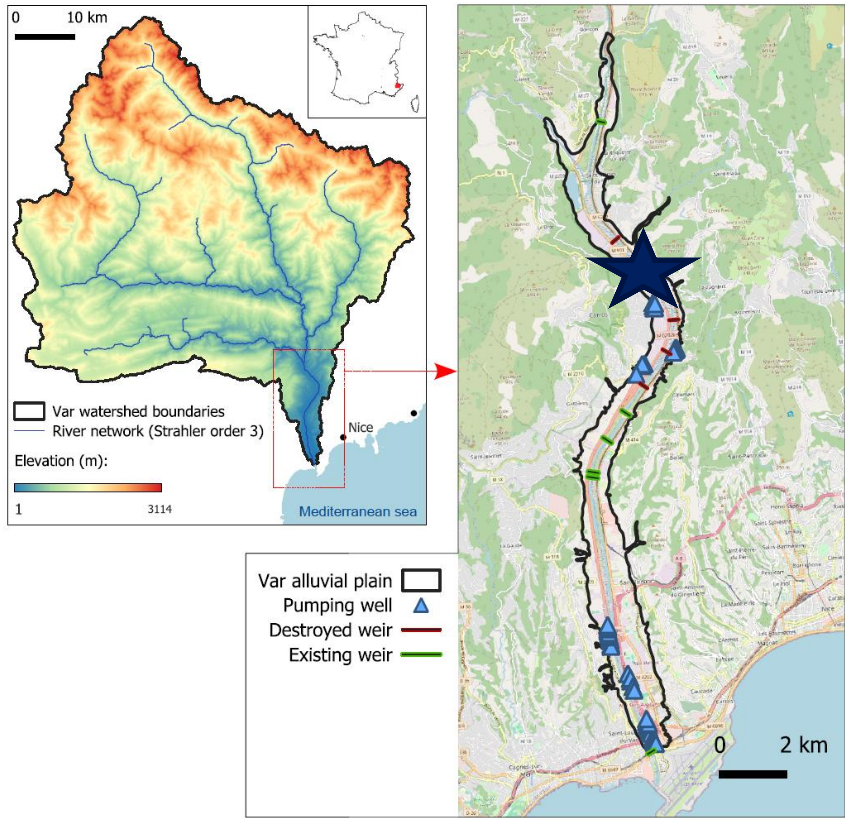


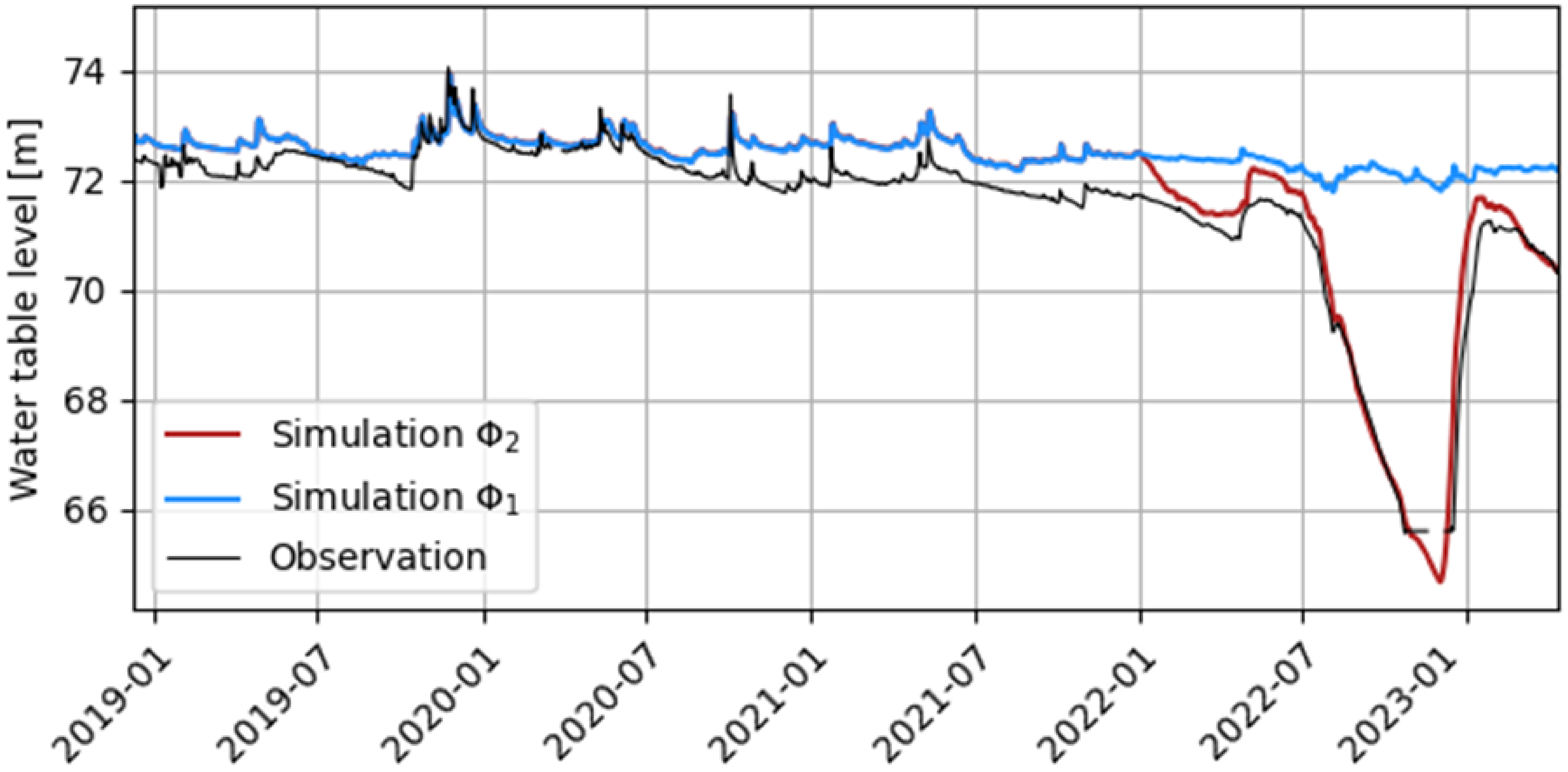


Topographic profile (in black) and interpolated water table along section A-B at different dates (in blue, yellow, and red)

4- DSS development through collaboration: R&D perspectives *(by Dr. PICOURLAT Fanny)*

River-Ground Water interactions – A look back at the 2022-2023- drought





- Du's (2016) FEFLOW model does not reproduce the evolution of the groundwater level at P40.
- However, this can be achieved by manually setting the conductance parameter Φ $[T^{-1}]$ to zero.

→ How can this be explained?
Was there a decrease in infiltration flow due to clogging?
Was there the creation of an unsaturated zone under the river?

→ Hypotheses to be tested via modelling of the physics of infiltration processes (i.e. modelling of flows in unsaturated zones).

4- DSS development through collaboration: R&D perspectives *(by Dr. PICOURLAT Fanny)*

River-Ground Water interactions – in the DSS

AQUAVAR HYDROGEOLOGICAL MODULE *(Du, 2016)* :

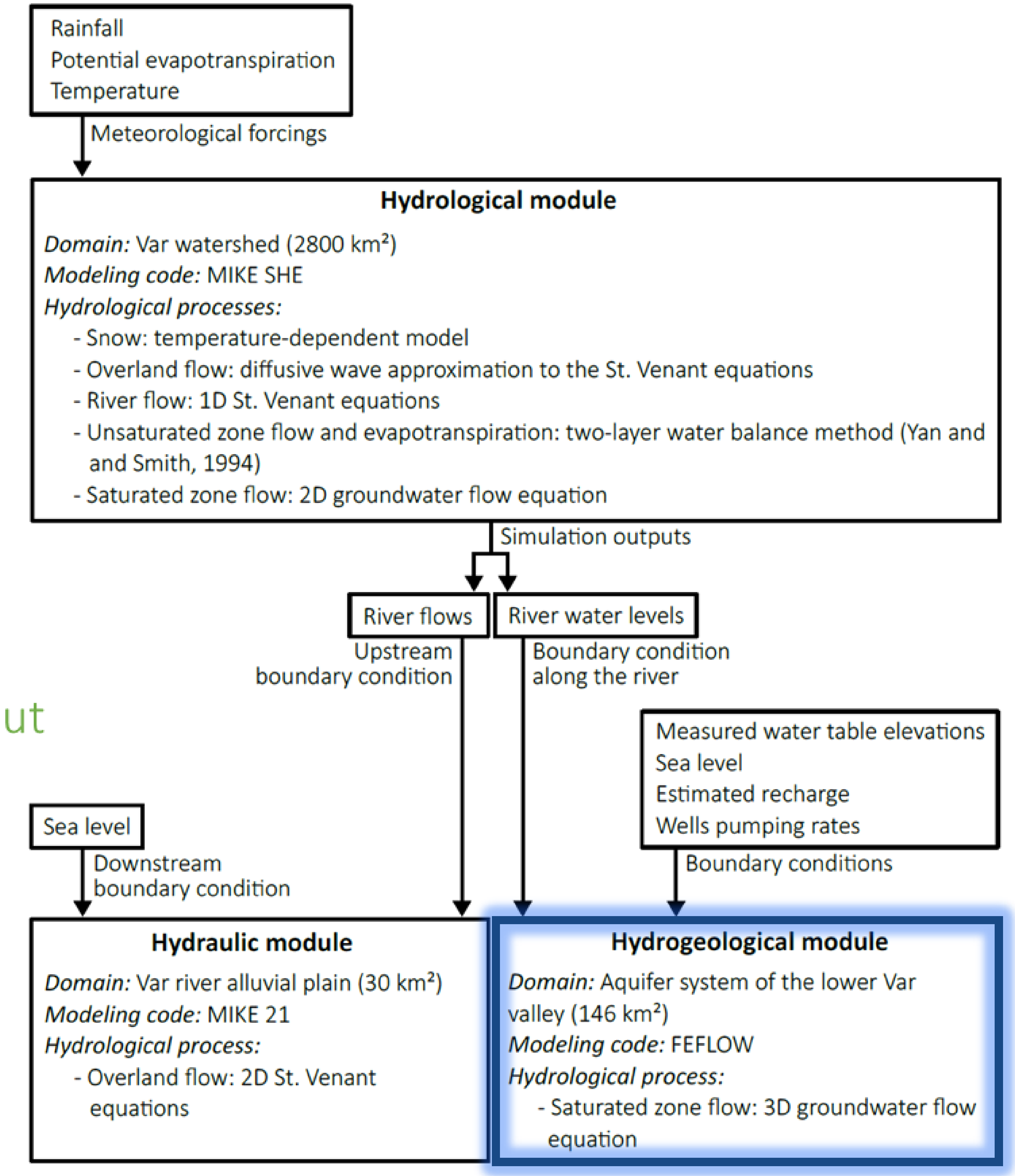
- Domain: Aquifer system of the lower Var valley (146 km^2)
- Modeling code: FEFLOW *(Diersch, 2013)*
- Saturated zone flow: 3D groundwater flow equation
- Exchange flow Q between river and aquifer :

$$Q = A\Phi(h_r - h_a),$$

with A [L^2] the transfer surface,
h_r [L] the water level in the river,
h_a [L], the water level in the aquifer,
Φ [T^{-1}] the transfer rate parameter.

Hydrological module output

Calibrated over the period from 10 May 2012 to 26 February 2013



4- DSS development through collaboration: R&D perspectives *(by Dr. PICOURLAT Fanny)*

Airborne infrared thermal measurements

Location of exchange areas groundwater → river

Piezometric maps combined with thermal images: Identification of flow areas

Piezometric measurements (groundwater and surface)

Reliable but spatially limited data (quality of interpolation depends on the density of measurement points)

Piezometry + borehole logging: Interpretation of resistivity profiles

Electrical resistivity tomography

Geology and groundwater levels interpreted on sections of interest

Data:

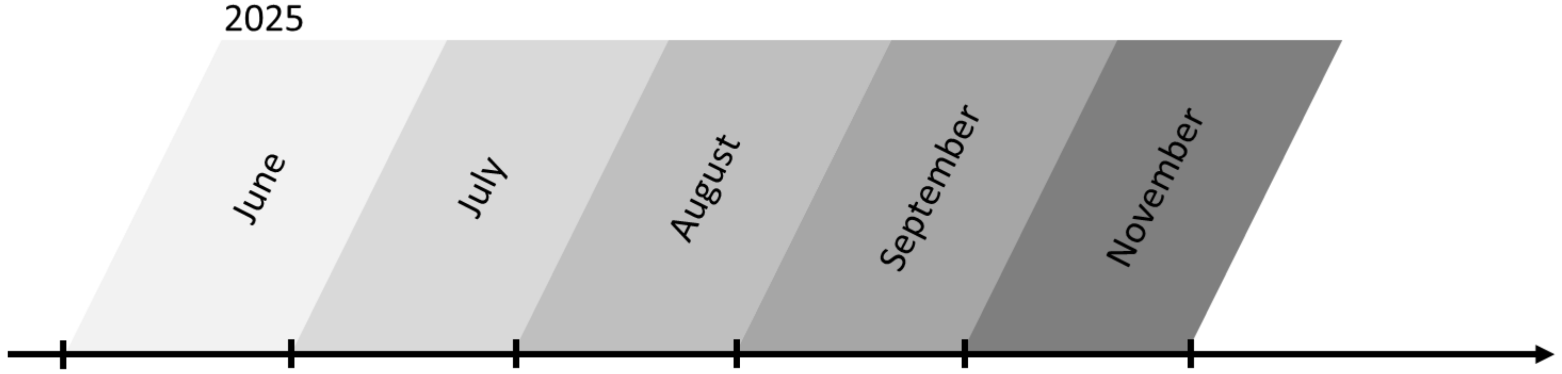
1) At the scale of the alluvial plain: Water levels (surface and underground)Areas of exchange between groundwater and river
2) At the scale of sections of interest: Geology, sediment characteristics, Saturation

→ Conceptual model

4- DSS development through collaboration: R&D perspectives *(by Dr. PICOURLAT Fanny)*

The objective is to **characterise the interaction processes between the Var and its alluvial aquifer** and to **implement them in the AquaVar DSS**

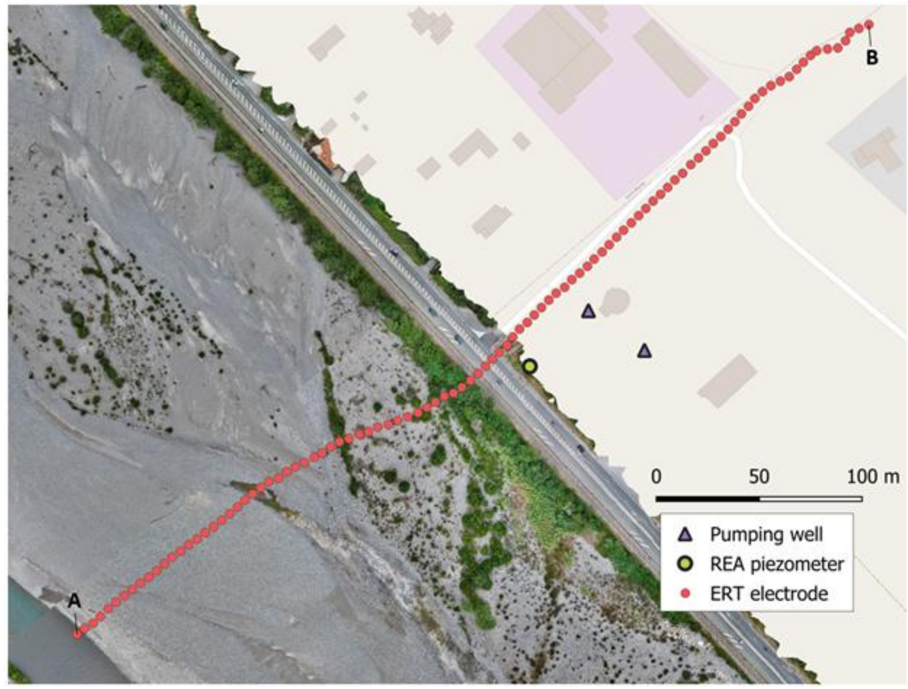
→ Summer 2025 campaign schedule:

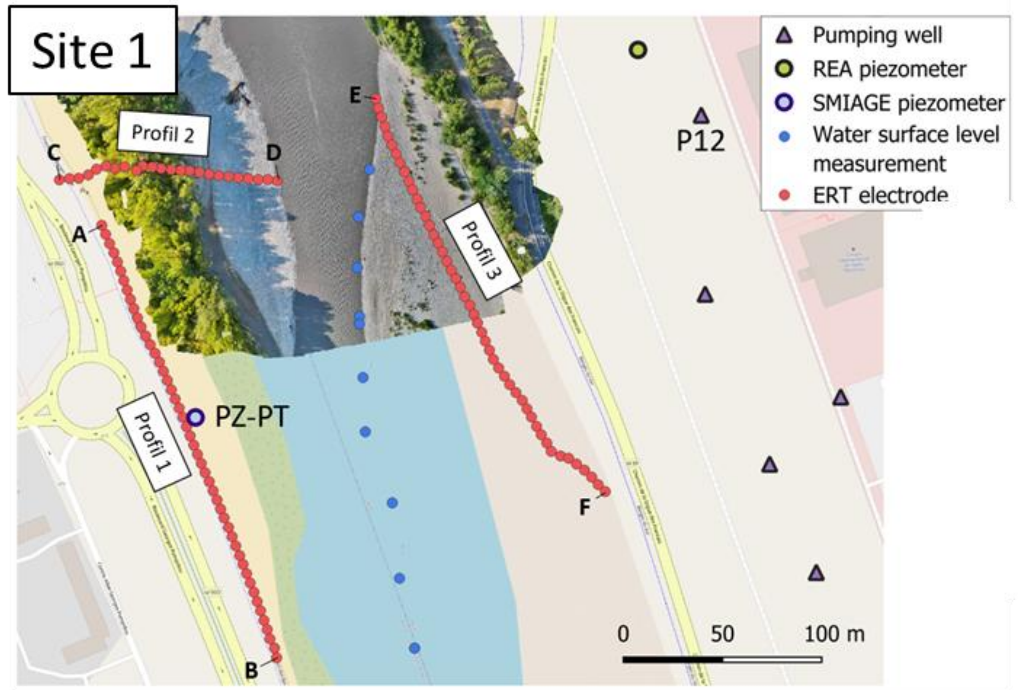


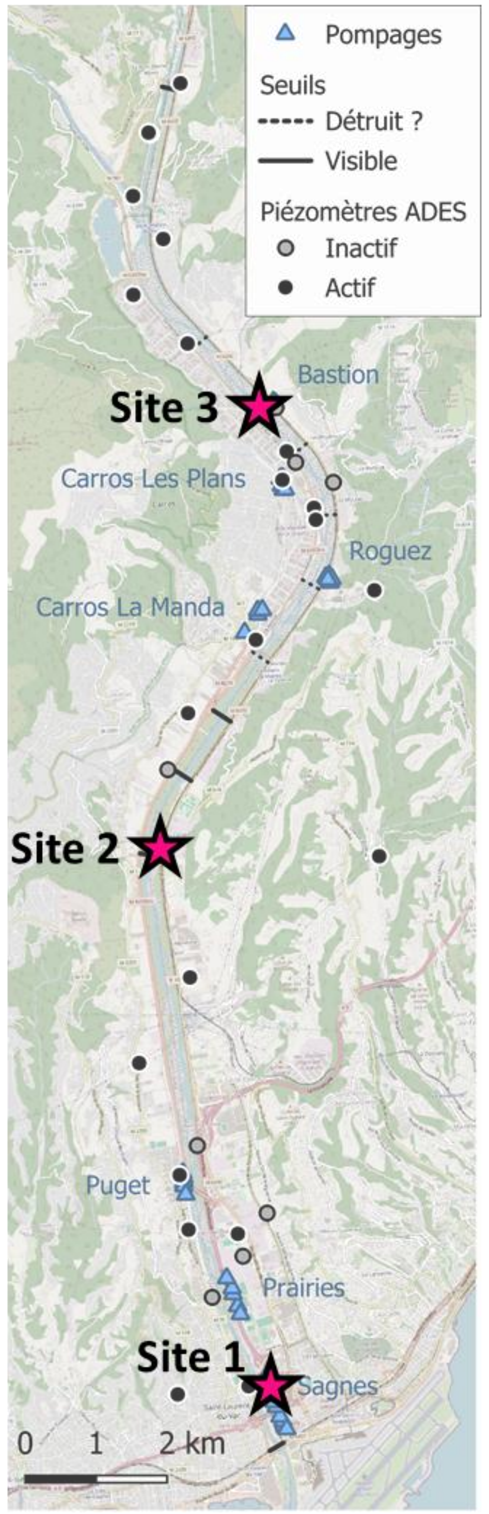
30th June to 4th July : Airborne infrared thermal measurement along the Var alluvial plain

15th to 18th September : Electrical resistivity tomography on 3 study sites

→ The ERT study sites:







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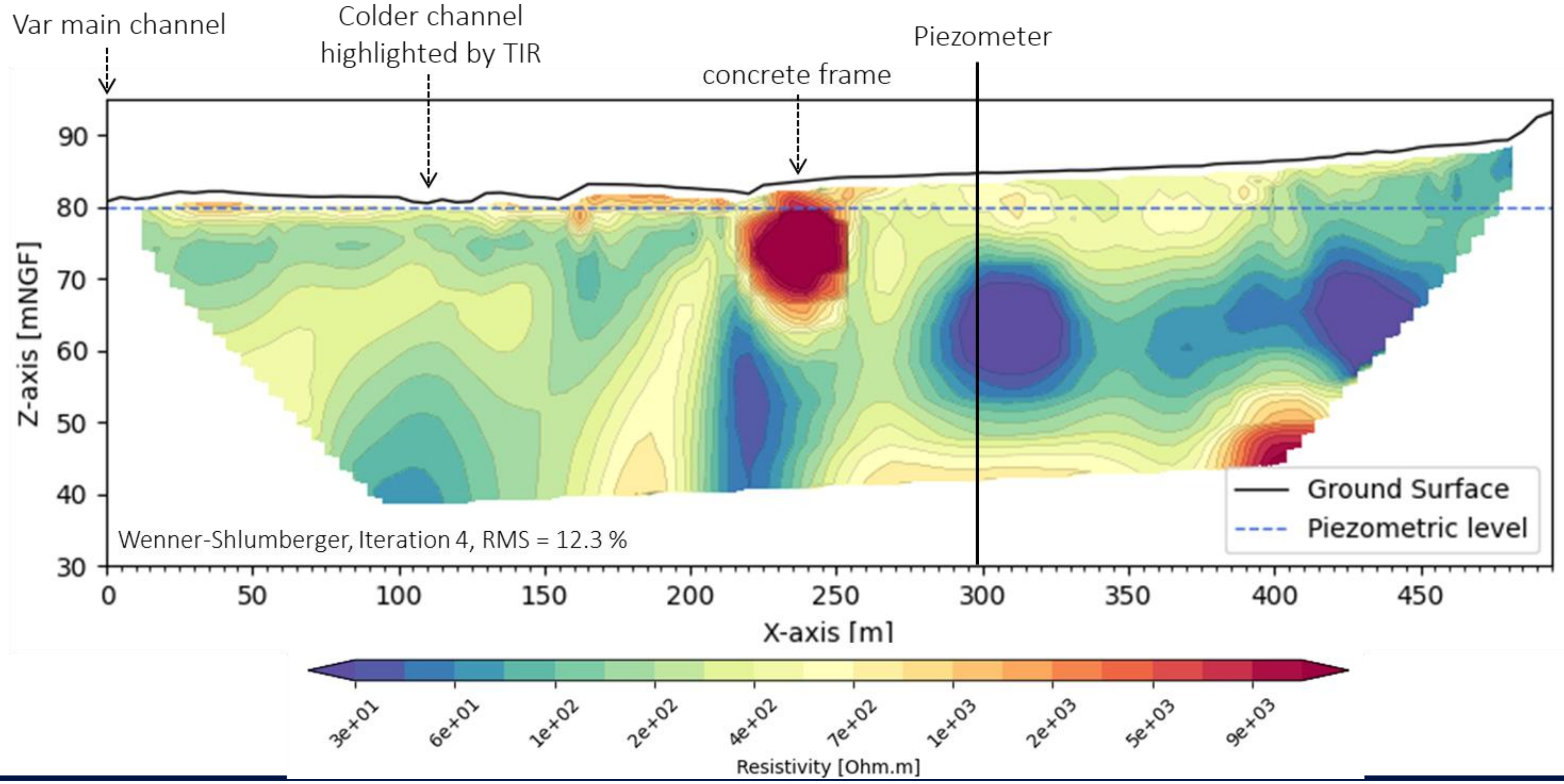
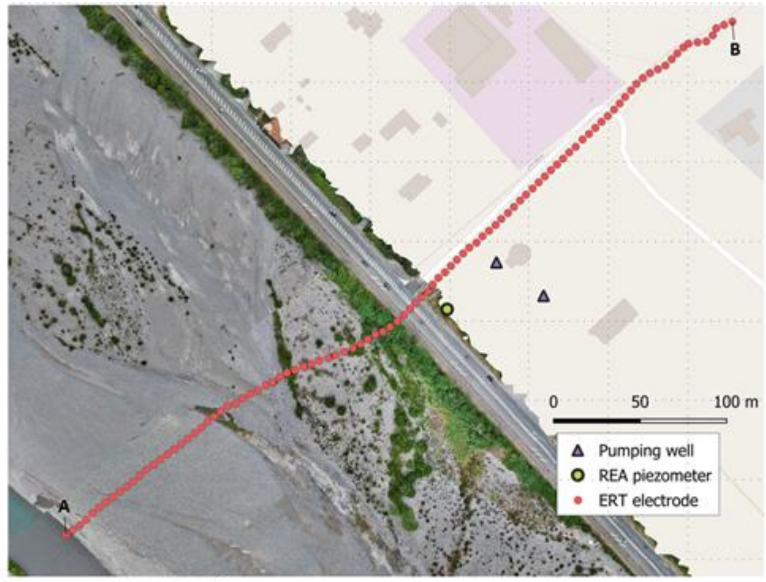
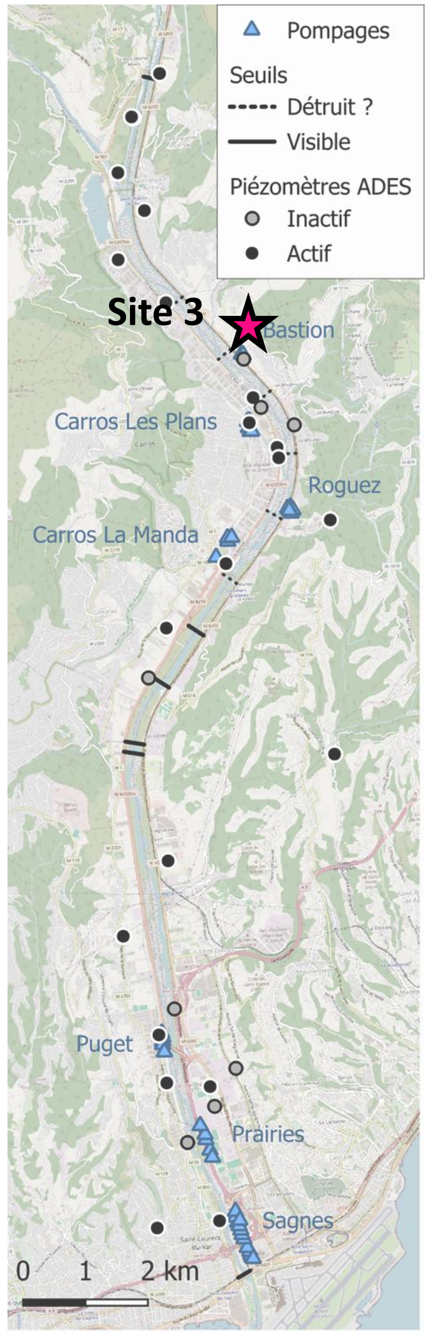
The objective is to **characterise the interaction processes between the Var and its alluvial aquifer** and to **implement them in the AquaVar DSS**

ERT results on the 3 sites show:
- the connection between surface water and alluvial aquifers
- very low or even zero lateral hydraulic head gradients

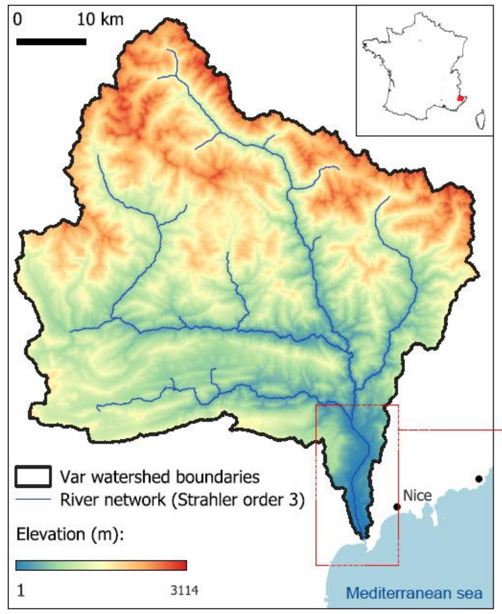


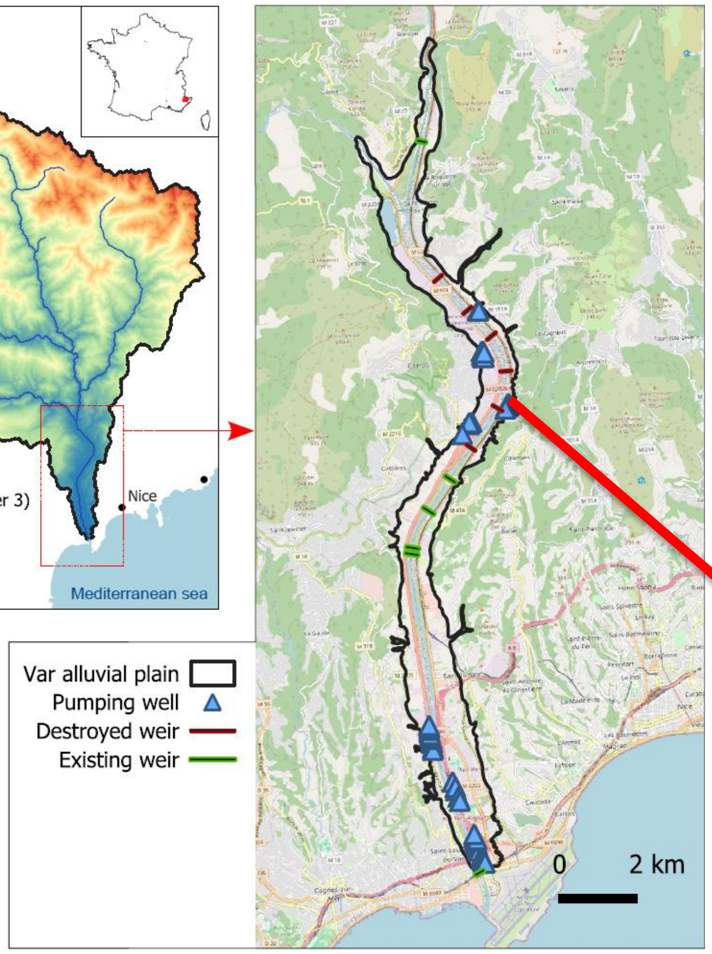


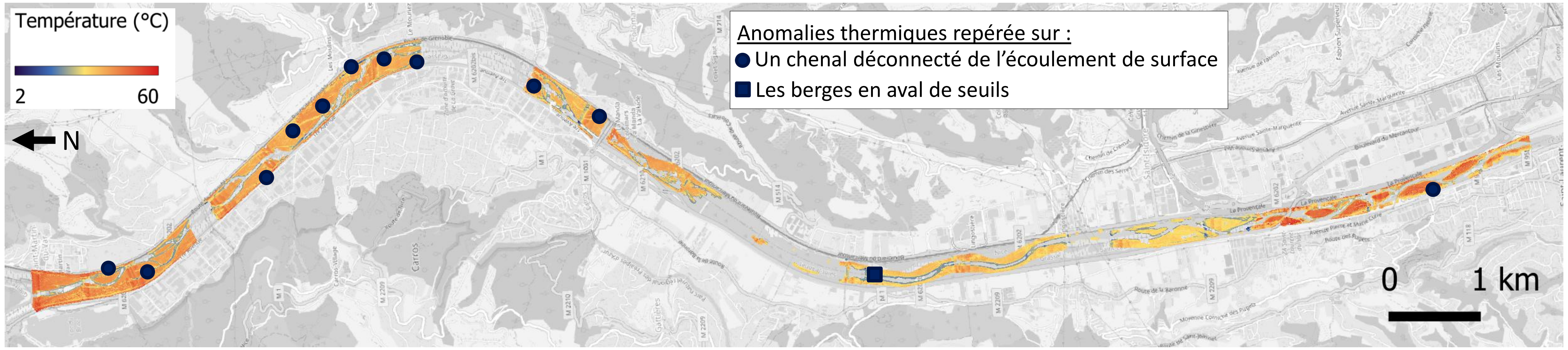


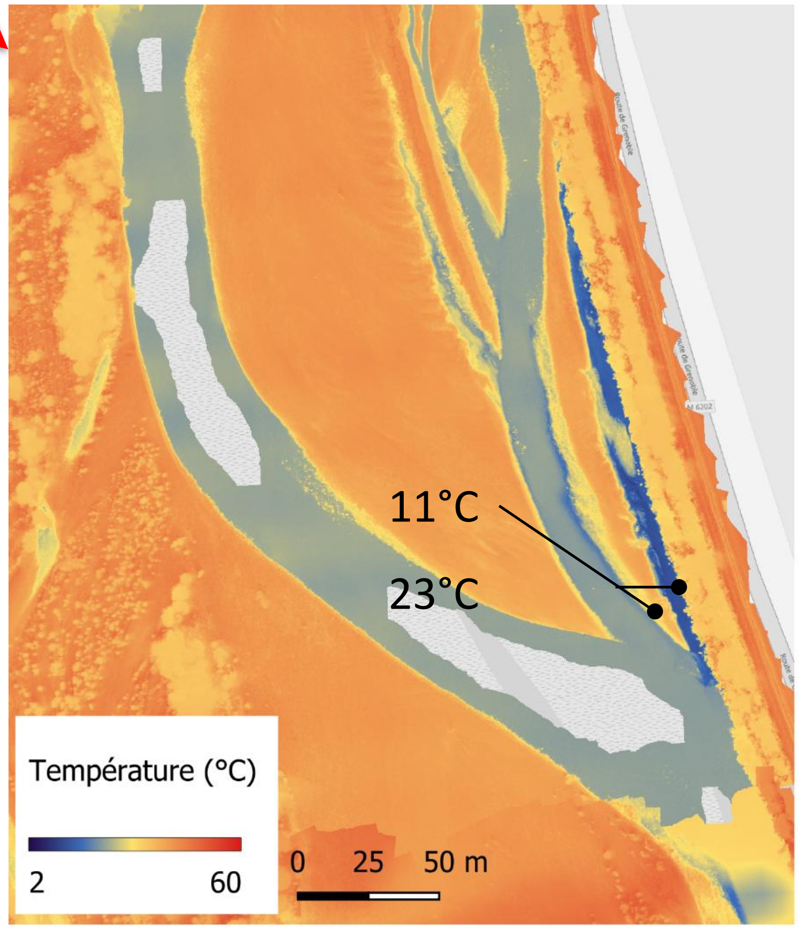
4- DSS development through collaboration: R&D perspectives *(by Dr. PICOURLAT Fanny)*

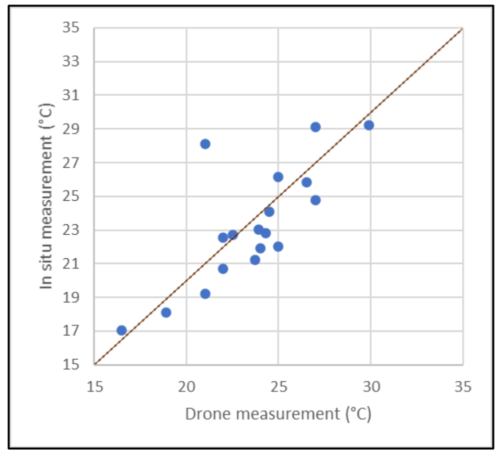
The objective is to **characterize the interaction processes between the Var and its alluvial aquifer** and to **implement them in the AquaVar DSS ➔ Aerial thermography data gathering campaigns**



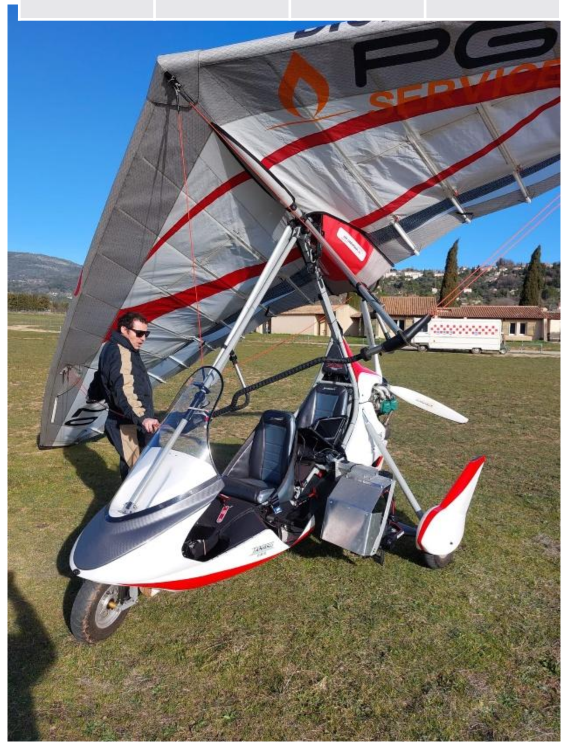








T_{drone}-$T_{in\text{-}situ}$ (°C)			
Min	Max	Moy	Ecart -type
-7.1	3.0	1.5	2.3



4- DSS development through collaboration: R&D perspectives *(by Dr. PICOURLAT Fanny)*

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Conceptual model

Of the alluvial plain and its hydrodynamics

Numerical model

Quantification of exchanges with high spatial and temporal resolution. Forecasting.

Geochemical analyses

Quantification of exchanges (continuation of Potot's work, 2011).

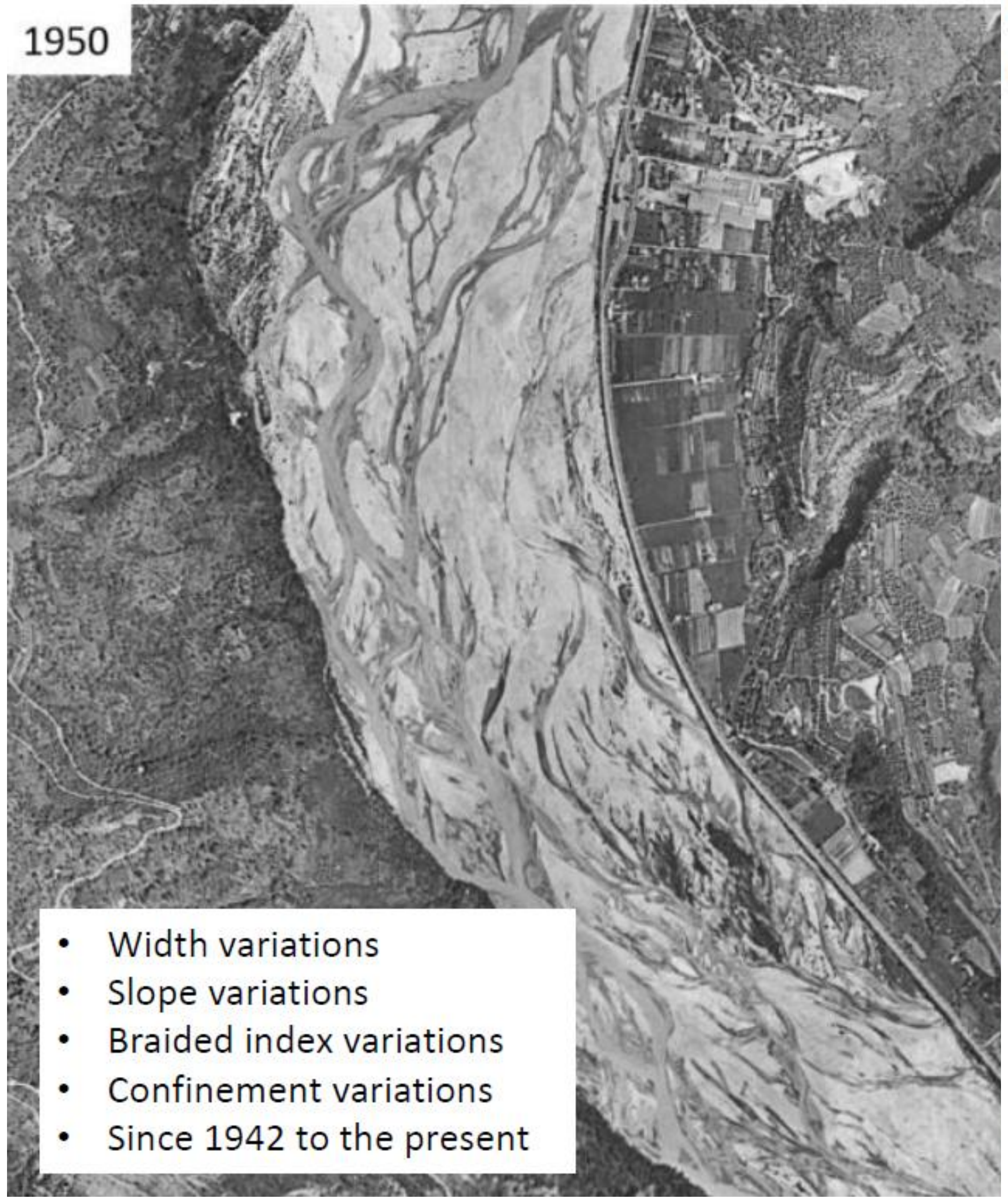
Analysis of remote sensing products

DEM, soil moisture, water levels, etc.

Hydro-sedimentological analysis

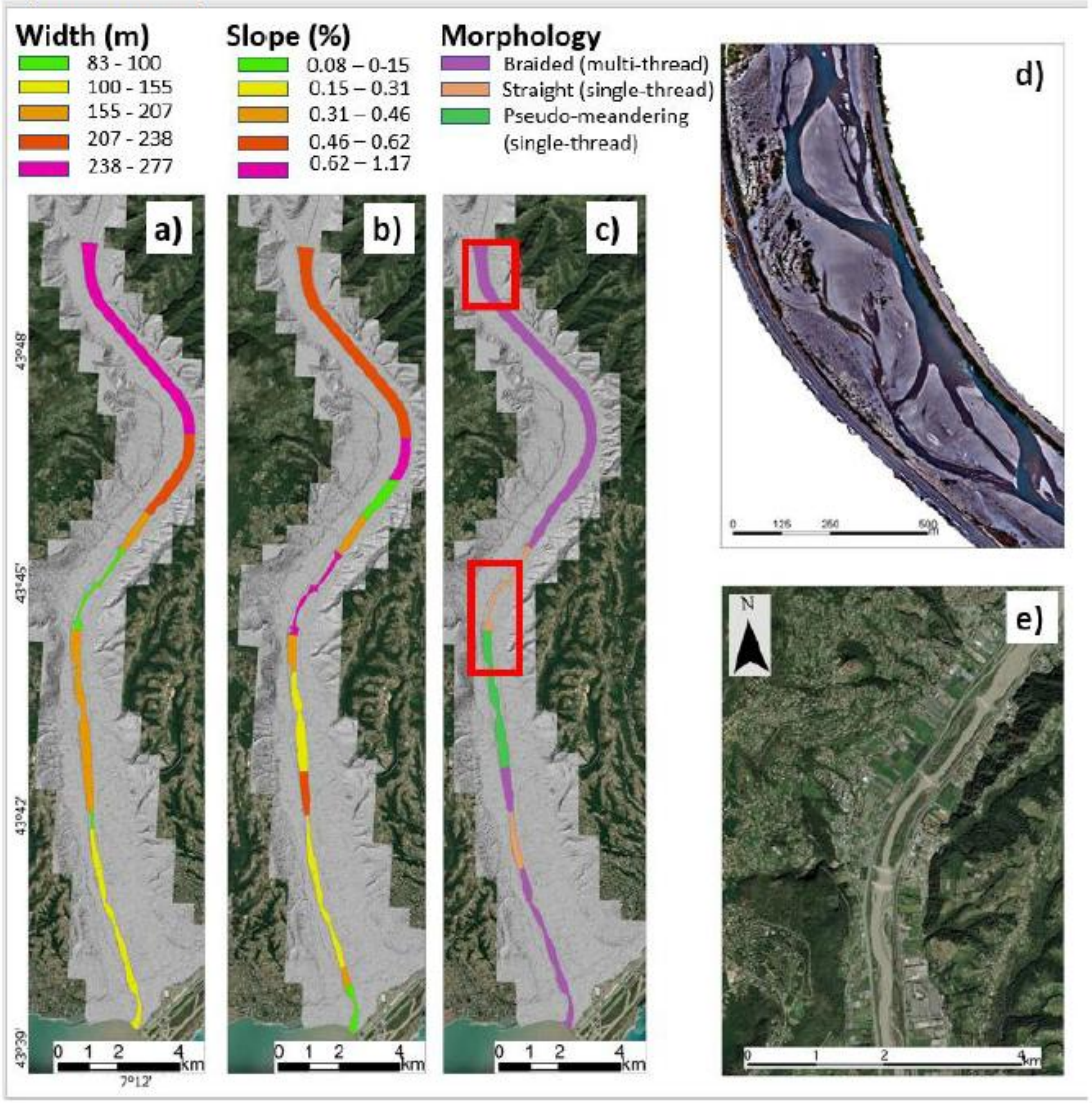
Sediment characterisation, sedimentation dynamics and erosion

OBJECTIVE: Understanding fluvial geomorphology evolution and sediment transport numerical modelling in the Var catchment



A little bit of the fundamentals of fluvial geomorphology that we are interested in the project (Some elements form modelling sediment dynamics)

- Slope
- Width
- Confinement (?)
- Braided index
- Sinuosity
- Connectivity
- Bar morphology
- Bank stratigraphy
- Particle size
- Flow type

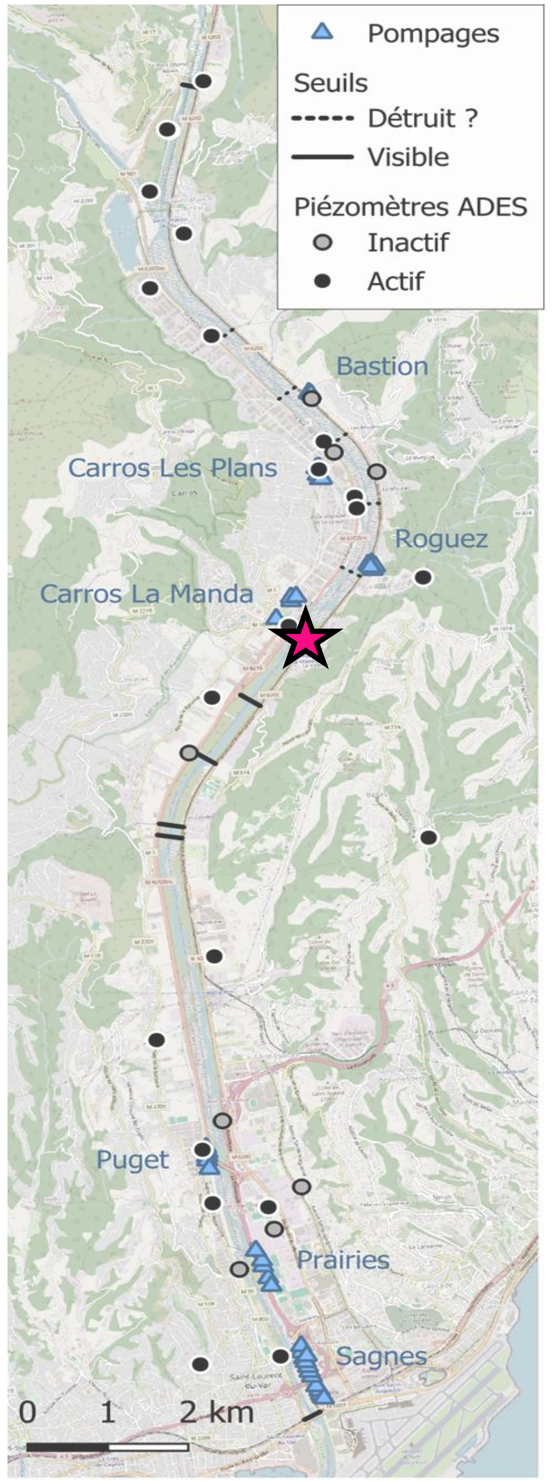


4- DSS development through collaboration: R&D perspectives *(by Dr. GRANADOS BOLANOS Sébastian)*

OBJECTIVE: Understanding fluvial geomorphology evolution and sediment transport numerical modelling in the Var catchment

Modelling certain reaches with sedimentological approaches can improve decision making

- For example: In 1 year around 3.5 ha of floodplain was eroded after the Weir removal
- Estimated volume in sediments ?
- Deposition and transit downstream ?
- Impacts on bridges and banks ?
- River section changed from a single thread to a multithread



- Feb 2024

- June 2025

4- DSS development : R&D perspectives *(by Ph.D. candidates MADELBOS Rémi & ZIMAOUI Mehdi)*

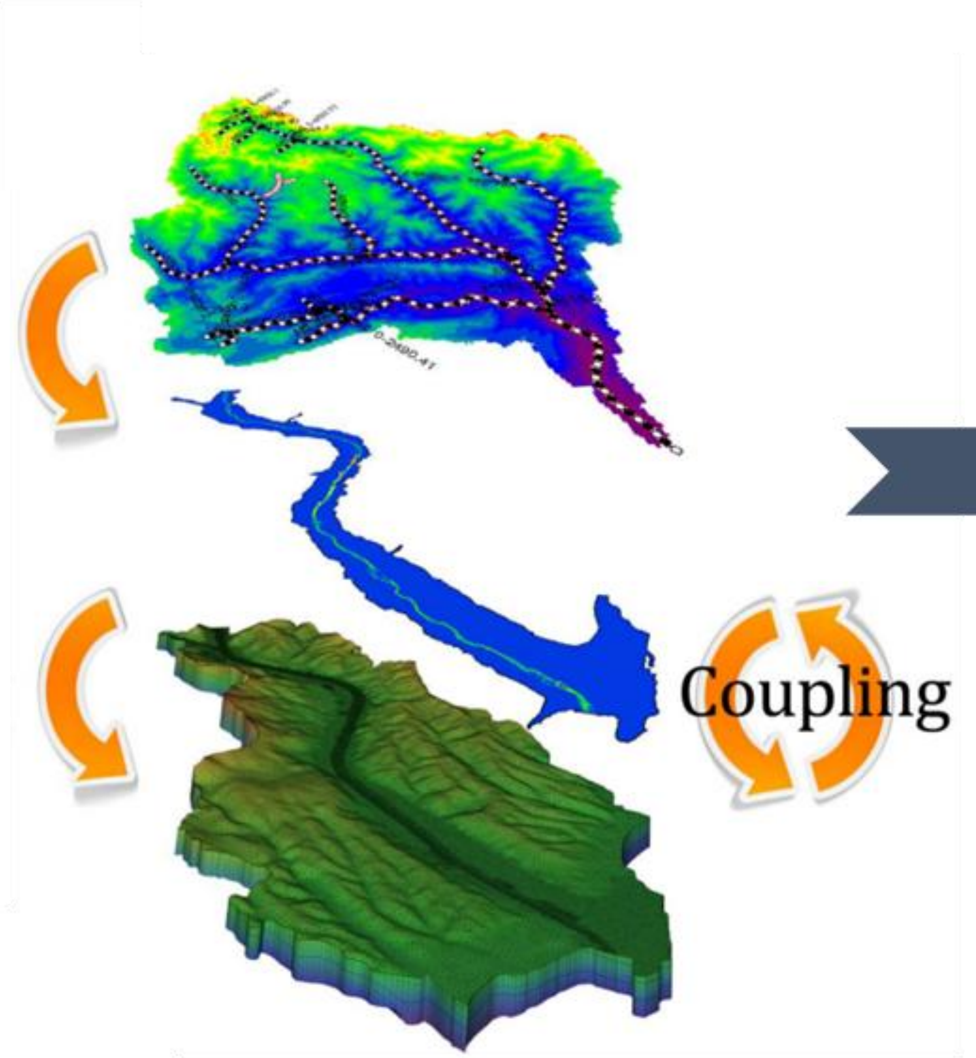
Non conventional Water REUSE in a complex context : can strategical choices can be informed using the AquaVar DSS?

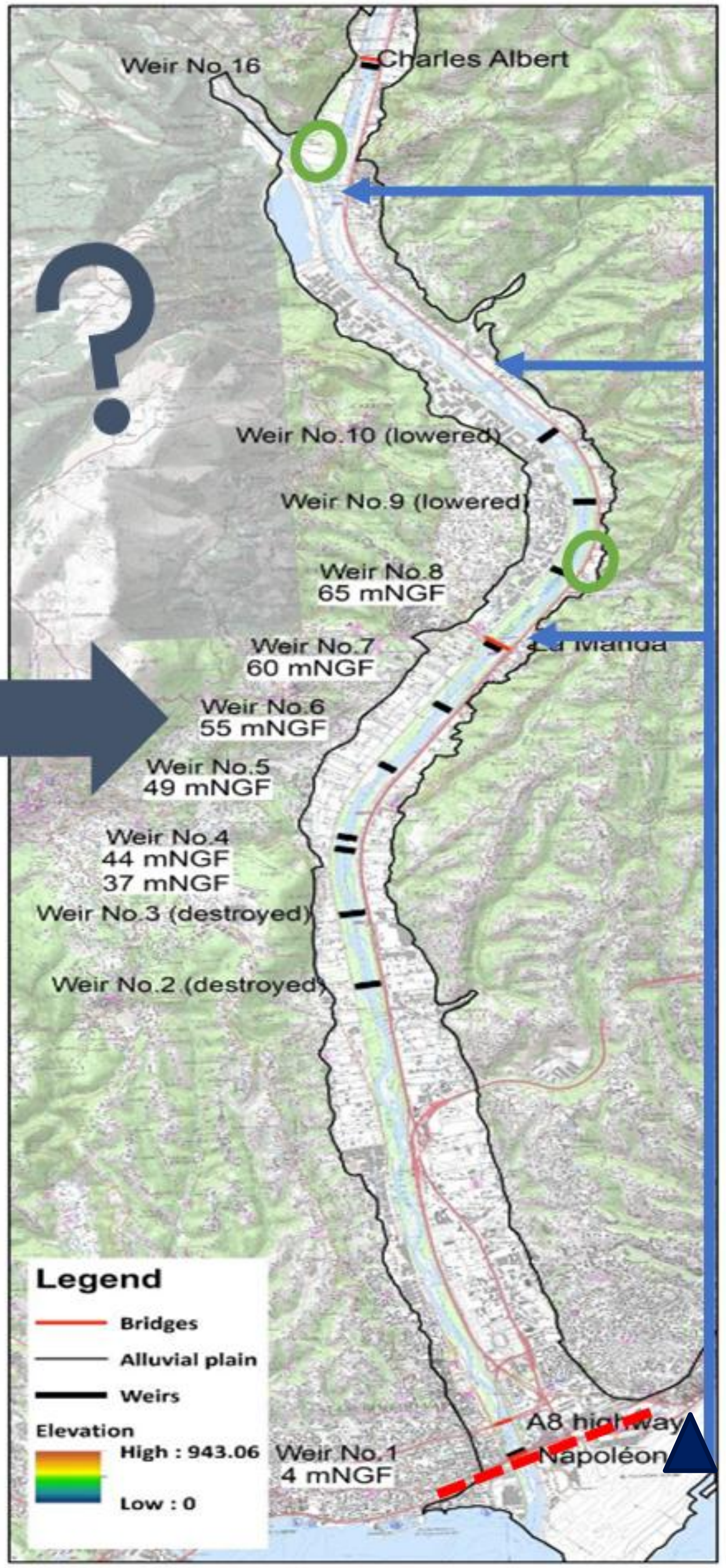
1- Treated Waste Water REUSE

MADELBOS Rémi

2- Sustainable Urban Drainage Systems

ZIMAOUI Mehdi





Legend:
- IDP
- WWTP
- Infiltration ponds
- Hydraulic barrier

4- DSS development : R&D perspectives *(by Ph.D. candidates MADELBOS Rémi & ZIMAOUI Mehdi)*

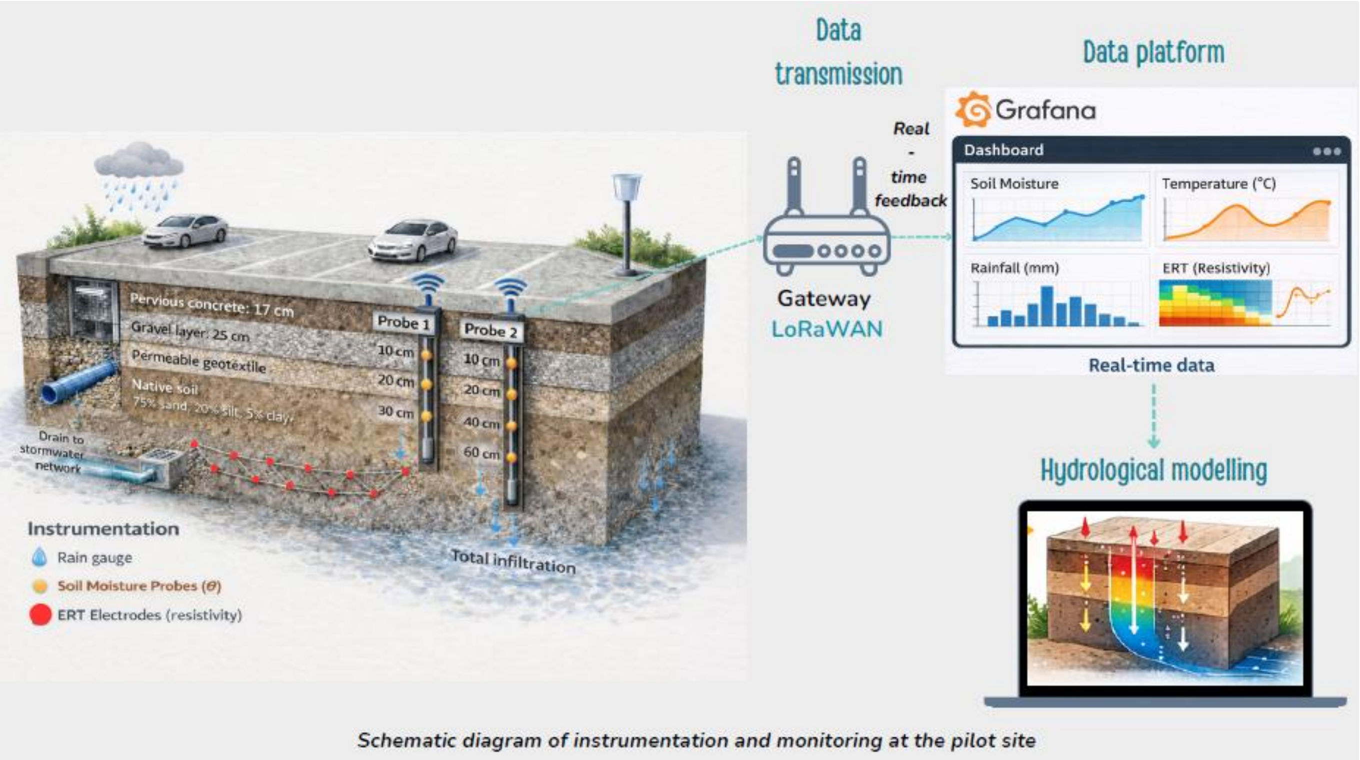
Non conventional Water REUSE in a complex context : can strategical choices can be informed using the AquaVar DSS?

Water REUSE objectives

How to apply REUSE strategic planning within a territory in the medium and long term through the use of DSS tools
?

SUDS objectives

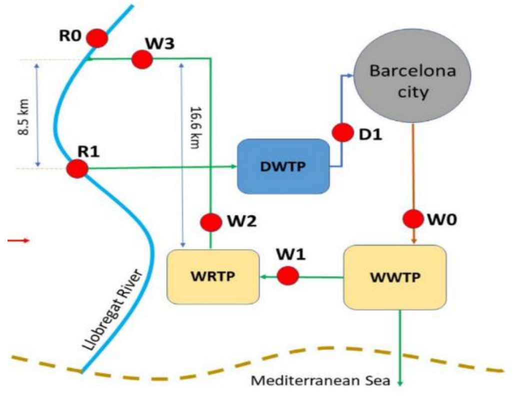
How to support the strategic planning and operational integration of Sustainable Urban Drainage Systems (SuDS) within a territory, through multi-scale modelling and DSS tools
?

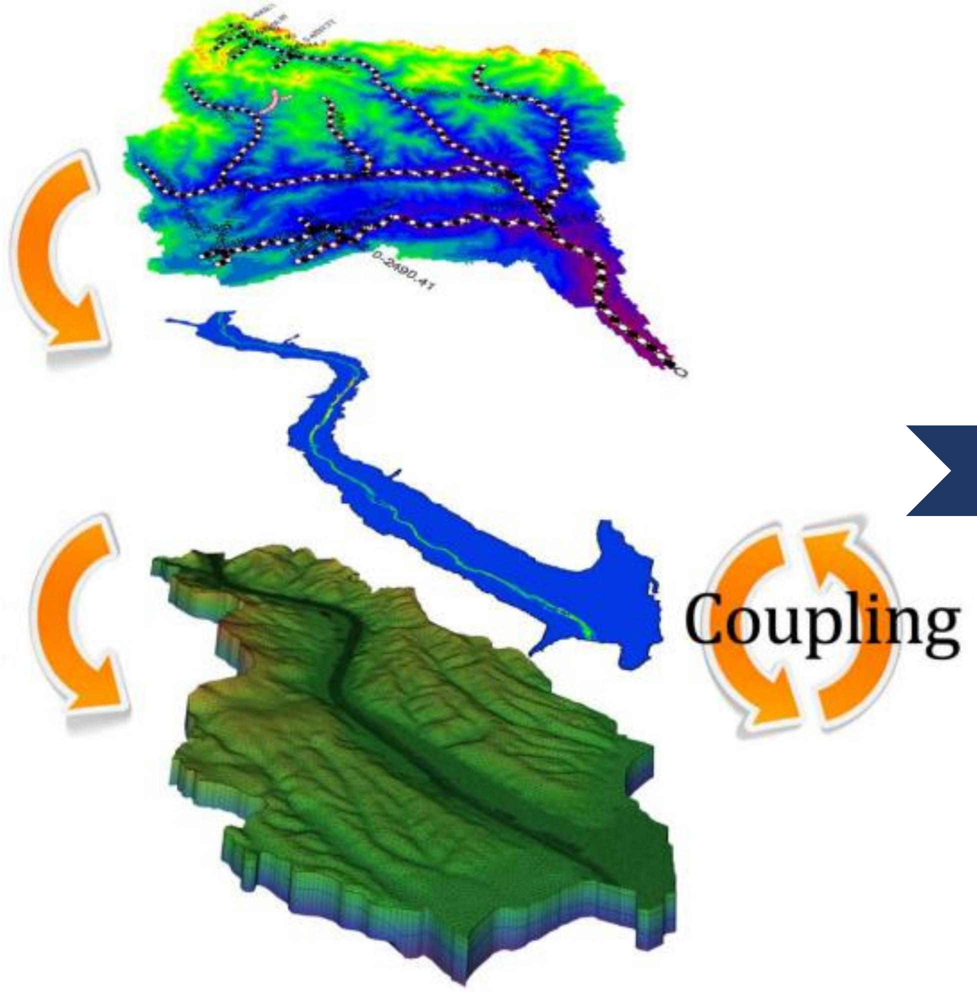


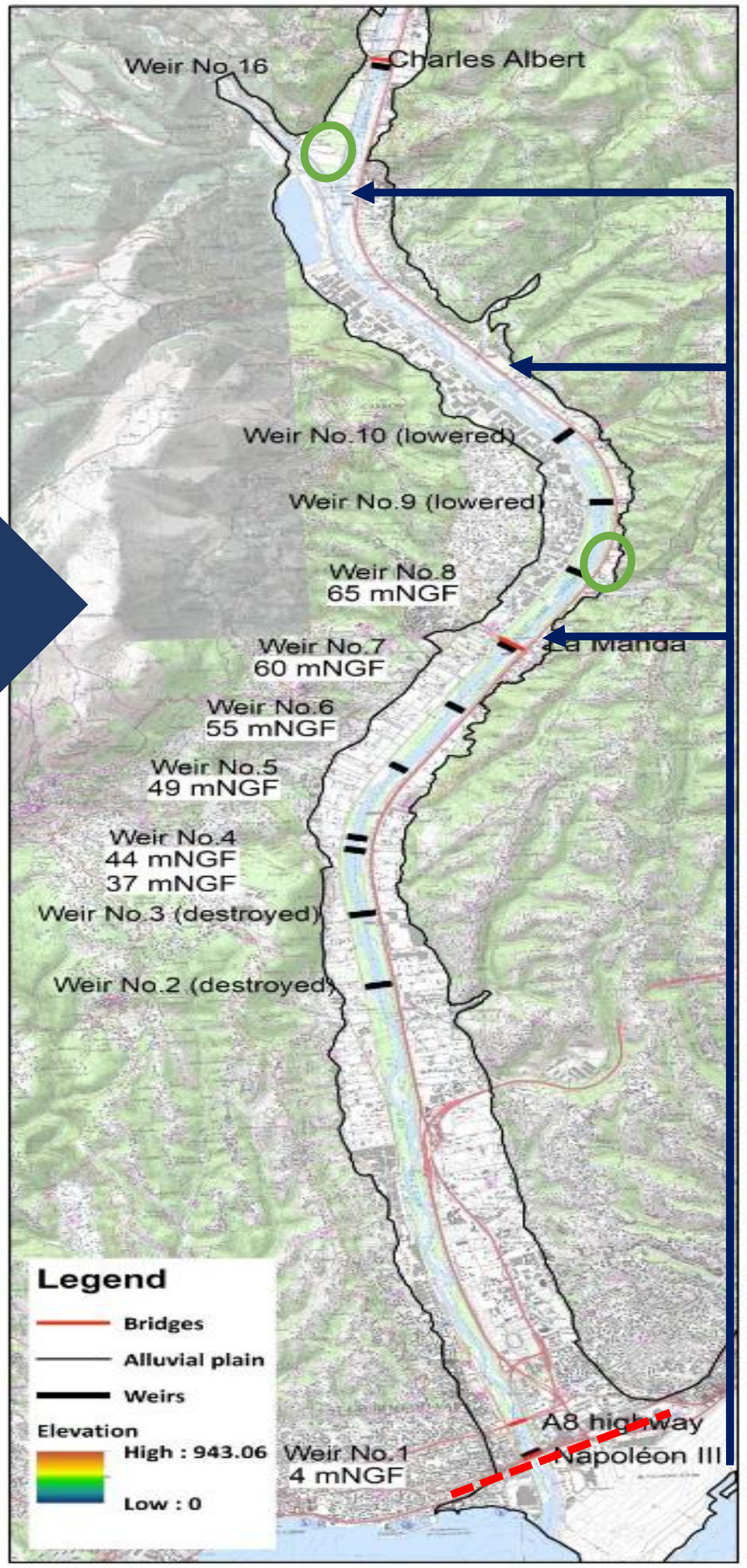
Conceptual view generated by Master Students using AI

4- DSS development : R&D perspectives *(by Ph.D. candidates MADELBOS Rémi & ZIMAOUI Mehdi)*

Non conventional Water REUSE in a complex context : can strategical choices can be informed using the AquaVar DSS?

River flow recharge	Infiltration ponds	Hydraulic barrier
		 Location of the 14 injection wells, and building phases
- Substitution of in-stream river flow (seasonal) = 175 000m^3/day, 2,00m^3/s - Restoration of wetland areas (seasonal) = 35 000m3/day, 0,40m^3/s - Substitution of irrigation water (seasonal) = 65 000m^3/day, 0,75m^3/s	- Volume = 0,3 & 1hm^3/y - Water available for recharge = 90% - Chemical impact = Low - CAPEX = 0,3-0,9M€/hm3/y - OPEX = 0,10 – 0,17€/m^3 - Energy = no	- Volume = 5,5hm3/y - Water available for recharge = >90% - Chemical impact = High - CAPEX = 5M€/hm^3/y - OPEX = 0,28€/m^3 - Energy = High (advanced treatment and injection SGAB)





Legend:

IDP

Infiltration ponds

Hydraulic barrier

4- DSS development : R&D perspectives *(by Ph.D. candidates MADELBOS Rémi & ZIMAOUI Mehdi)*

Non conventional Water REUSE in a complex context : can strategical choices can be informed using the AquaVar DSS?

Performance Indicators Method

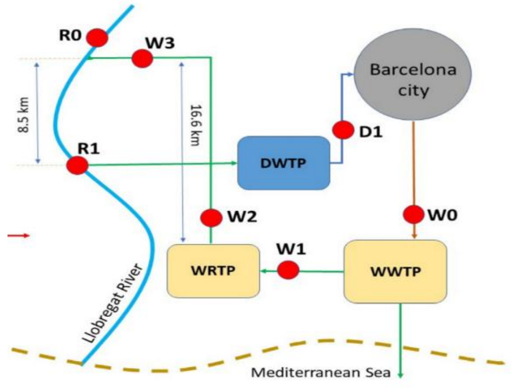
Building elements

- **Hybrid** approach(bottom-up + top-down)
- Nexus **Water Resource – Economic – Sanitary & Environmental**
- Strategic Performance Indicators (**SPI**)
- Performance Indicators(**PI**)

Data System (bottom-up)

- Data elements
- **Variables**
- Contextual information(**CI**)
- Explanatory factors

River flow recharge



Infiltration ponds

Hydraulic barrier

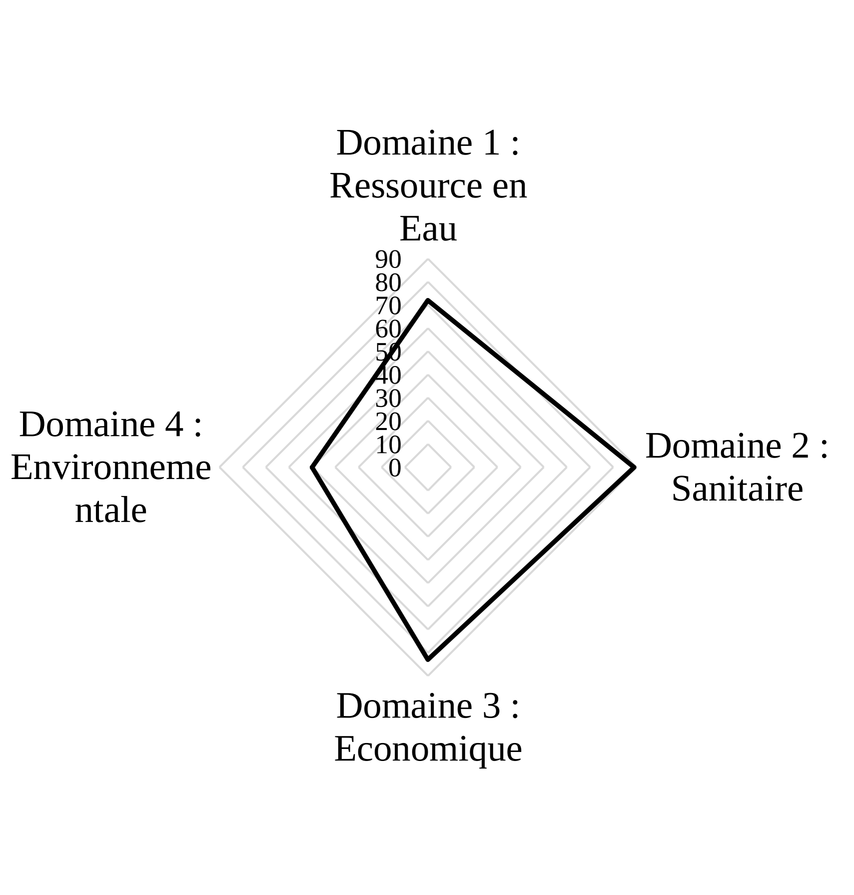
Location of the 14 injection wells, and building phases

Domain 1: Water resources

Indicateurs de performance stratégique (PIS)	Indicateurs de performance (PI)
PIS-1 : Impact global sur le bilan hydrique	WR1- Taux de substitution effectif
	WR2- Amélioration du débit d'étiage
	WR3- Recharge effective de l'aquifère
	WR4- Résilience face aux sécheresses
PIS-2 : Impact global sur la qualité du milieu	WR5- Respect des objectifs de qualité du milieu récepteur
	WR6- Flux de nutriments ajoutés au milieu
	WR7- Accumulation de micropolluants

Domain 2: Economic

Indicateurs de performance stratégique (PIS)	Indicateurs de performance (PI)
PIS-4 : Indicateurs opérationnels	Eco1- Employés par connexion
	Eco2- Disponibilité de la ressources
	Eco3- Qualité de l'eau
	Eco4- Réhabilitation du réseau
	Eco5- Réhabilitation des raccordements de service
	Eco6- Pertes d'eau
	Eco7- Pannes de réseau
	Eco8- Échecs de connexion au service
PIS-5 : Indicateurs financier	Eco9- Coûts totaux (CAPEX & OPEX)
	Eco10- Ratio de couverture des coûts totaux
	Eco11- Ratio de couverture des coûts d'exploitation
	Eco12- Contribution des sources internes à l'investissement

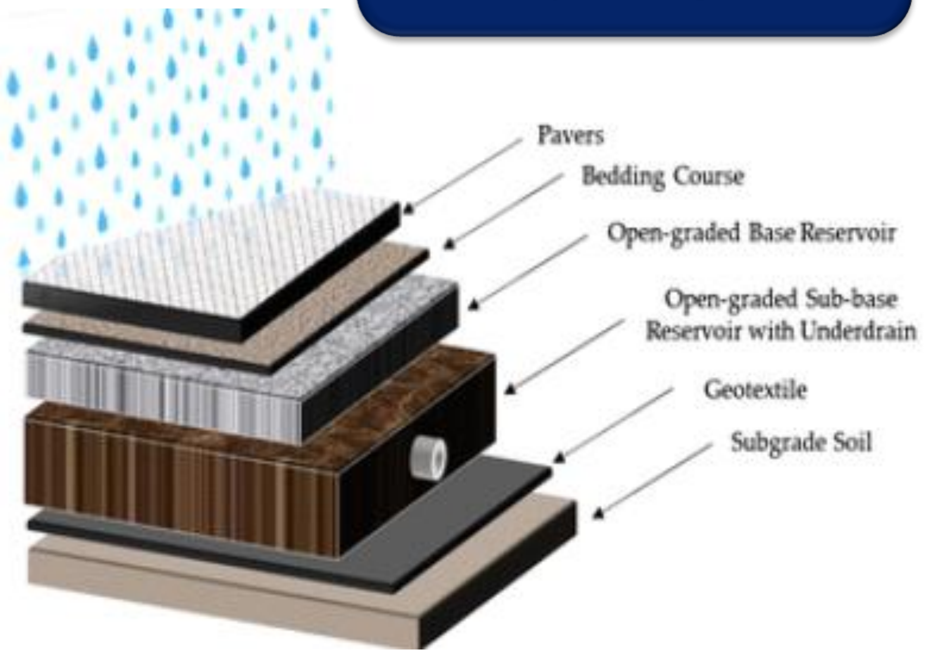


4- DSS development : R&D perspectives *(by Ph.D. candidates MADELBOS Rémi & ZIMAOUI Mehdi)*

Non conventional Water REUSE in a complex context : can strategical choices can be informed using the AquaVar DSS for SUDs?

The 4 pillars of SUDS

Quantity	***Quality***	***Amenity***	***Biodiversity***
Control runoff and flooding	*Improve water quality*	*Enhance urban comfort*	*Support ecological functions*



Sustainable urban drainage systems. Source: adapted from Fonseca et al. (2017), Vijayaraghavan (2016) and Winston et al. (2016).

- **Nature-based solutions** designed to manage rainwater where it falls.
- Mimic **natural hydrological processes**: infiltration, storage, filtration, evapotranspiration.
- Reduce **runoff peaks** and promote **groundwater recharge**.
- Improve **water quality** by filtering pollutants through soils and vegetation.
- Provide **co-benefits**: cooling effect, biodiversity, urban amenity.
- Represent a paradigm shift from conventional **"grey"** drainage networks to **"blue–green"** infrastructure.

Permeable pavement and Bioretention system[2]

Swale[1]

Detention Basin[3]

Rain gardens[2]

Infiltration basin[2]

[1] Perales-Momparler et al. (2017) 'The role of monitoring sustainable drainage systems for promoting transition towards regenerative urban built environments: a case study in the Valencian region, Spain', Journal of Cleaner Production, 163pp. S113–S124.
[2] De la Fuente García et al. (2021) Guía Básica para el Diseño de Sistemas Urbanos de Drenaje Sostenible en la Cuidad de València.
[3] Woods Ballard et al.(2015) The SuDS Manual.

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Non conventional Water REUSE in a complex context : can strategical choices can be informed using the AquaVar DSS for SUDs?

Yet, regarding SUDS, research and operation questions remain pending

Lake of clear methodology to assess local and SUDs strategy implementation impacts

- What are the exact quantitative impacts in terms of infiltration?
- How does specific SUDs solutions can be selected in terms of SuDs functionality to favour?
- Can/shall these solutions be monitored?
- Can the solutions be implemented in AquaVar DSS and how?

SUDS: Pollution Concerns in Infiltration-based Systems

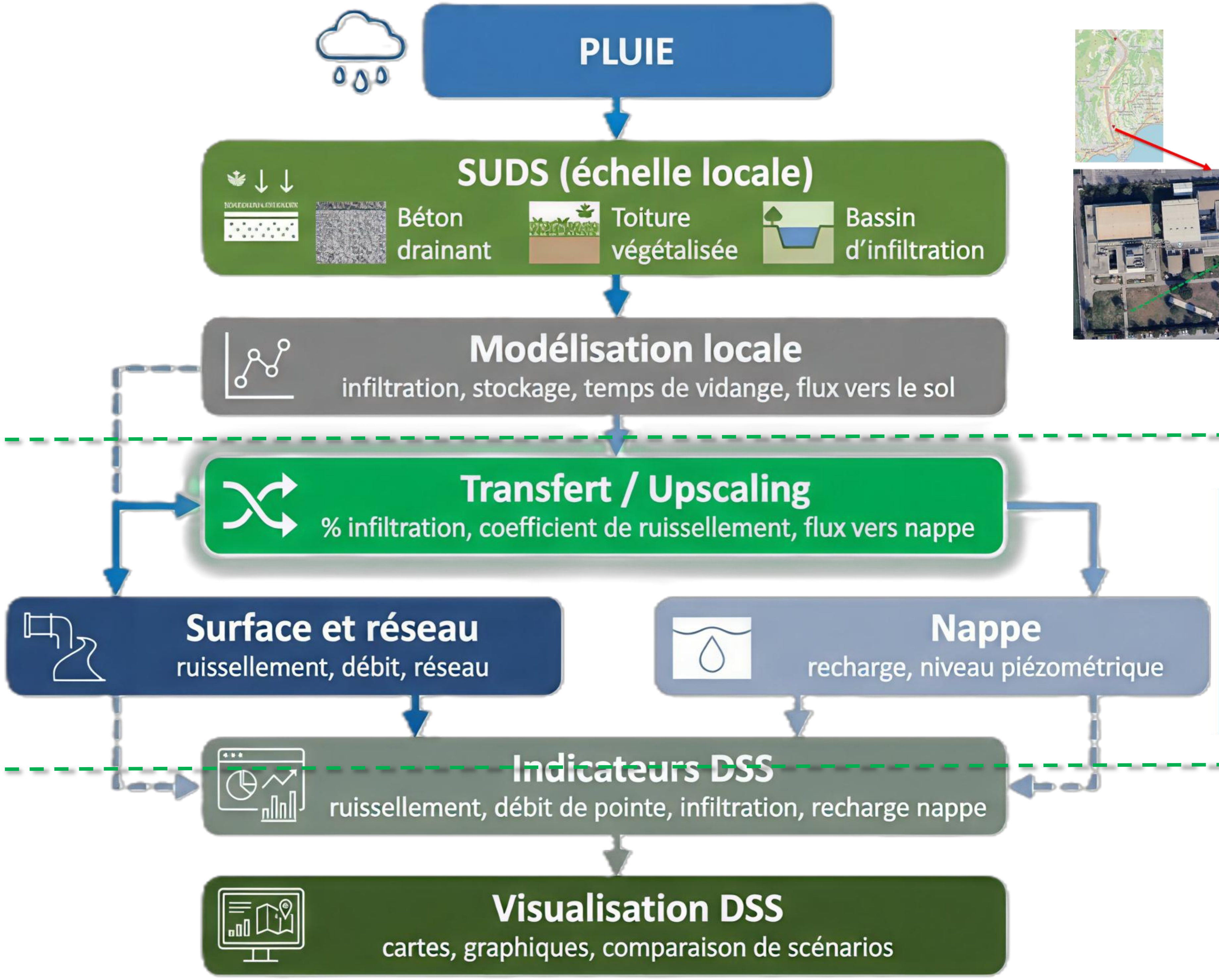
- Lack of research in this field.
- Infiltration is one of the main processes through which runoff quality improvement is attained.
- Vehicular traffic: one of the major sources of contamination (metals: zinc, lead, aluminium).
- Urban stormwater: considered a serious issue for the environment and health; acting as a significant obstacle to preserving high-quality levels of water resources.
- First flush concerns. The behaviour has been observed in Valencia, Spain.
- Surface contaminant (metals and hydrocarbons) distribution: appears to be difficult to predict.
- Vertical distribution: Concentrated in the 0.10 - 0.30 m soil top layer.
- Lack of knowledge about the pollutant portion that might have reached the groundwater.

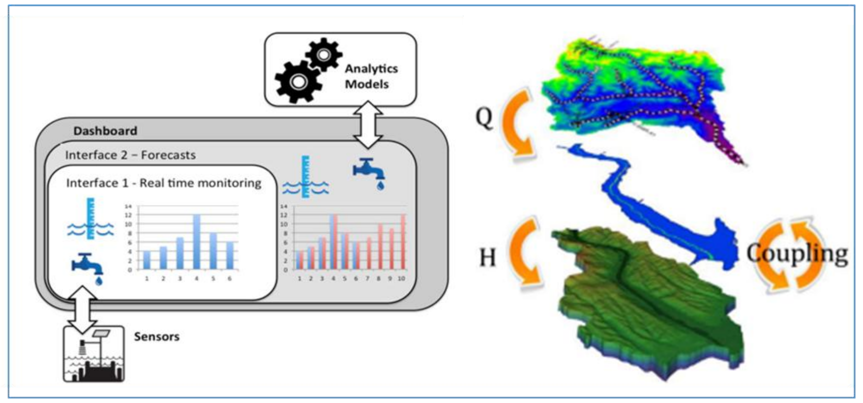
4- DSS development : R&D perspectives *(by Ph.D. candidates MADELBOS Rémi & ZIMAOUI Mehdi)*

Non conventional Water REUSE in a complex context : can strategical choices can be informed using the AquaVar DSS for SUDs?

Local Scale
Refined modeling of SuDs solutions

Larger Spatial Scale (Lower Var Valley)
Cummulated effects at teritorial scale (Surface runoff, network, GW)





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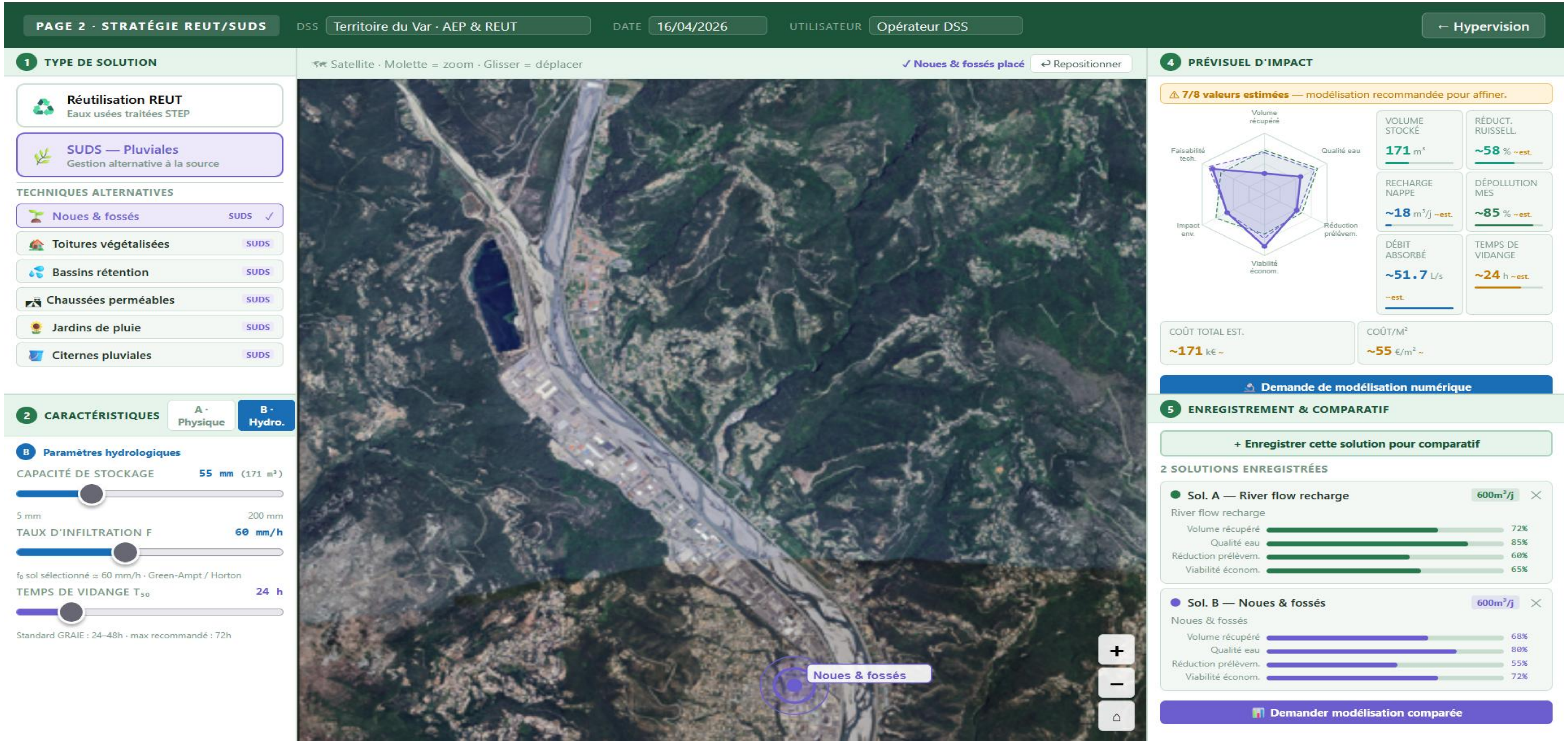


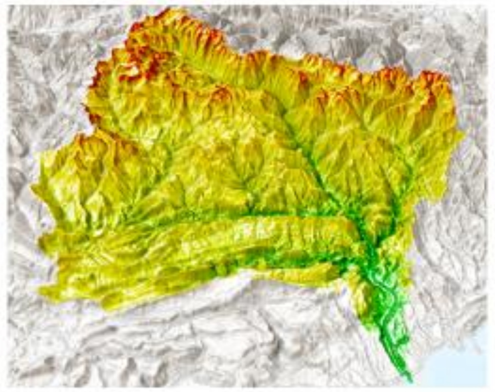
Future dashboard mock-up (visual generated via AI)

4- DSS development through collaboration: R&D perspectives

Objective: AquaVar Digital Twin Enhancement and integration in Hypervision

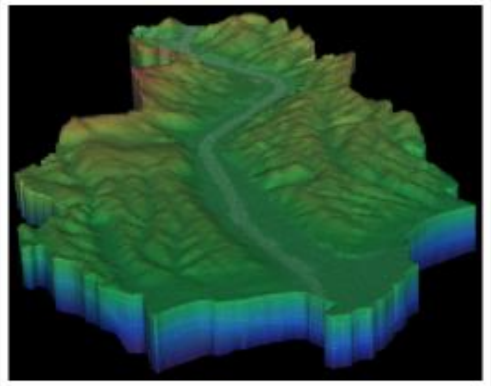
Observations

✓ Ontology



Hydrologie

Hydraulique



Hydrogéologie (bientôt disponible)

✓ Integrating Remote sensing data

- Rainfall/ET/SM products
- Snow cover maps
- DEMs (monthly/seasonal maps)

✓ River hydro-sedimentary assessment

- Hydro-morphological evolution of the Var valley
- Integration of debris-flow risk assessment

✓ River-Aquifer Interaction

✓ Hydrogeo-chemistry & Hydrogeo-physics

✓ Non-Conventional water (REUT & SUDS) and hydroinformatics

AquaVar : DSS for water resource management in a Mediterranean watershed

THANKS FOR YOUR ATTENTION

Morgan Abily *- Université Côte d'Azur, CNRS, Observatoire de la Côte d'Azur, IRD, Géoazur, France*
morgan.abily@univ-cotedazur.fr