LIÈGE université
Gembloux
Agro-Bio Tech

What can be done to improve the hydrological resilience of the Vesdre catchment? What are the constraints?

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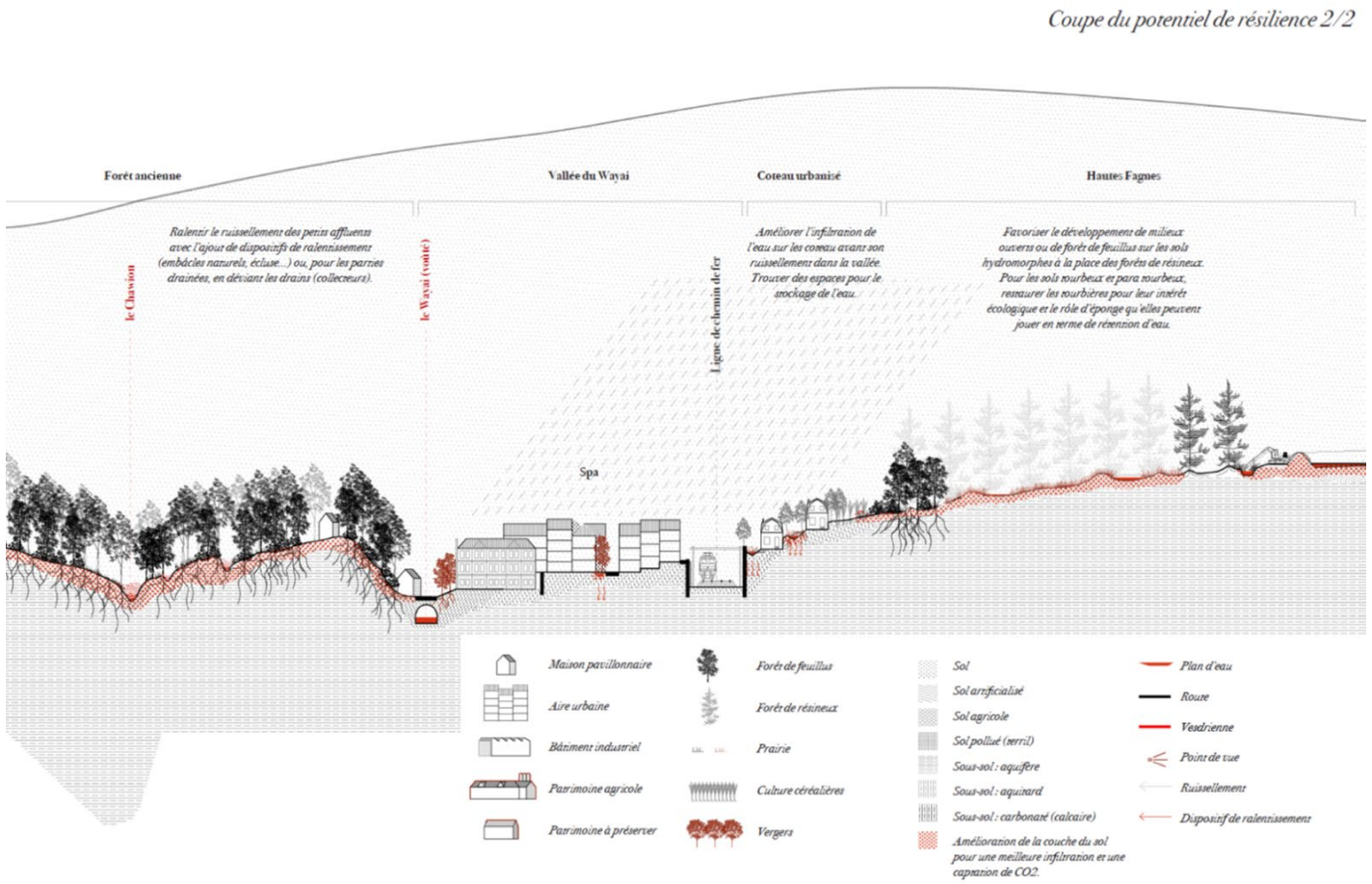
Context : Vesdre 2021

- After the floods of 2021, the strategic master plan proposes four theoretical development programmes for the catchment area
- These plans cover housing and mobility, as well as agriculture, biodiversity and the management of natural areas
- What are the potential effects of these developments on the hydrology of the catchment?

MODREC project - physically based hydrology section

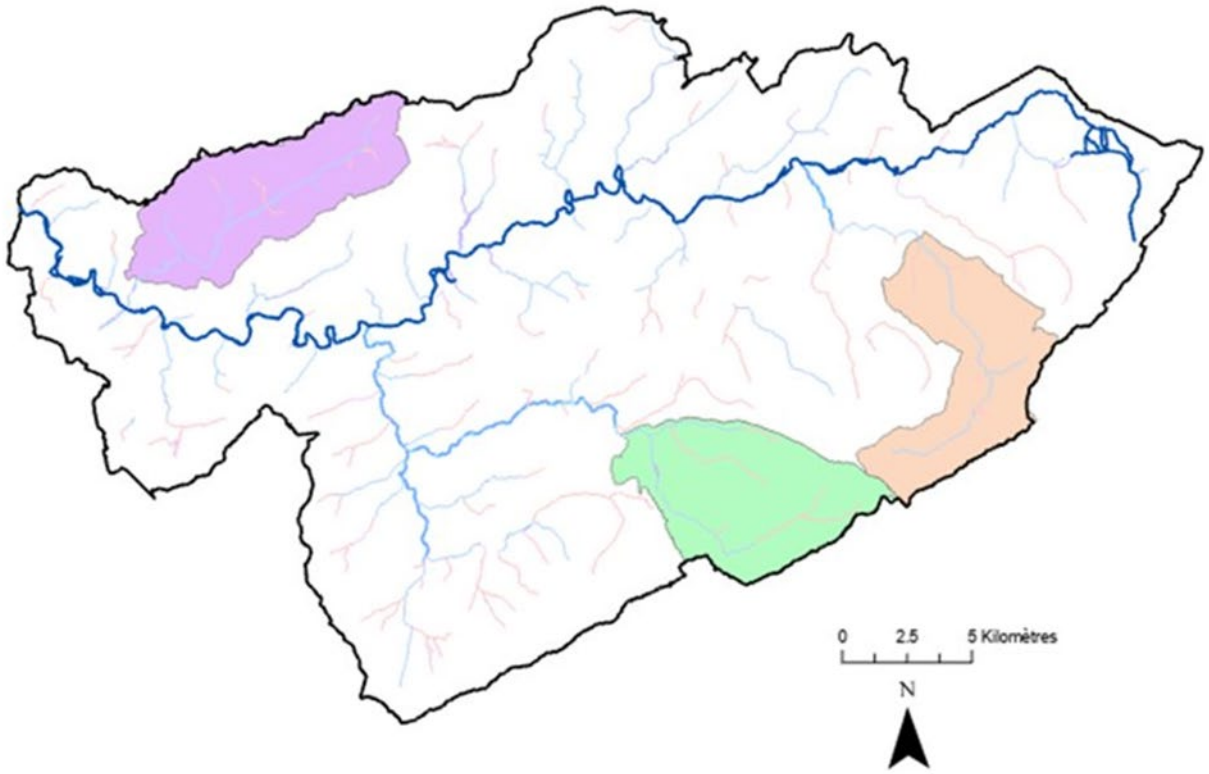
In the diversity of a catchment area

All combinations of land/land use/landscape have a potential role to play



Physically Based Hydrological Modelling

Quantifying the effectiveness of the strategies proposed in the Vesdre scheme

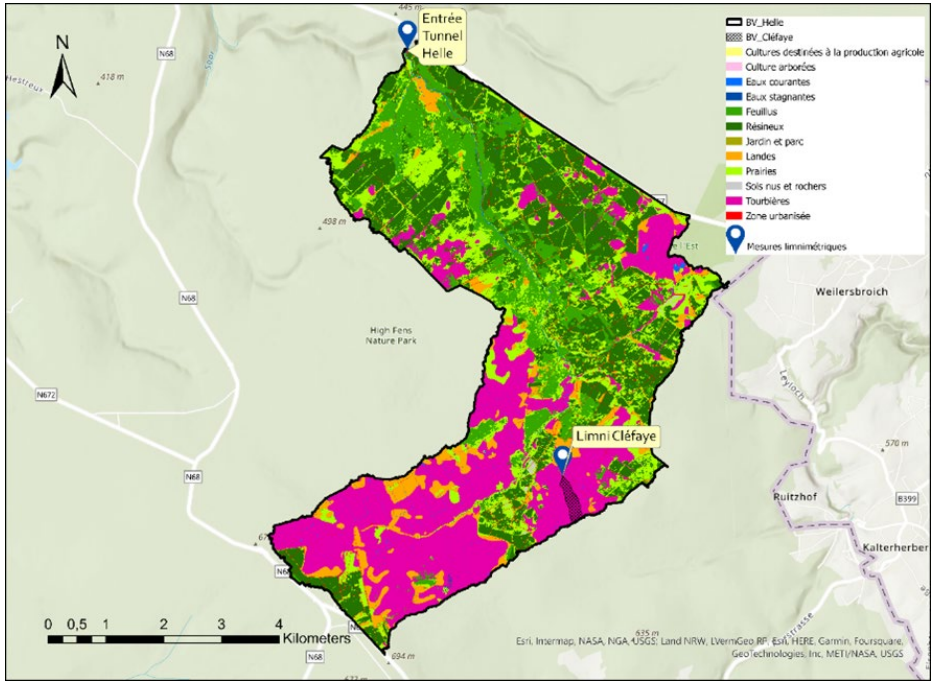


Magne catchment area
- Dominantly agricultural

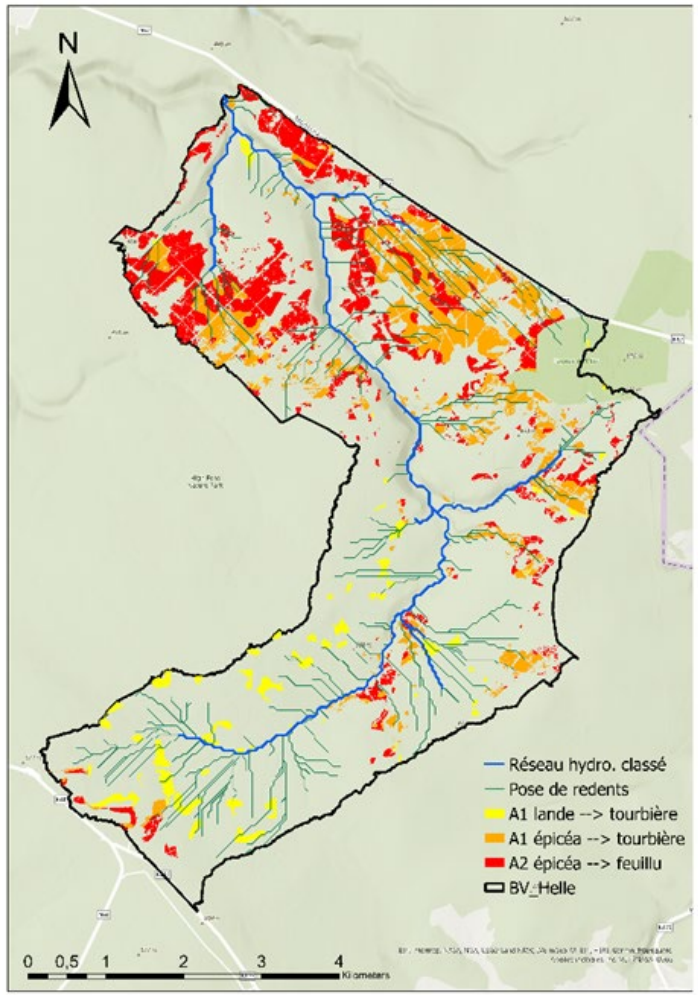
Hoëgne catchment area
- Forest dominated

Helle catchment area
- Dominantly peat bogs

Helle catchment – peats and forests



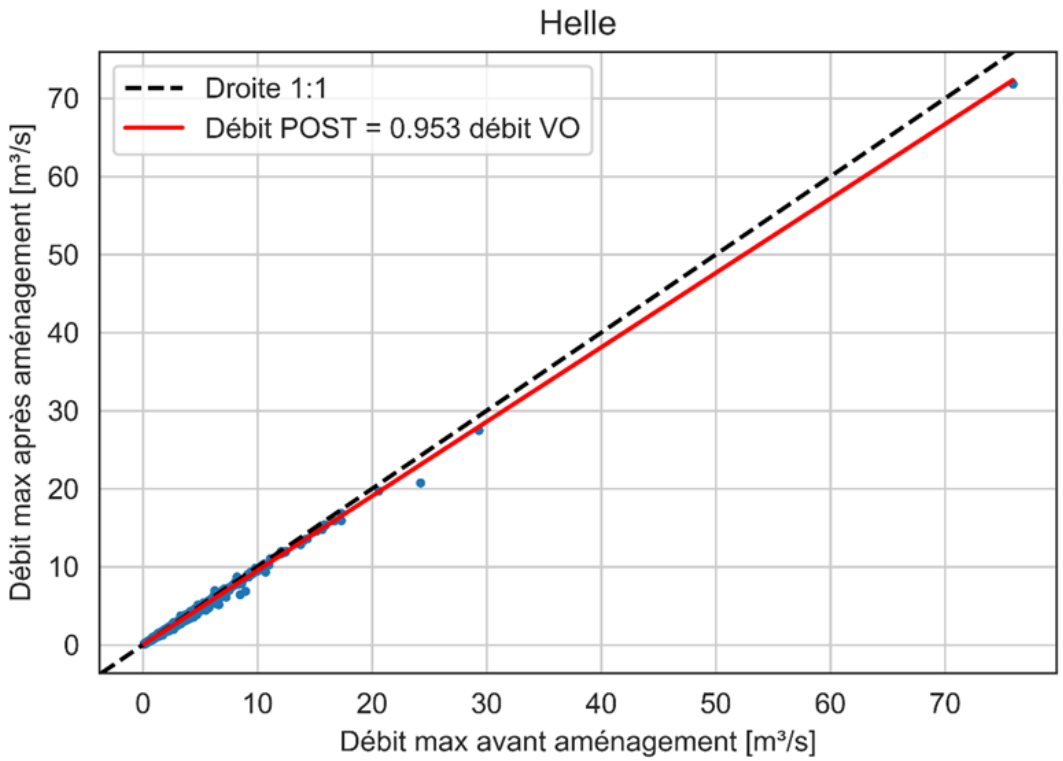
Hydrological improvements



Total developed: 35% of surface area (over 36 km²)
Forestry practices limiting soil compaction (A5): 24% surf.
Diversification of environments on hydromorphic soils (A2): 9% surf.
Restoration of peat and para-peat soils (A1): 11% surf.
Redents (B2 + B3): 197
Ponds: 26

Hautes Fagnes Fraisage Décapage Bouchage Drains Geitzbusch 2012

Hydrological efficiency



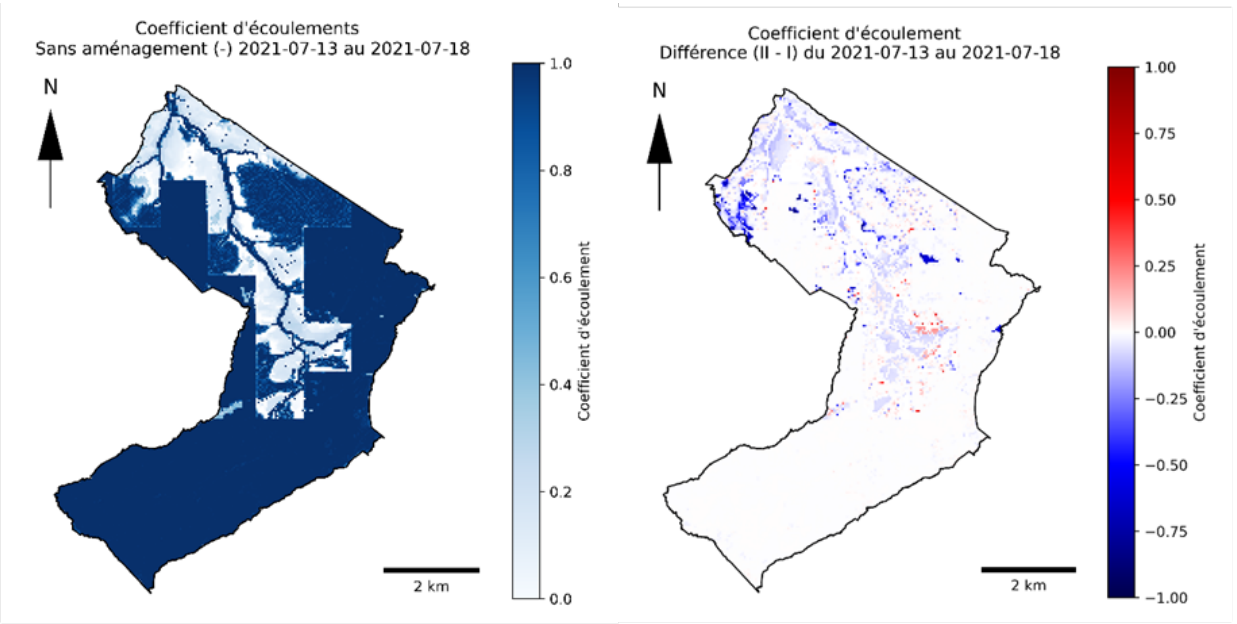
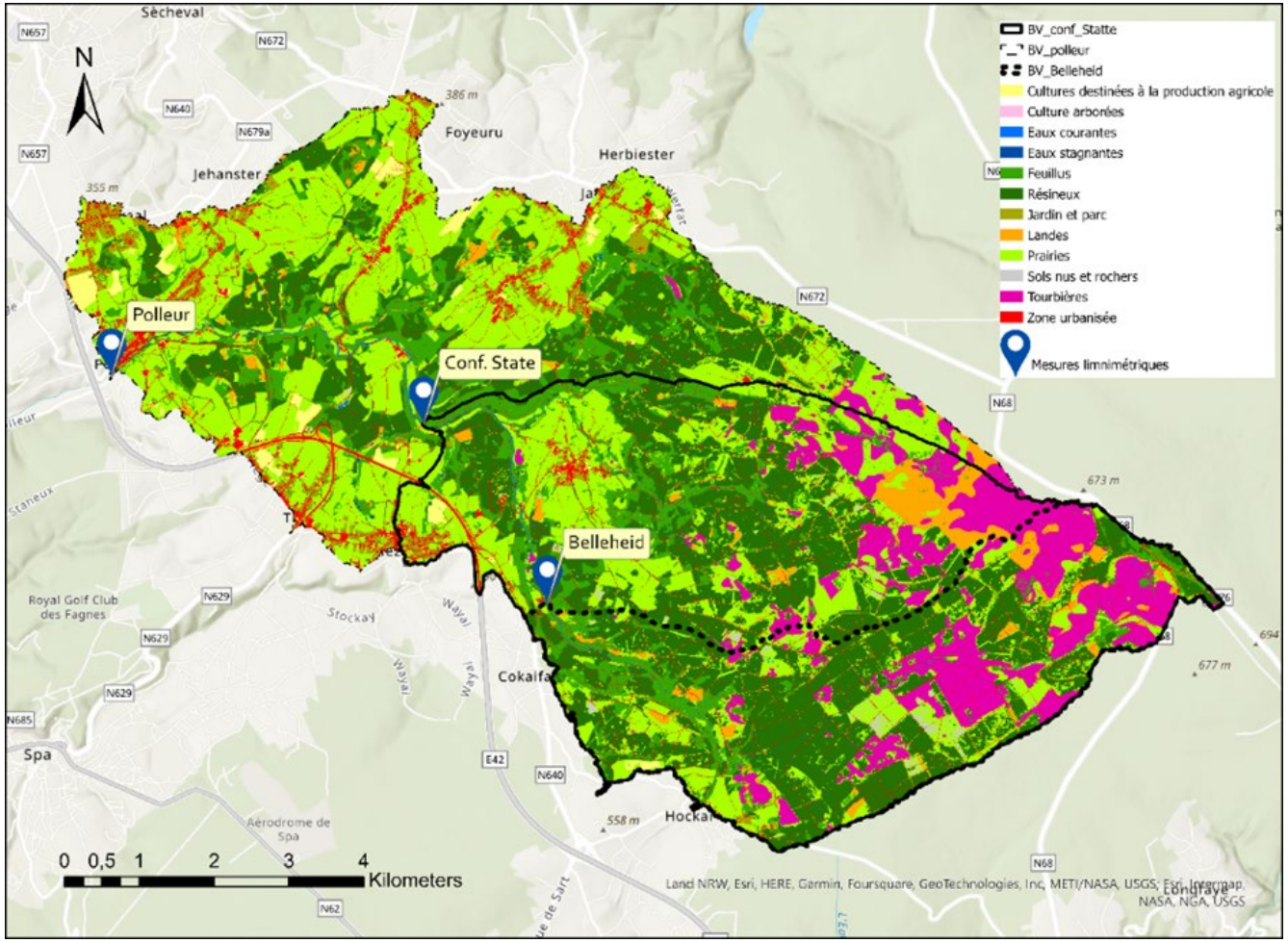
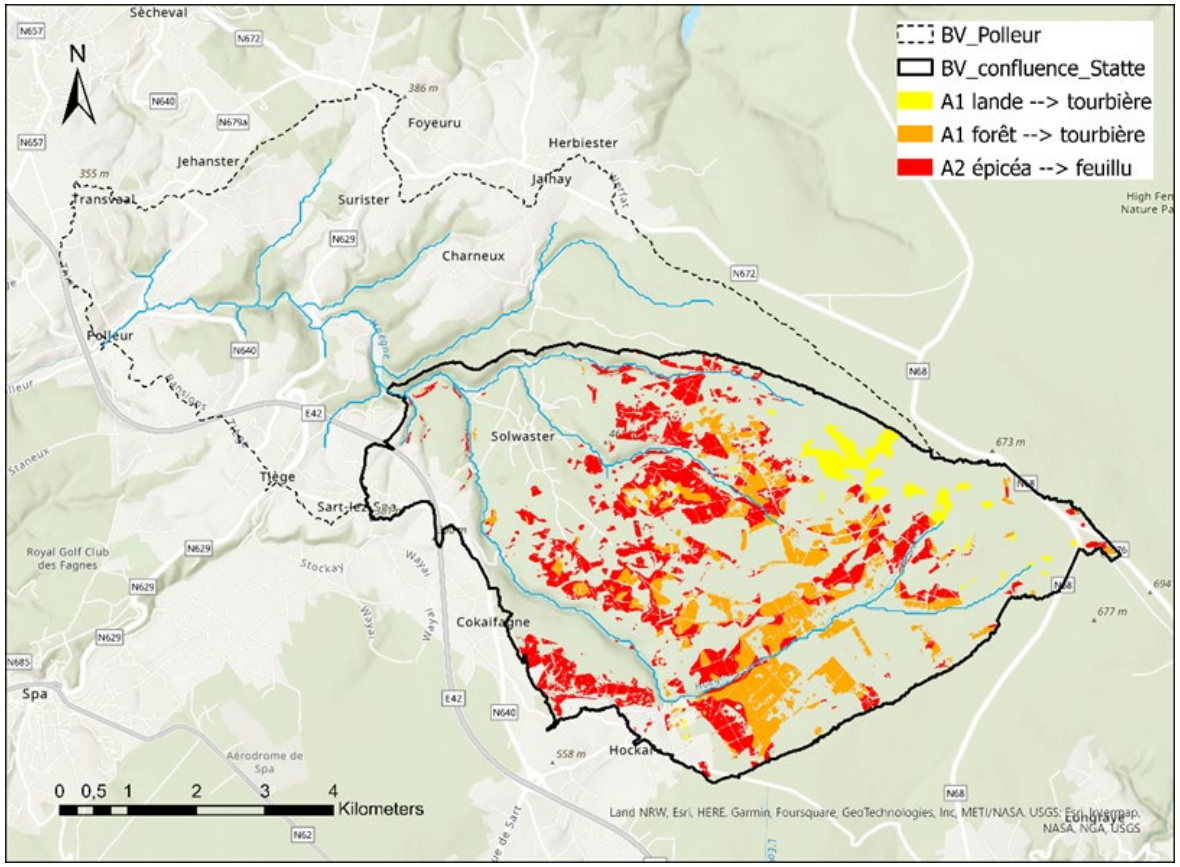


Figure 1 : Coefficients d'écoulement du 13 juillet au 18 juillet 2021 avant aménagement (en haut à gauche), après aménagement (en haut à droite) et différence après – avant aménagement (en bas). Les quantités ruisselées diminuent dans les zones en bleu.

Hoegne Catchment – forests and (para-)peat



Hydrological improvements



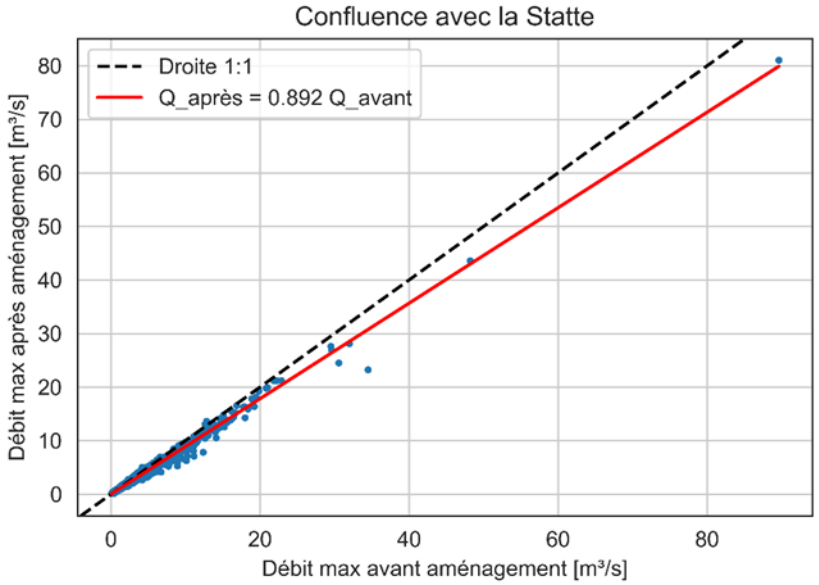
Soil conservation forestry practices

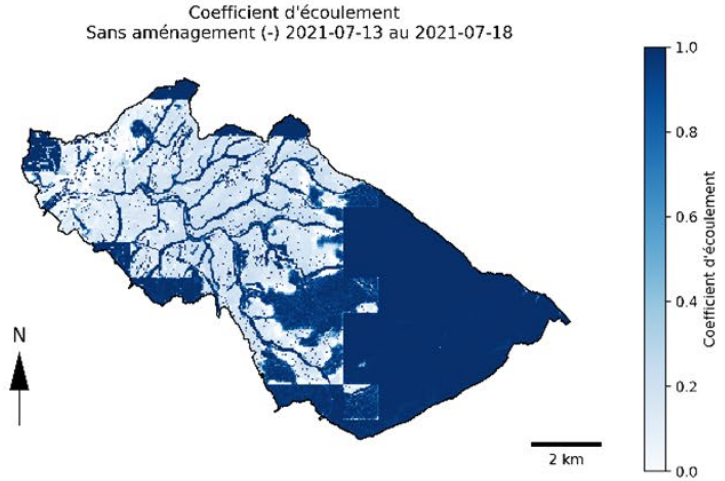
Peat and para-peat soils (460 Ha)
11% of BV Conf_Statte
6% of BV Polleur

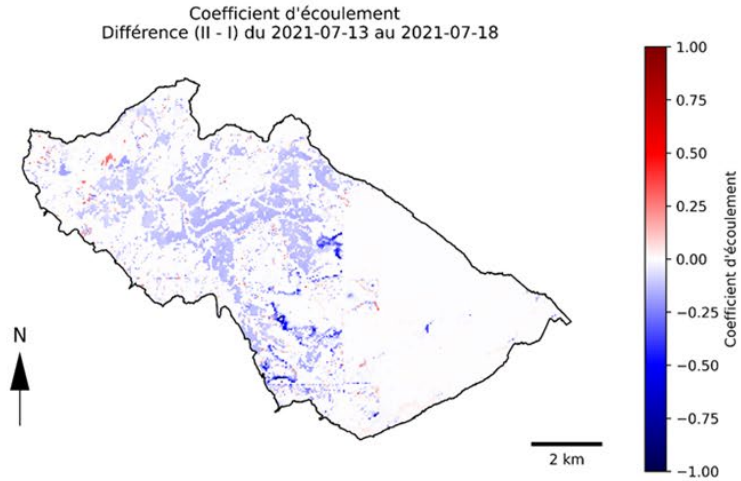
Hydromorphic soils (539 Ha)
13% of BV Conf_Statte
7% of BV Polleur

49 ponds
165 redents (± 25 km of developed routes

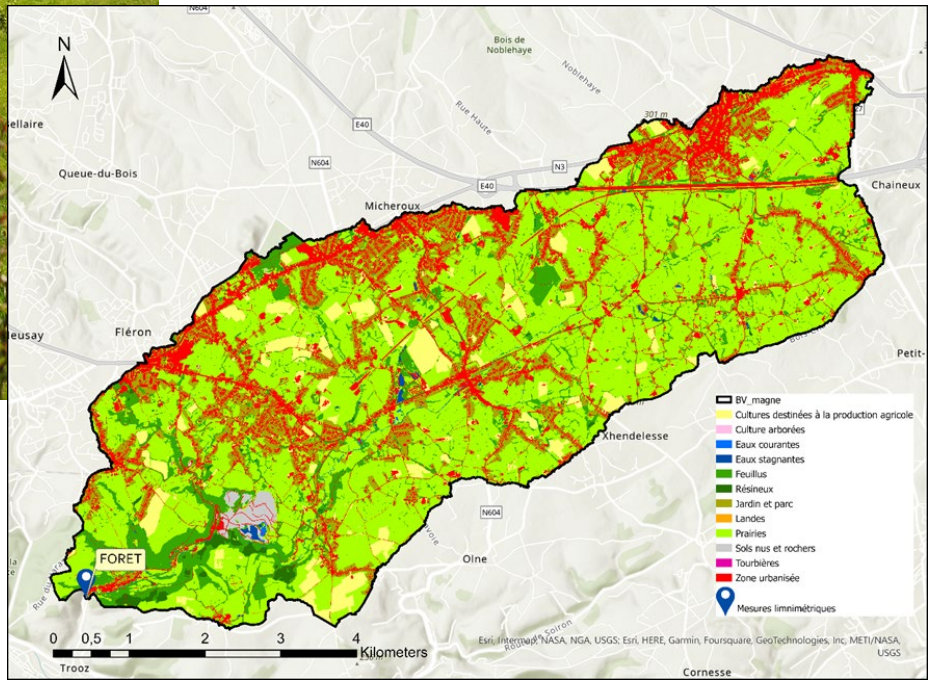
Hydrological efficiency



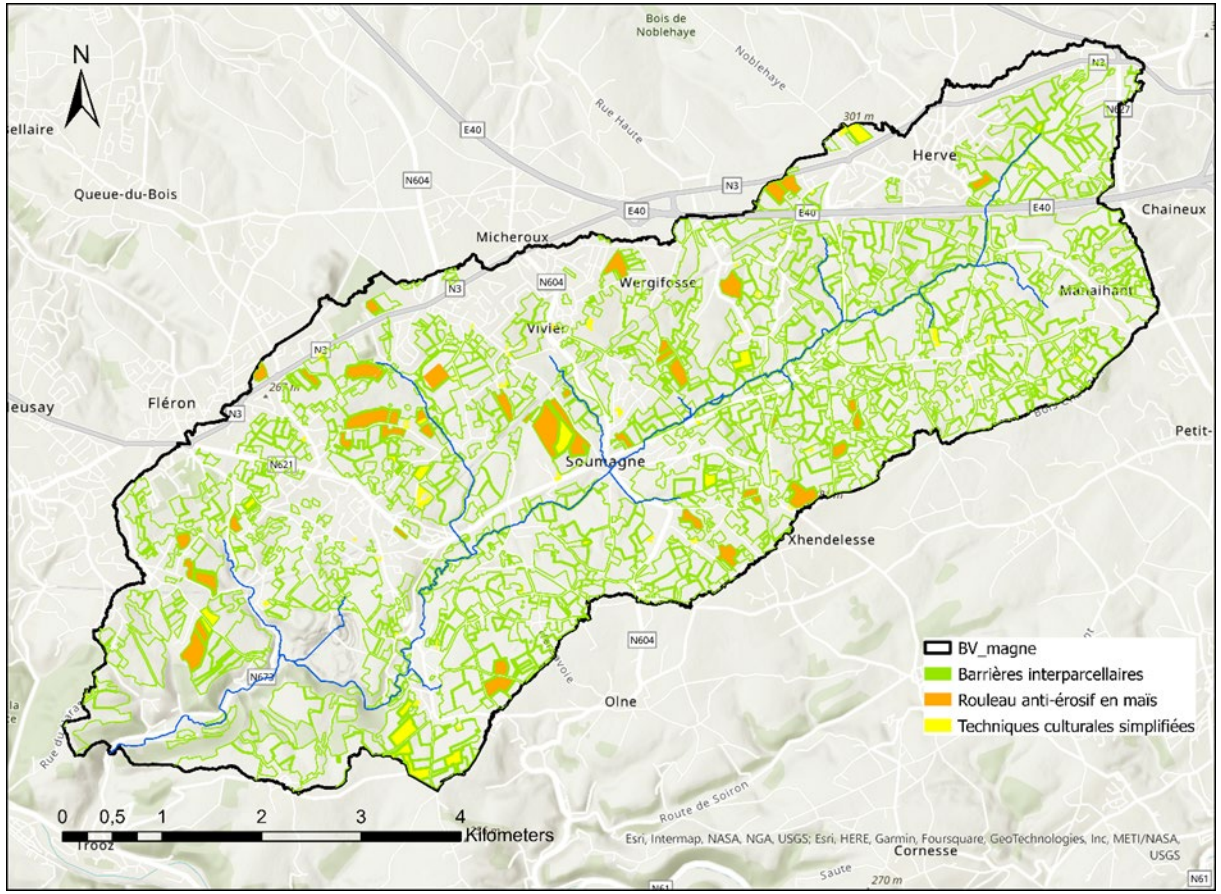




Magne catchment – agriculture & residential areas



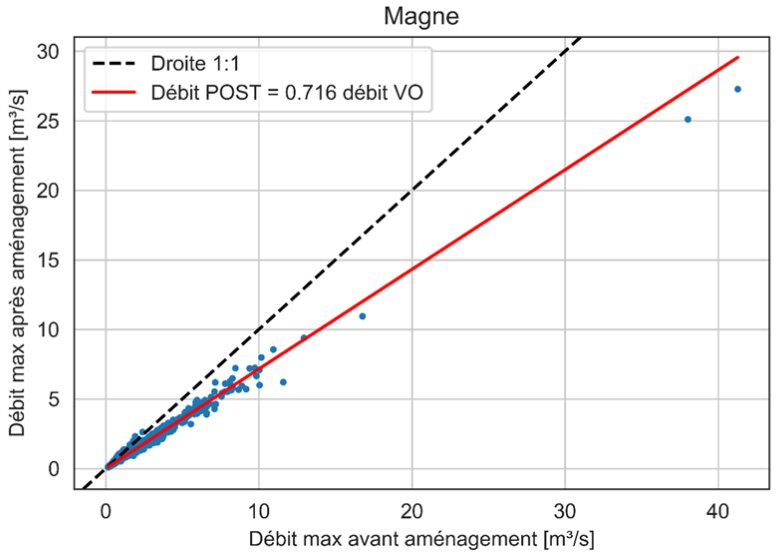
Hydrological improvements

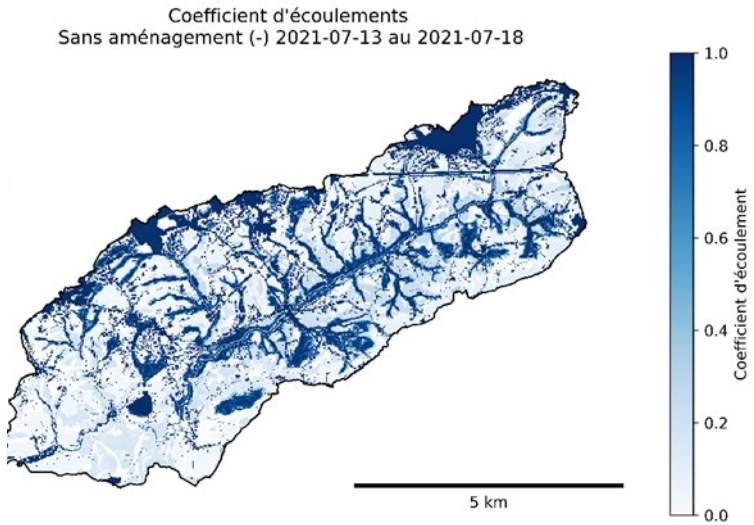


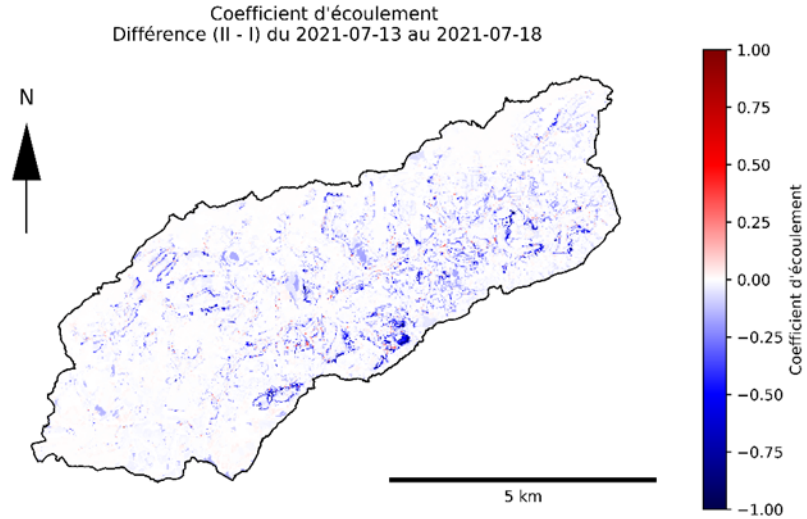
cipf

- ± 42 ha reduced tillage
- ± 86 ha anti-erosion roller for maize
- ± 700 km vegetation barriers between plots

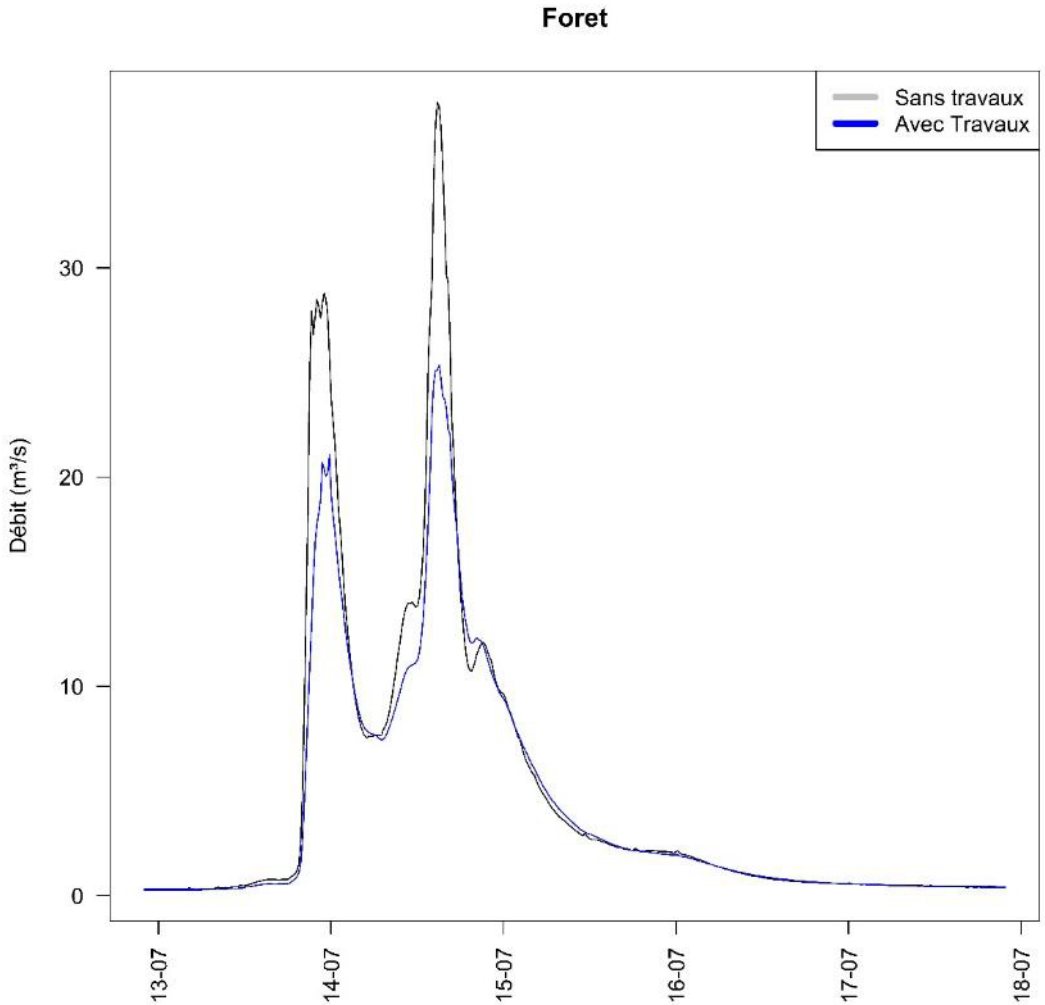
Hydrological efficiency







Results: July 2021 - Hydrographs



EPISODE : 2021-07-13 AU 2021-07-18
BV aménagé - BV non aménagé

	site_ref	QMax delta (%)	Qmax Time delta (min)	Vol. tot. delta (%)
1	Foret	-33	15	-14

Efficiency per measure

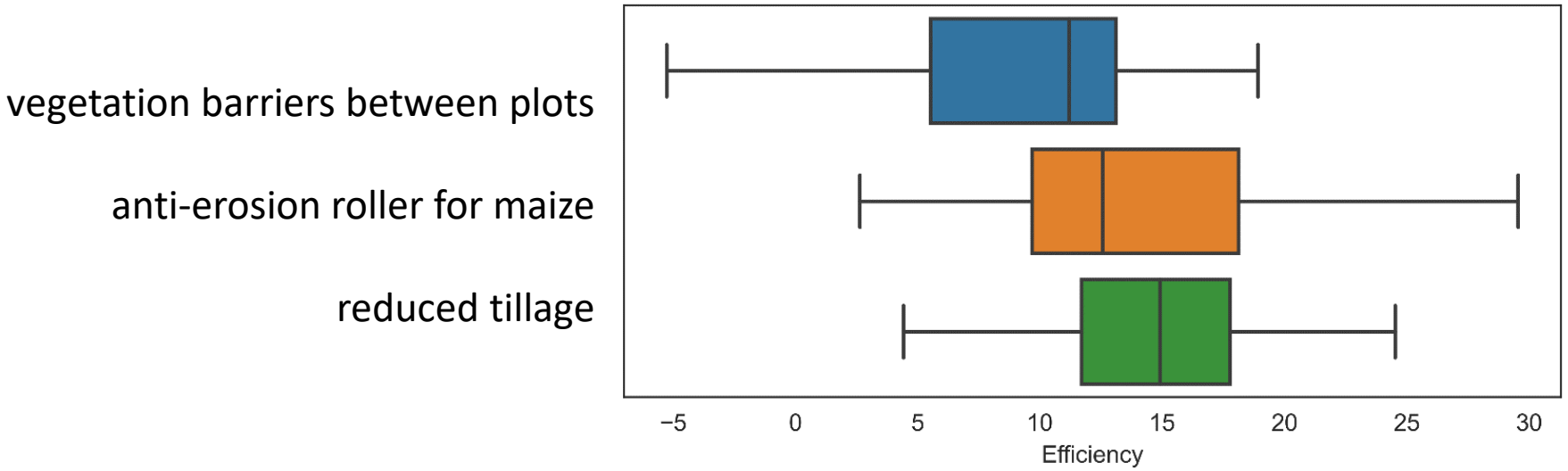


Figure 1 : Réduction du ruissellement (en %) selon la stratégie d'aménagement utilisée : restauration d'une trame bocagère en marge des parcelles agricoles (barrières interparcellaires), utilisation du rouleau anti-érosif sur cultures de maïs (Mais), adoption de techniques culturales simplifiées sur les autres cultures (Autres cultures).

Hydrological balance by type of development

Interparcel barriers intercept more rain and greatly increase evapotranspiration in summer.
Water stocks in the soil are locally reduced, allowing intense rainfall to be infiltrated.
Winter recharge is virtually unchanged

Figure 1 : Valeur (VO : en haut) et différence (POST – VO : en bas) absolue moyenne sur 19 ans des flux et stocks d'eau exprimés en mm par semestre hydrologique (été - hiver) en fonction des différents aménagements et sur l'ensemble du bassin versant de la Magne.

Hydrological chronicles

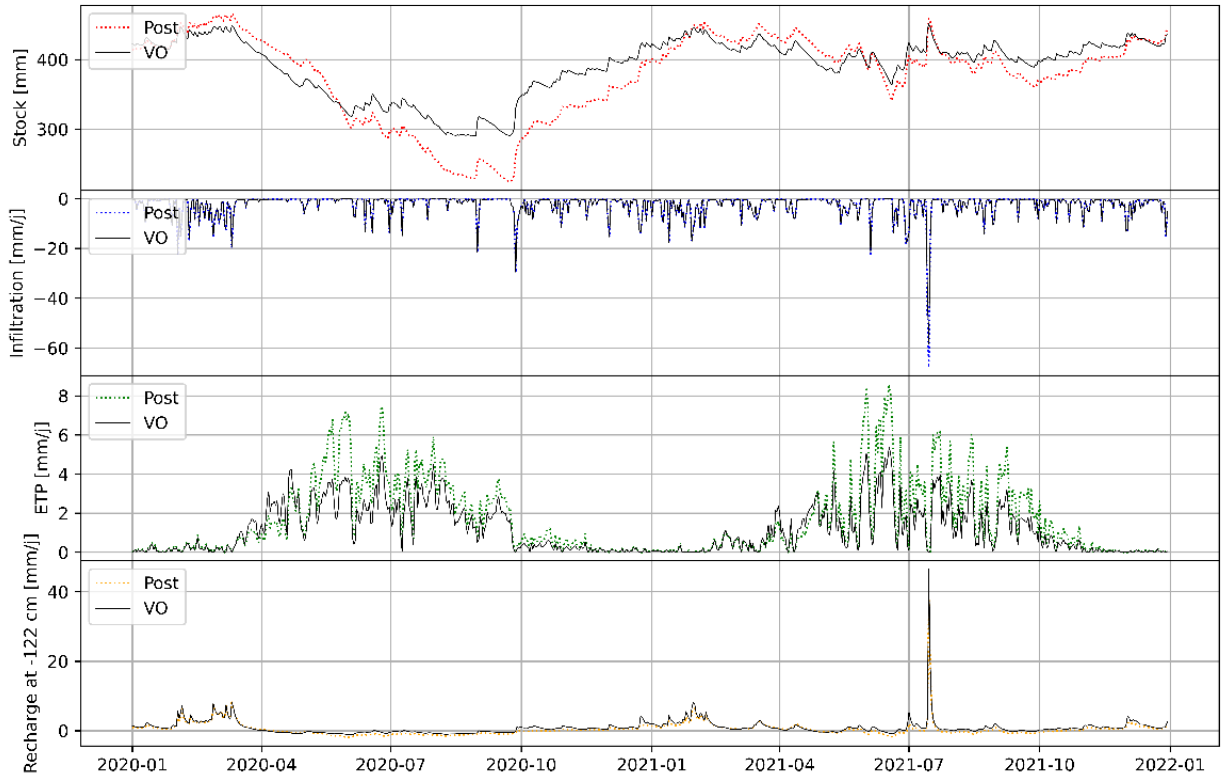
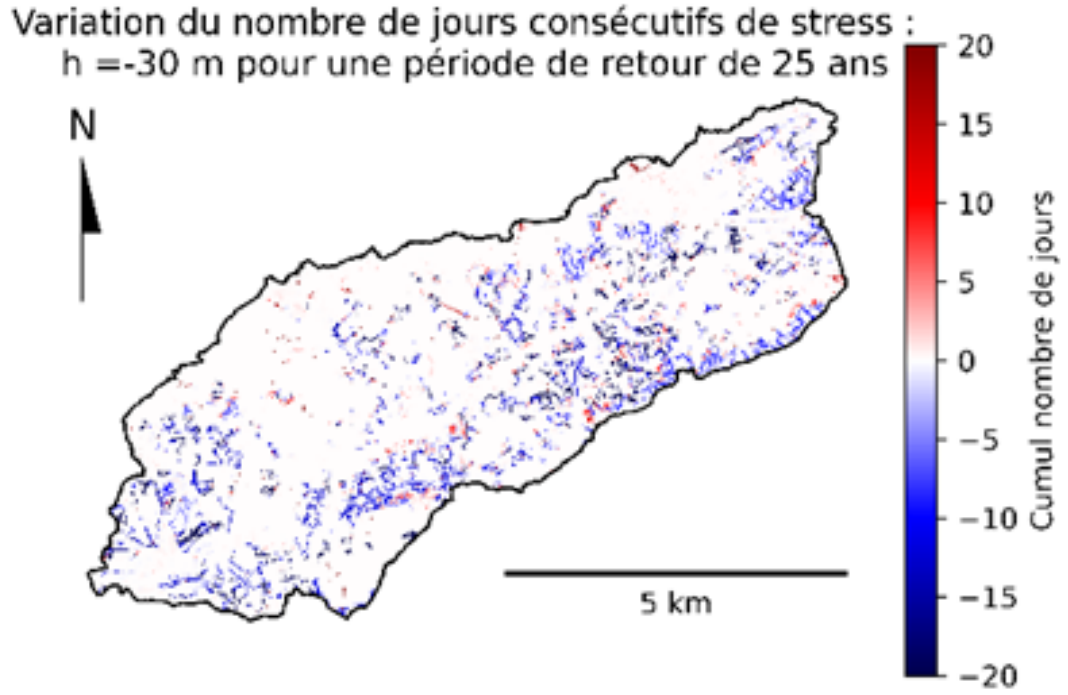


Figure 1 : Bilan moyen des zones concernées par les aménagements barrières interparcellaires : moyenne des stocks d'eau dans les 120 premiers centimètres du sol, de l'infiltration, de l'évapotranspiration et de la recharge à 120 centimètres entre 2020 et 2022.

Impact of measures on drought

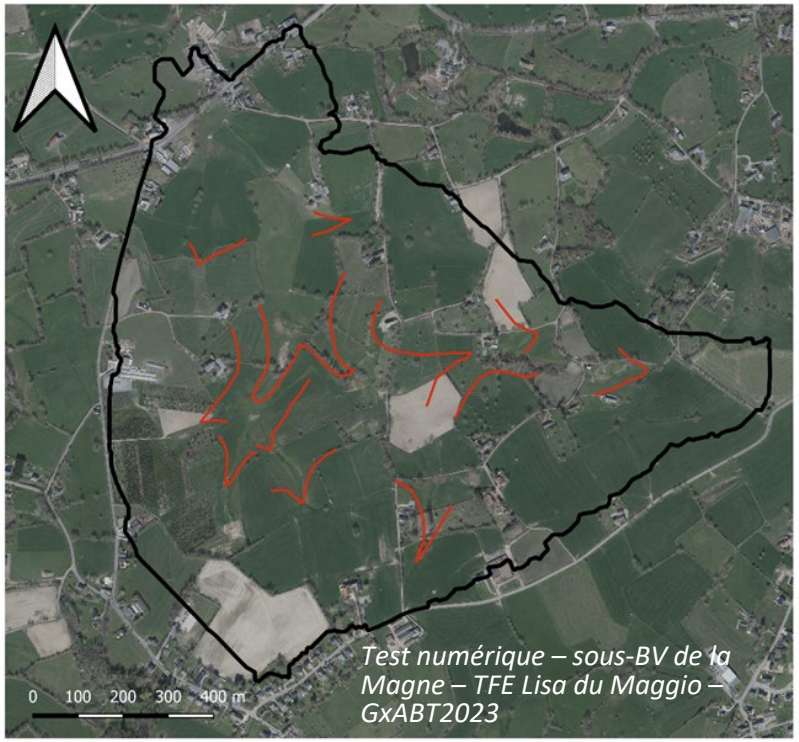
Large predominance of a reduction in the number of dry days

-> no regret



Keyline design principles

- Collect water in thalwegs,
- Redistributing water in the landscape
- Maximising infiltration
- Activate the hydrological pump by planting hedges



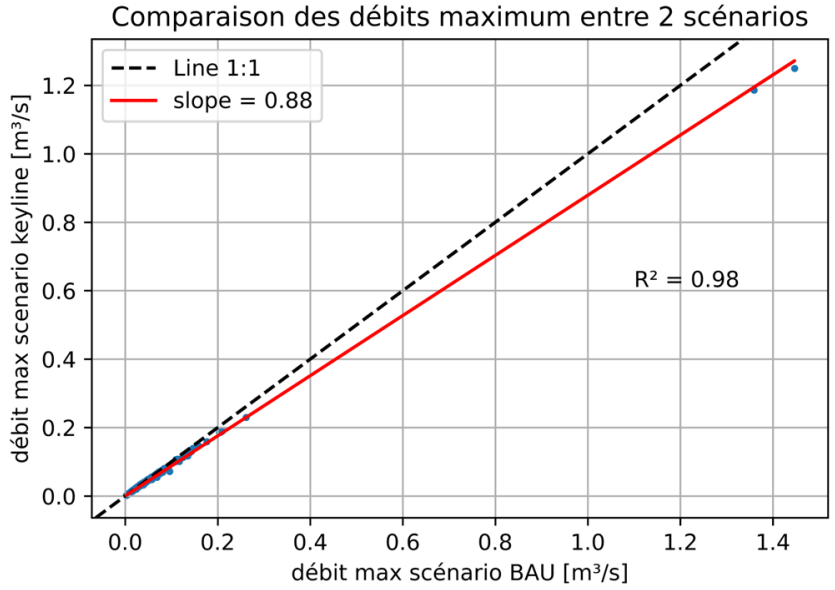
Test numérique – sous-BV de la Magne – TFE Lisa du Maggio – GxABT2023

Ponce-Rodríguez et al., 2021

Hydrological efficiency

- In **agricultural areas with draining soils**, keylines can **distribute water** to naturally **draining** areas where it can be **reinfiltrated**, helping to significantly **reduce runoff.**
  - **12% to 14% reduction in maximum flow at outlet**
- **Keylines** can form a **hydrologically optimised hedgerow**. Their effectiveness adds to that of other measures

- In **hydromorphic conditions**, **soils** are often **waterlogged** and **keylines** are **only effective** during a **single** rainfall following a **dry period** (summer thunderstorm).



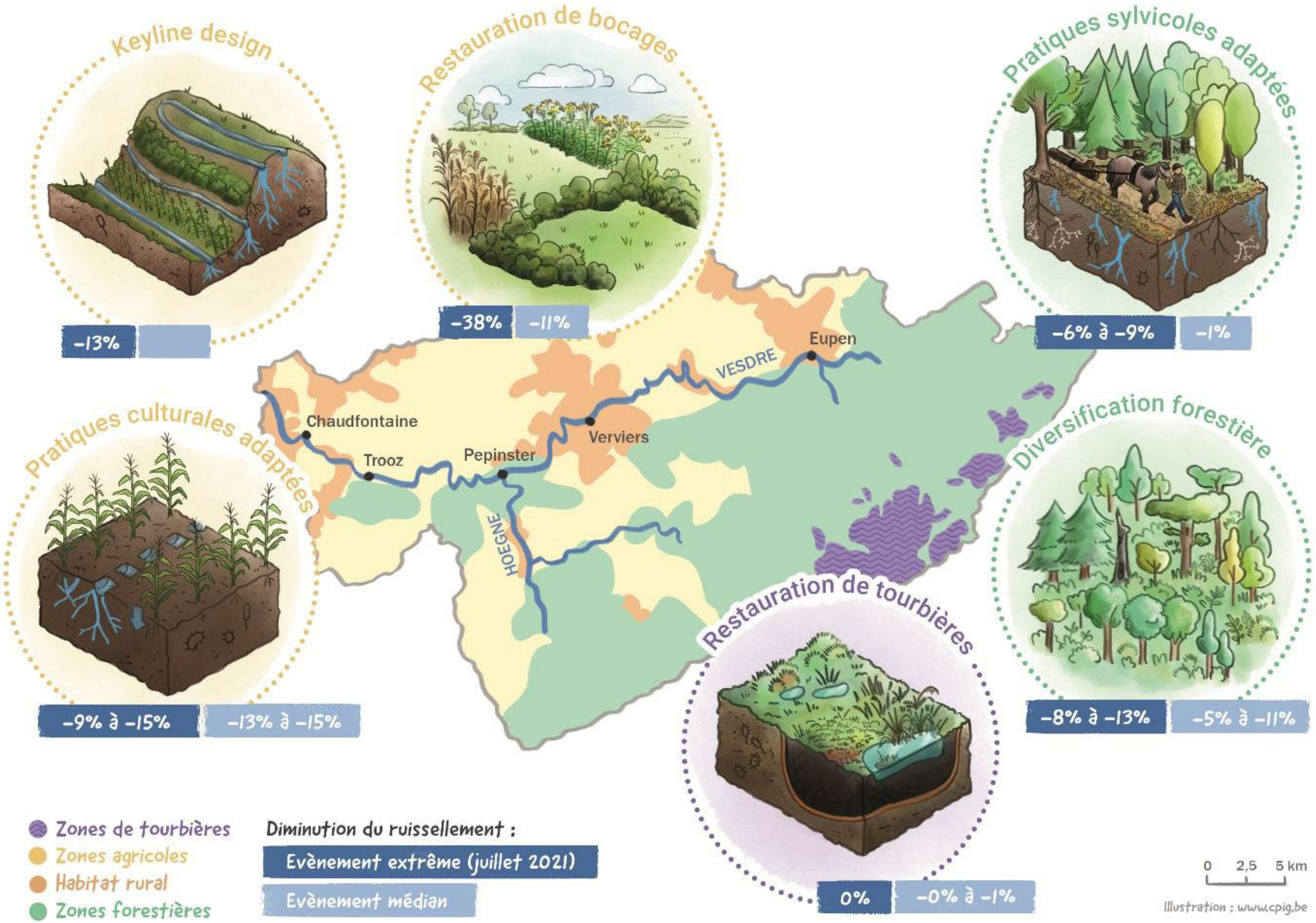
Figuur 9. *Contourboslandbouw als corridor en visueel aantrekkingspunt in het complexe natuur-, landbouw- en belevingslandschap te Heuvelland (2020).*

Landscaped plots in Flanders, ILVO, 2020

Towards a hydrologically optimized landscape?

Illustrations Drome – Biovallée – hydrologie régénérative

Infiltration: Action depends on context



In residential areas

- In July 21, the **15% of impervious surfaces** on the Magne contributed to **25% of the total runoff produced.**
- The first priority for a resilient BV is **to stop the sealing of soils**
- In town
  - **De-Waterproofing of soils**
  - Using solutions inspired by nature for storage, infiltration and evaporation

SOILveR Soil and land research funding platform for Europe

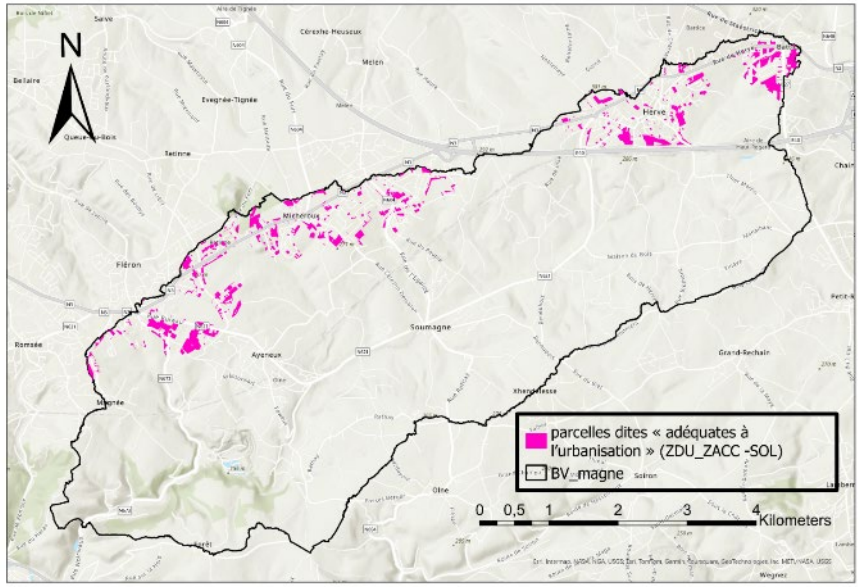
LA DÉSIMPERMÉABILISATION DES SOLS, POUR UN RETOUR DE LA NATURE EN MILIEU URBAIN…

Jardin de pluie GxABT

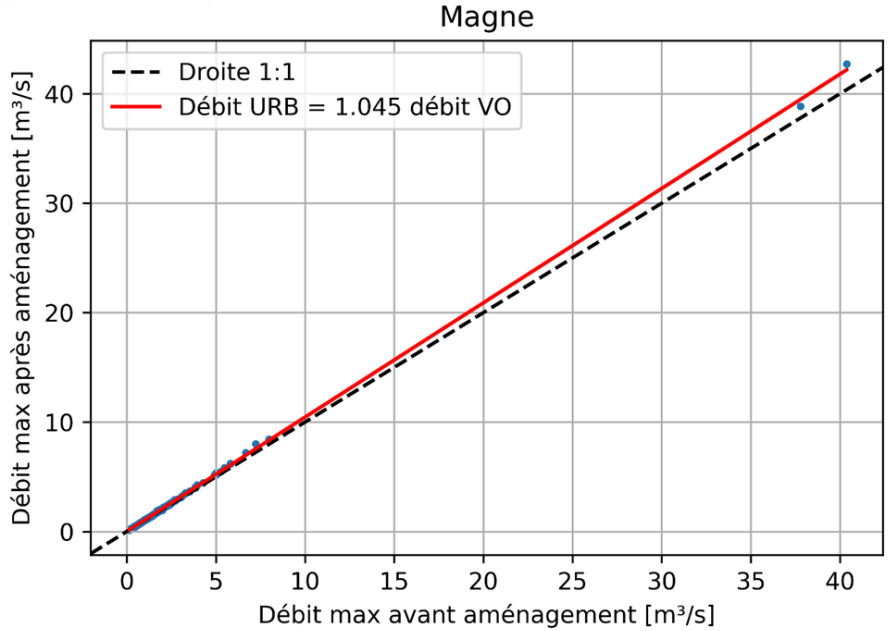
Quadu F, Bâlon P., Limasset E., Malherbe A., 2021, La désimperméabilisation des sols, pour un retour de la nature en milieu urbain…

SSV scenario for potential building extension on La Magne

- Urbanisation of parcels designated as "suitable for urbanisation" in the SSV
- 2.4% of the surface area of the BV
- We assumed that 70% of these surfaces (arbitrarily) would be sealed.

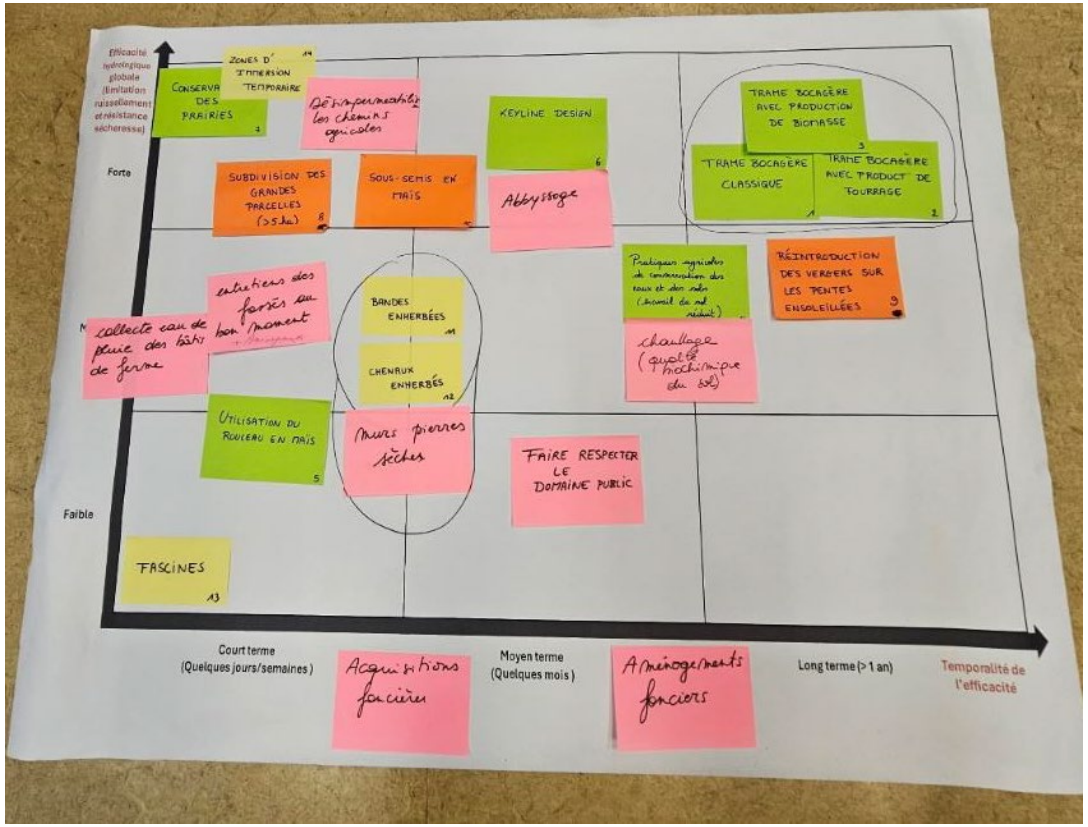


If the areas designated as "suitable for urban development" are actually built on, the average peak flow at the Magne outlet will increase by 5%.



Next steps : Implementation and efficiency

- Technical aspects :
  - When and how does a measure become effective?
  - Effect of barrier age on effectiveness Inter-annual
  - variability in the effectiveness of soil conservation measures
- Socio-cultural aspects
  - How to generate practical change?
  - What is the transition period?
  - From a spruce stand to a diversified forest
    - What are the implementation difficulties?
- “Suitcases and balloons” workshops



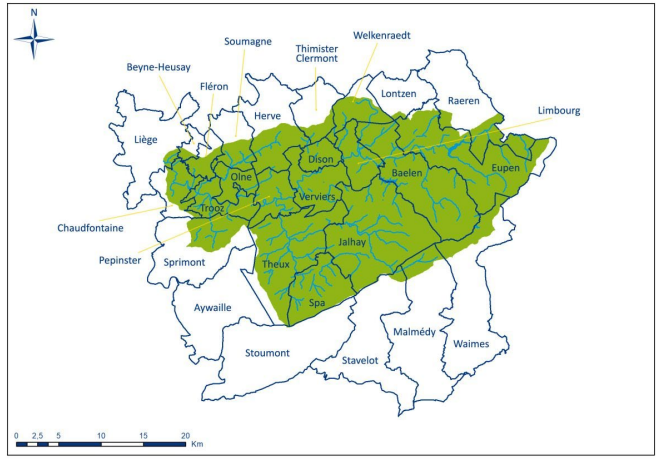
Towards territories of hydrological innovation

Wallonie environnement SPW

Contrat de Rivière VESDRE

FJA Fédération des Jeunes Agriculteurs

FWA



And many more…

Thank you!

Still a lot to show, a lot to discuss…
do not hesitate to contact us
aurore.degre@uliege.be