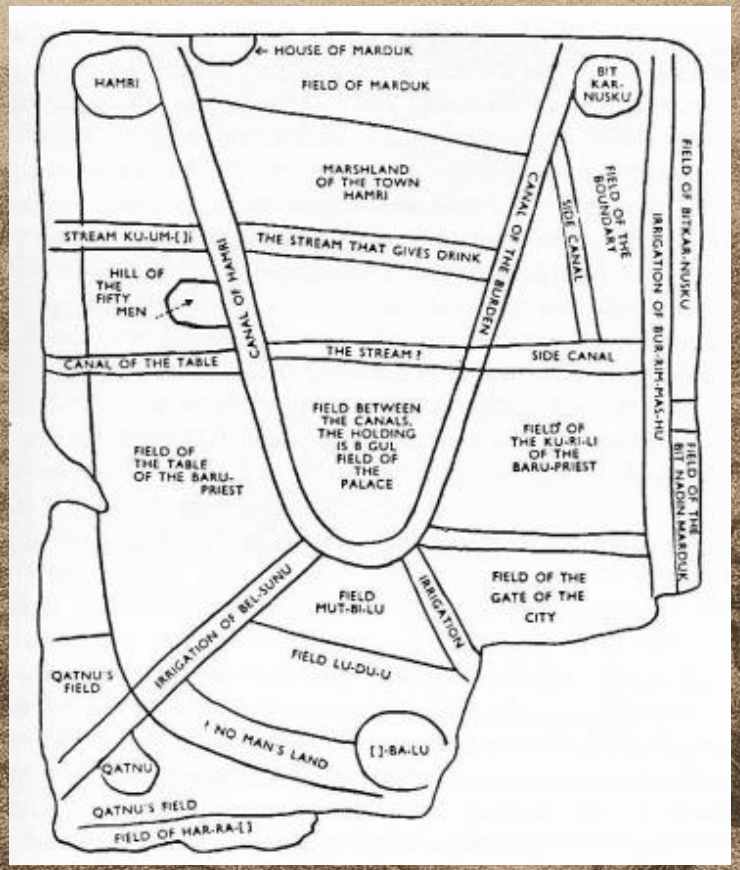
LIÈGE université
Gembloux
Agro-Bio Tech

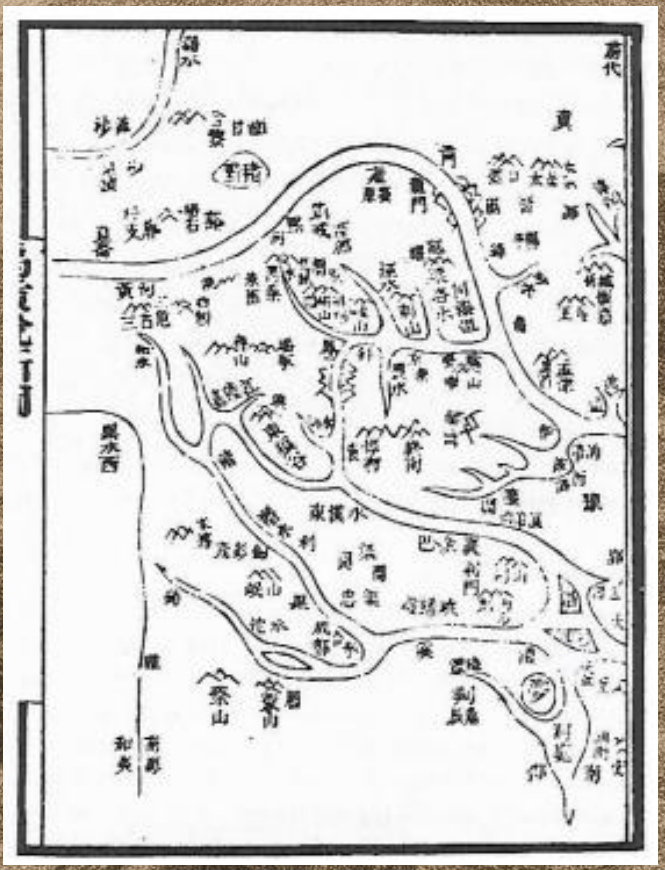
# Façonner des territoires d'avenir : l'eau, les sols et le temps

Illustration : Caroline Levicek - CπG

Aurore Degré

EESP – 30 septembre 2025

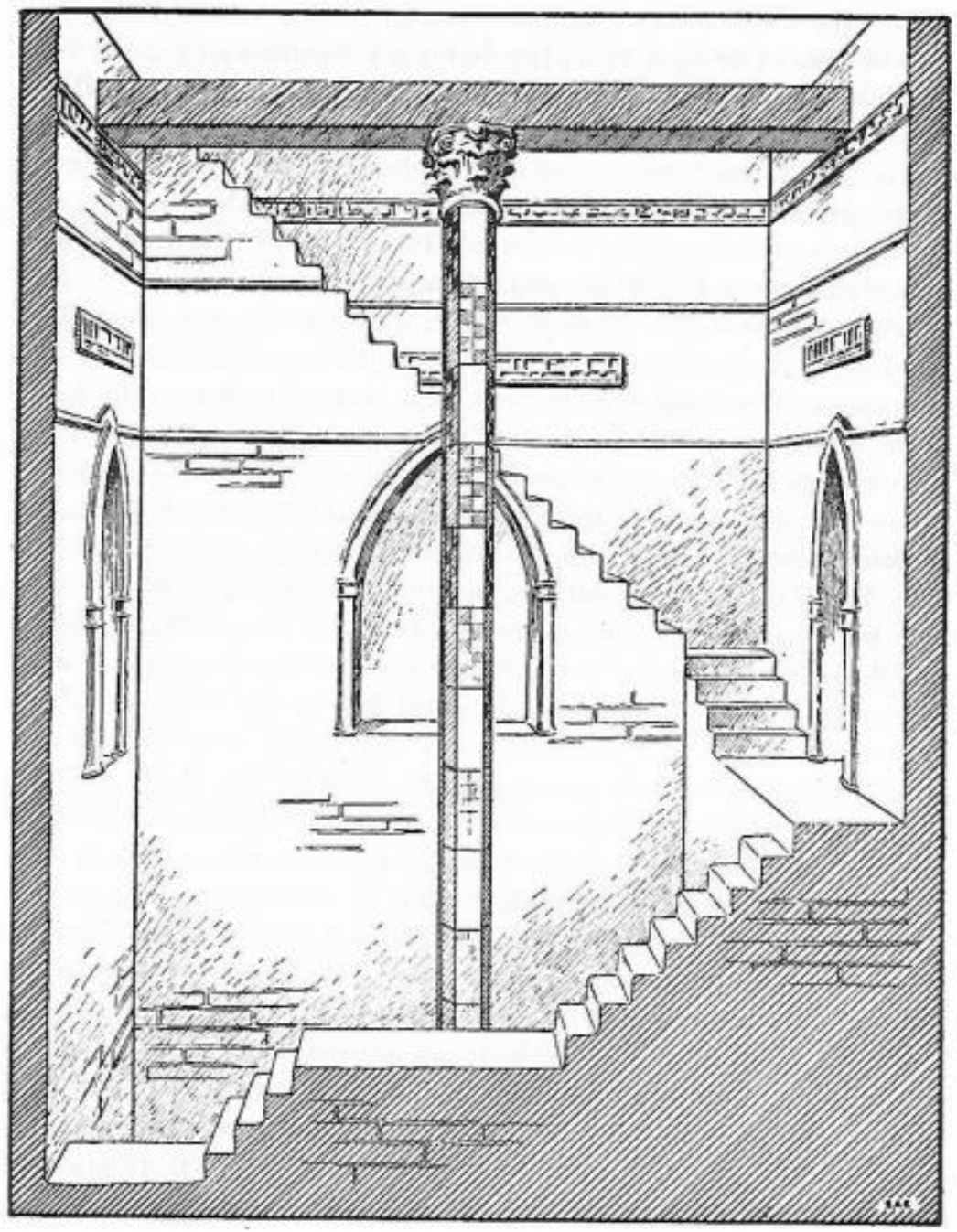


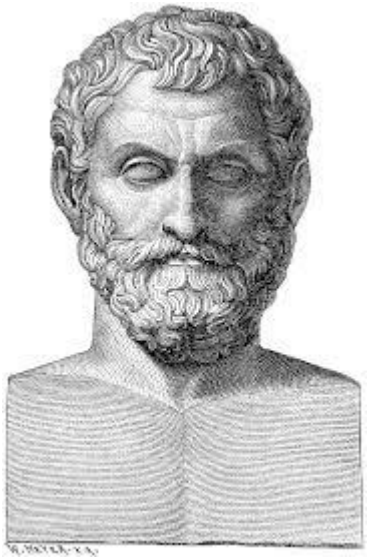
Carte du système d'irrigation de Nippur en Mésopotamie vers 1300 ACN (Pennsylvania Museum) et sa traduction (History of hydrology(Biswas, 1970)

Hydrographie de l'ouest de la Chine par Fu Yin (History of hydrology(Biswas, 1970)

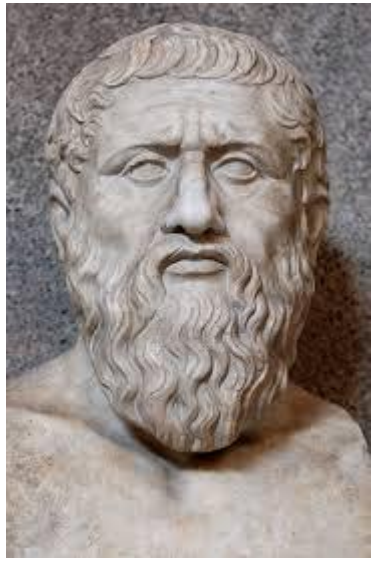
Illustration générée par IA



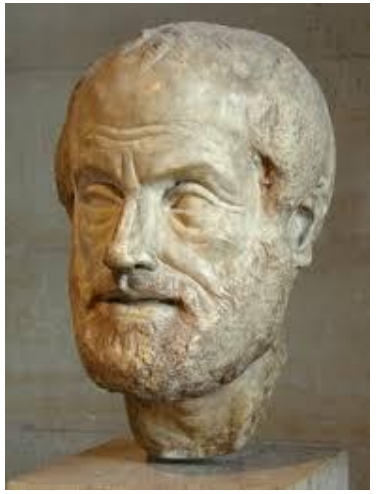
Limnimètre sur le Nil
(Biswas, 1970)



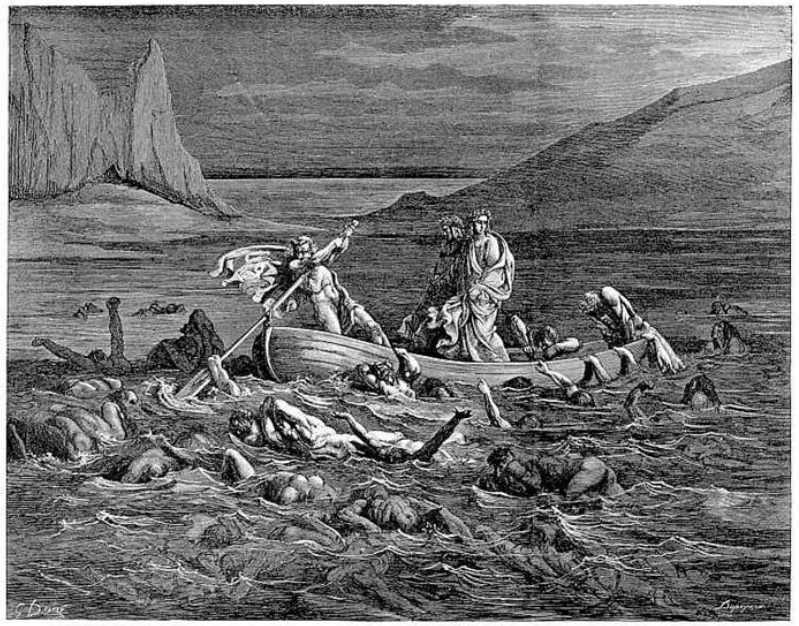
Thales



Platon



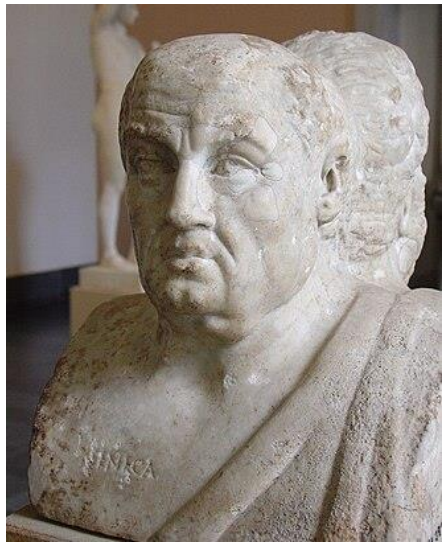
Aristote

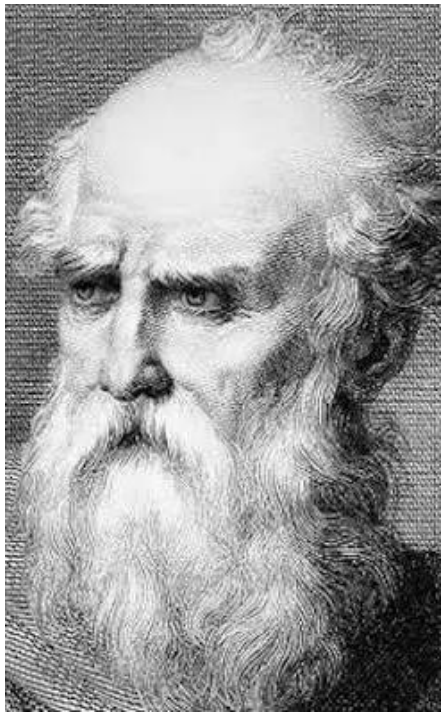
THE STYX—PHLEGYAS
The antique prow goes on its way, dividing / More of the water than 't is wont with others (*Inf.* VIII, 29, 30)

doi.org/10.1002/wat2.1216

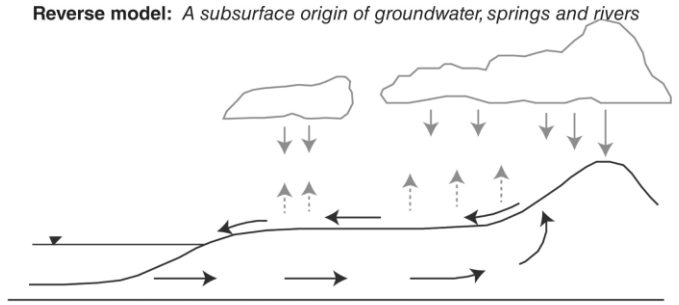
The 'reverse hydrologic cycle' as illustrated in the frontispiece of Johann Herbinius 1678, Dissertationes de Admirandis Mundi Cataractis Supra et Subterraneis.

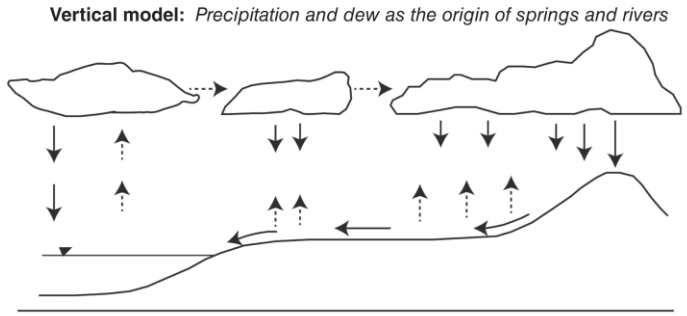


Seneque



Vitruvius




doi.org/10.1002/wat2.1216

Leonard de Vinci

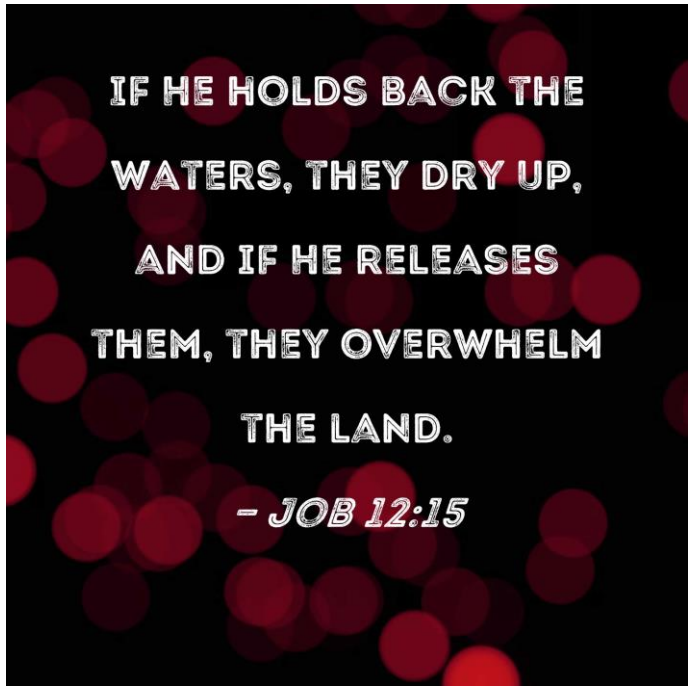



**Figure 1.** Leonardo da Vinci conducting experiments on the velocity-distribution in streams. Source: *Water Current Meters* by Frazier (1974).

DE

L'ORIGINE

DES

FONTAINES.

A PARIS,

Chez PIERRE LE PETIT, Imprimeur & Libraire ordinaire du Roy, ruë saint Jacques à la Croix d'or.

M. DC. LXXIV.

AVEC PRIVILEGE DE SA MAIESTE'.

# TRAITE'

DU

# MOUVEMENT DES EAUX

ET

DES AUTRES CORPS FLUIDES.

DIVISE' EN V. PARTIES.

*Par feu* M. Edme MARIOTTE, *de l'Academie Royale des Sciences.*

Mis en lumiere par les soins de M. DE LA HIRE, Lecteur & Professeur du Roy pour les Mathematiques, & de l'Academie Royale des Sciences.

*Nouvelle édition corrigée.*

A PARIS,

Chez JEAN JOMBERT, prés des Augustins, à l'Image Nôtre-Dame.

M. DCC.

*AVEC PERMISSION.*

*J. Molyneux.*

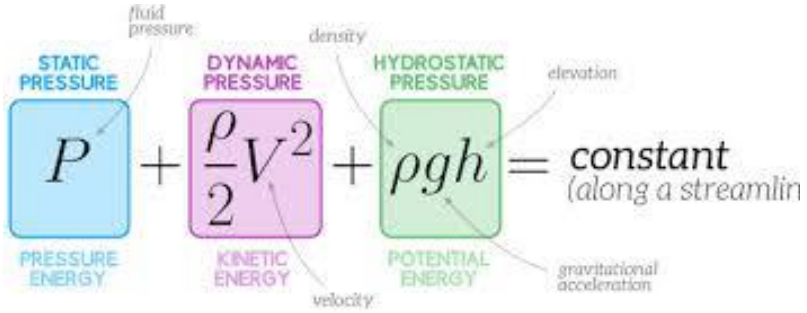


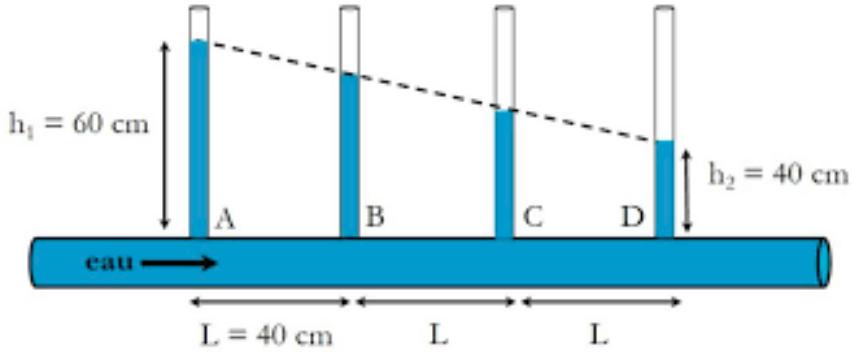
# Miscellanea Curiosa.

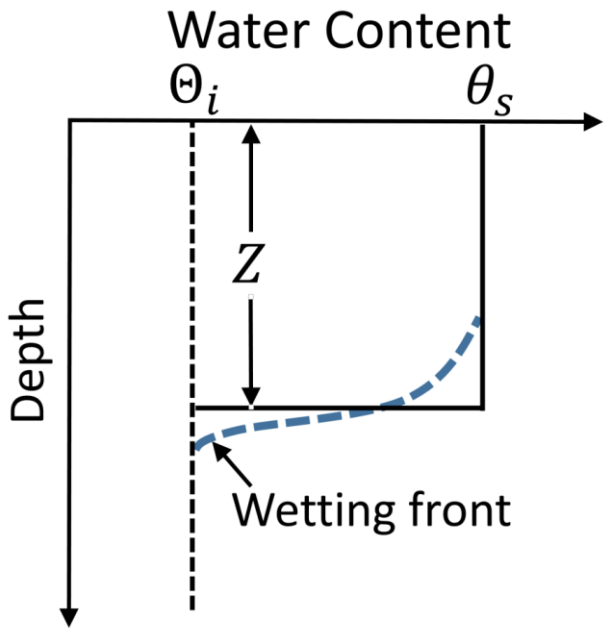
## *An Estimate of the Quantity of Vapours raised out of the Sea, derived from Experiment: Together with an Account of the Circulation of the watry Vapours of the Sea, and of the Cause of Springs, presented to the Royal Society,*

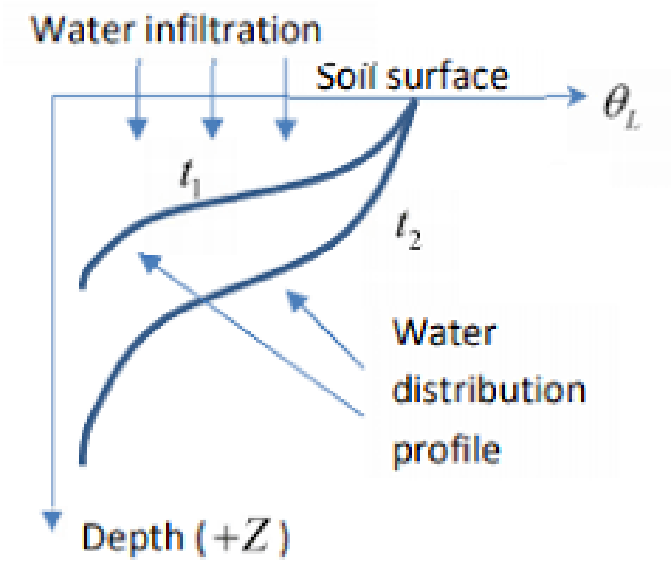
*By Mr.* E. Halley, F. R. S.

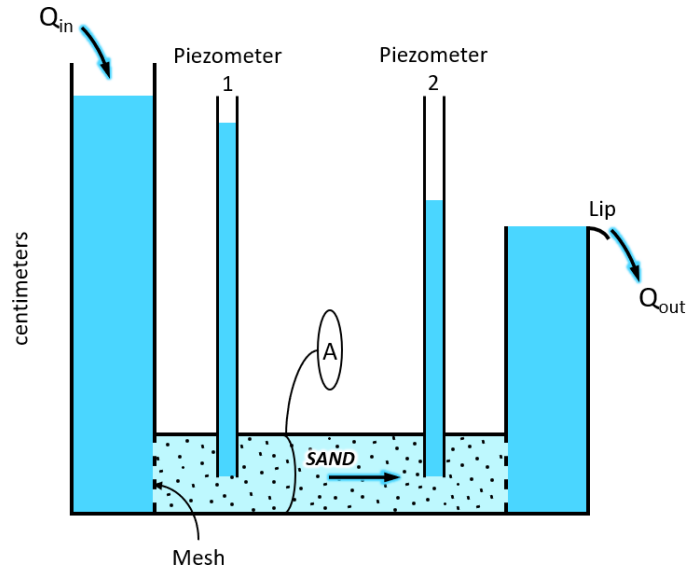
THAT the Quantity of Aqueous Vapours contain'd in the Medium of the Air, is very considerable, seems most evident from the great Rains and Snows which are sometimes observ'd to fall, to that degree, that the Water thus discharg'd out of the Interstices of the Particles of Air, is in weight a very sensible part of the incumbent Atmosphere: But in what proportion these Vapours rise, which are the Sources not only of Rains, but also of Springs or Fountains (as I design to prove) has not, that I know of, been any where well examin'd, tho' it seem to be one of the most necessary Ingredients of a Real and Philosophical Meteorology, and as such to deserve the Consideration of this Ho-


fluid pressure
density
elevation
STATIC PRESSURE
DYNAMIC PRESSURE
HYDROSTATIC PRESSURE
$P + \frac{\rho}{2}V^2 + \rho g h = \text{constant}$
(along a streamlin
PRESSURE ENERGY
KINETIC ENERGY
POTENTIAL ENERGY
velocity
gravitational acceleration


$h_1$ = 60 cm
$h_2$ = 40 cm
A
B
C
D
eau
L = 40 cm
L
L


Water Content
$\Theta_i$
$\theta_s$
Z
Depth
Wetting front


Water infiltration
Soil surface
$\theta_L$
$t_1$
$t_2$
Water distribution profile
Depth (+Z)


$Q_{in}$
Piezometer 1
Piezometer 2
Lip
$Q_{out}$
centimeters
A
SAND
Mesh

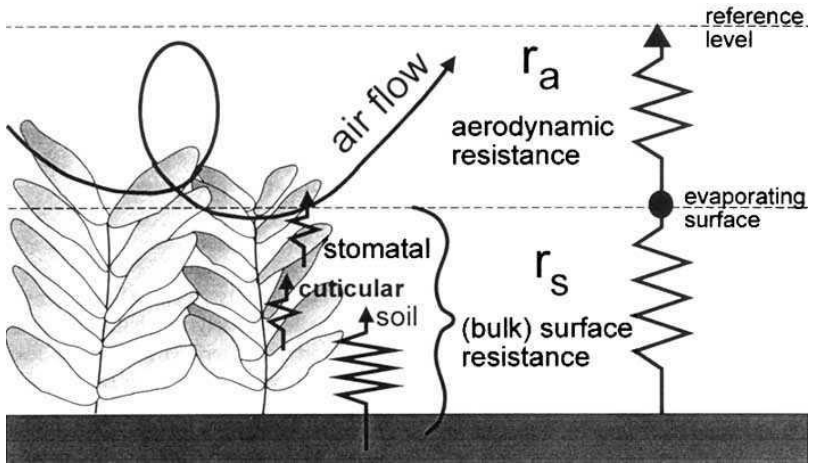
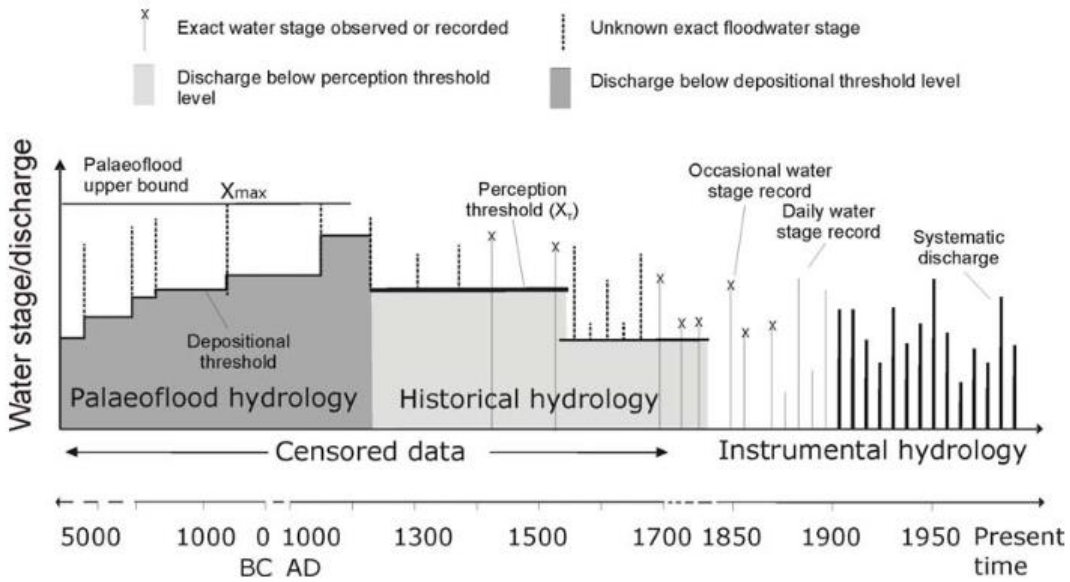

reference level
air flow
$r_a$
aerodynamic resistance
evaporating surface
stomatal
cuticular
soil
$r_s$
(bulk) surface resistance

**Figure 2.** First IAHS President Edward Wade (left) taking flow measurements in the Nile River at Aswān in the early 1920s.

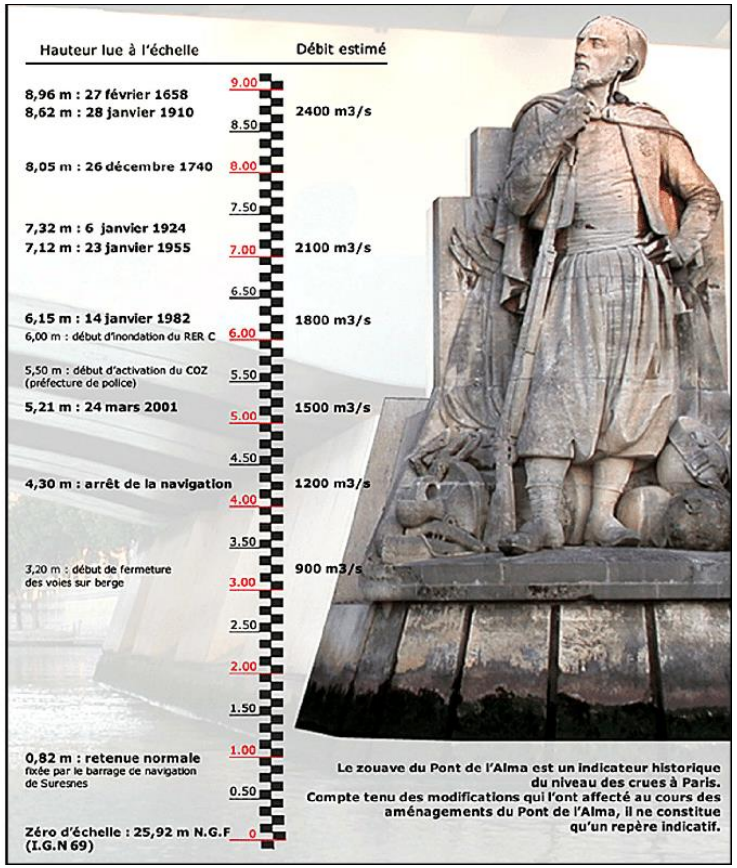




JOIN THE

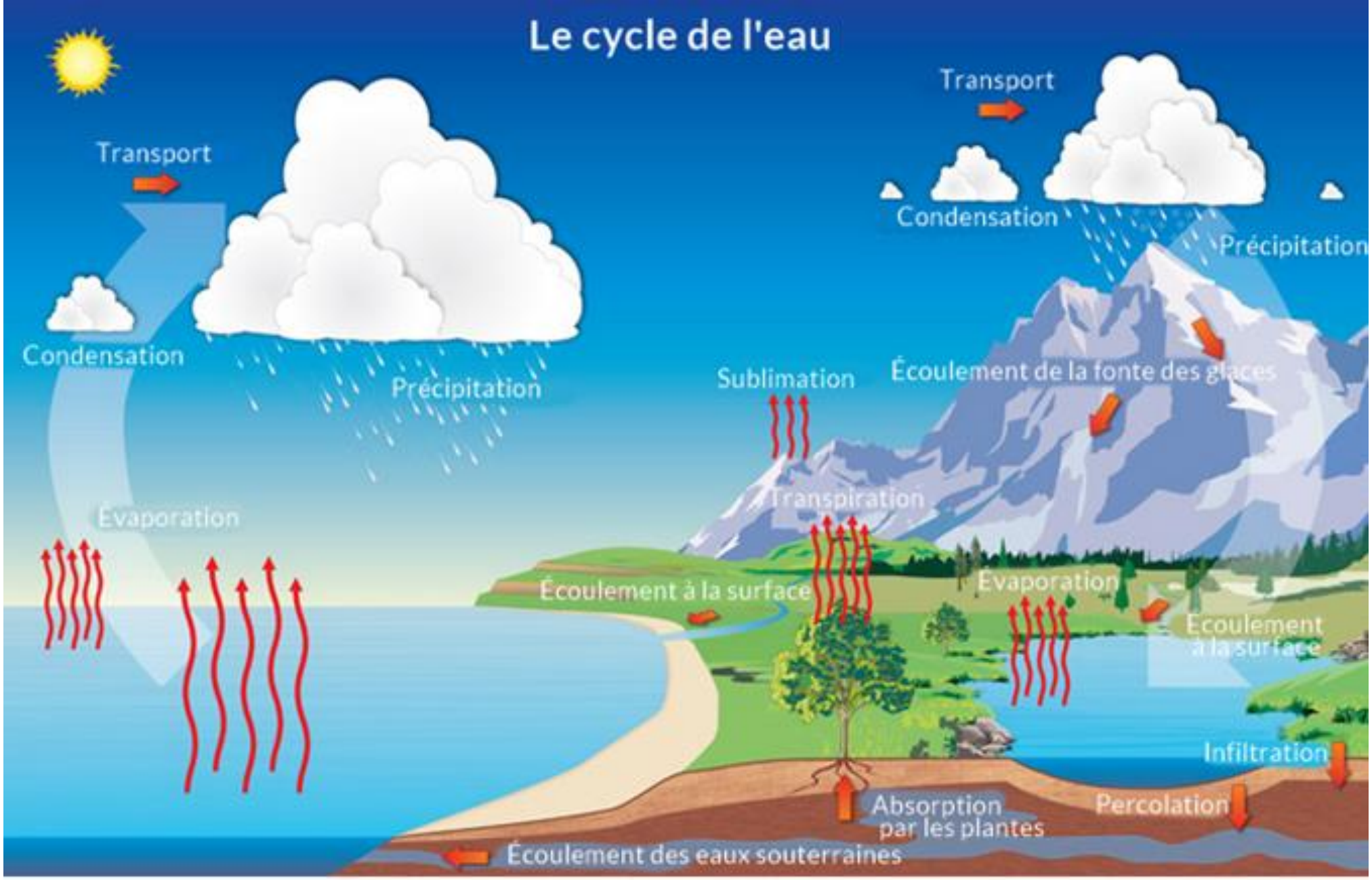
1922 IAHS AISH 2022

THE NEXT SCIENTIFIC DECADE

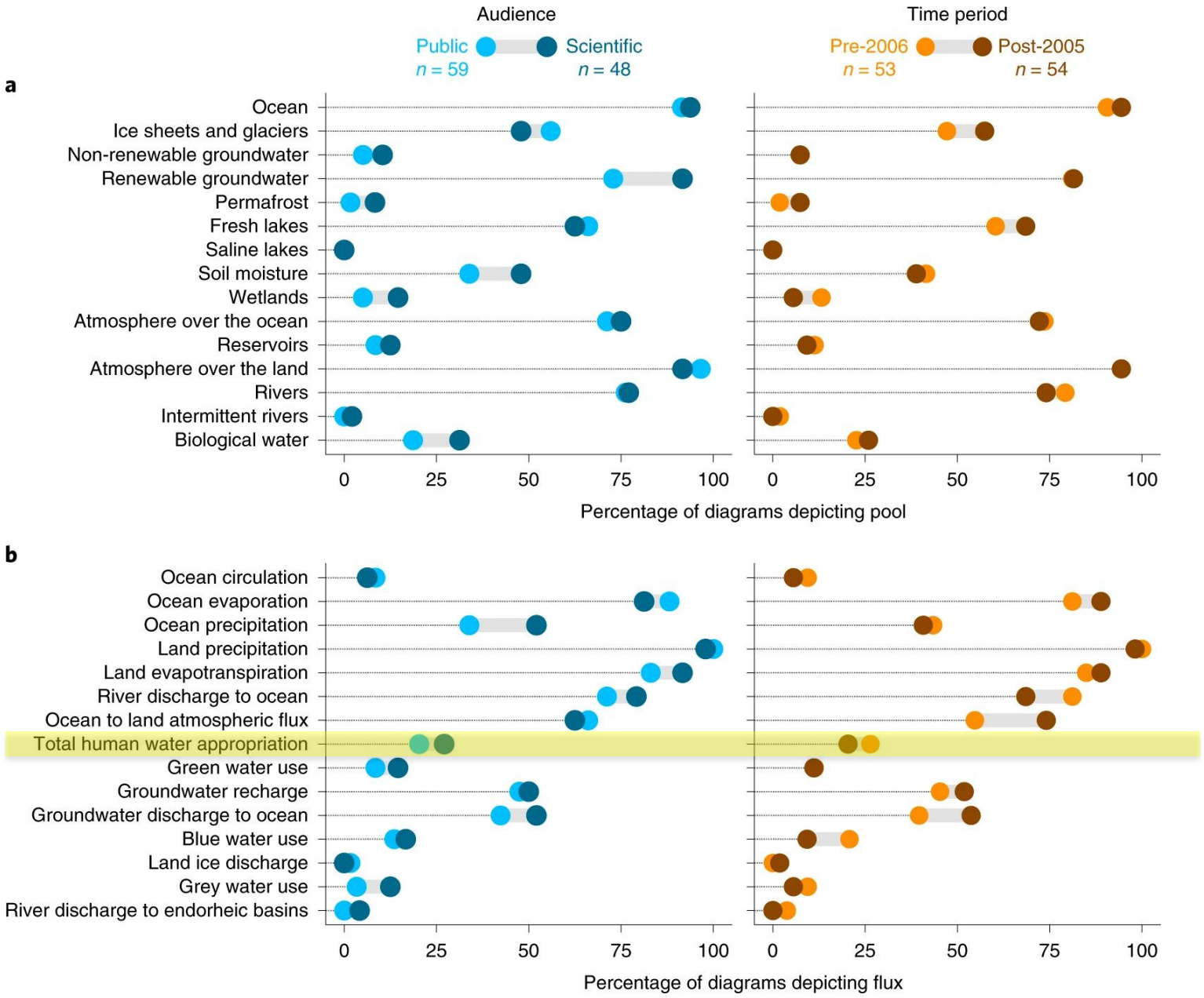



doi.org/10.1623/hysj.51.5.739

Lacaze et al, 2008




Crédit d'image : *The water cycle* par NOAA National Weather Service Jetstream, CC BY 2.0




**a,b, Percentage of water cycle diagrams that represent major pools (a) and fluxes (b) in the global water cycle.**

Pools and fluxes are ordered by size, starting with the largest pool (ocean) and flux (ocean circulation).

We categorized diagrams by intended audience and time period.

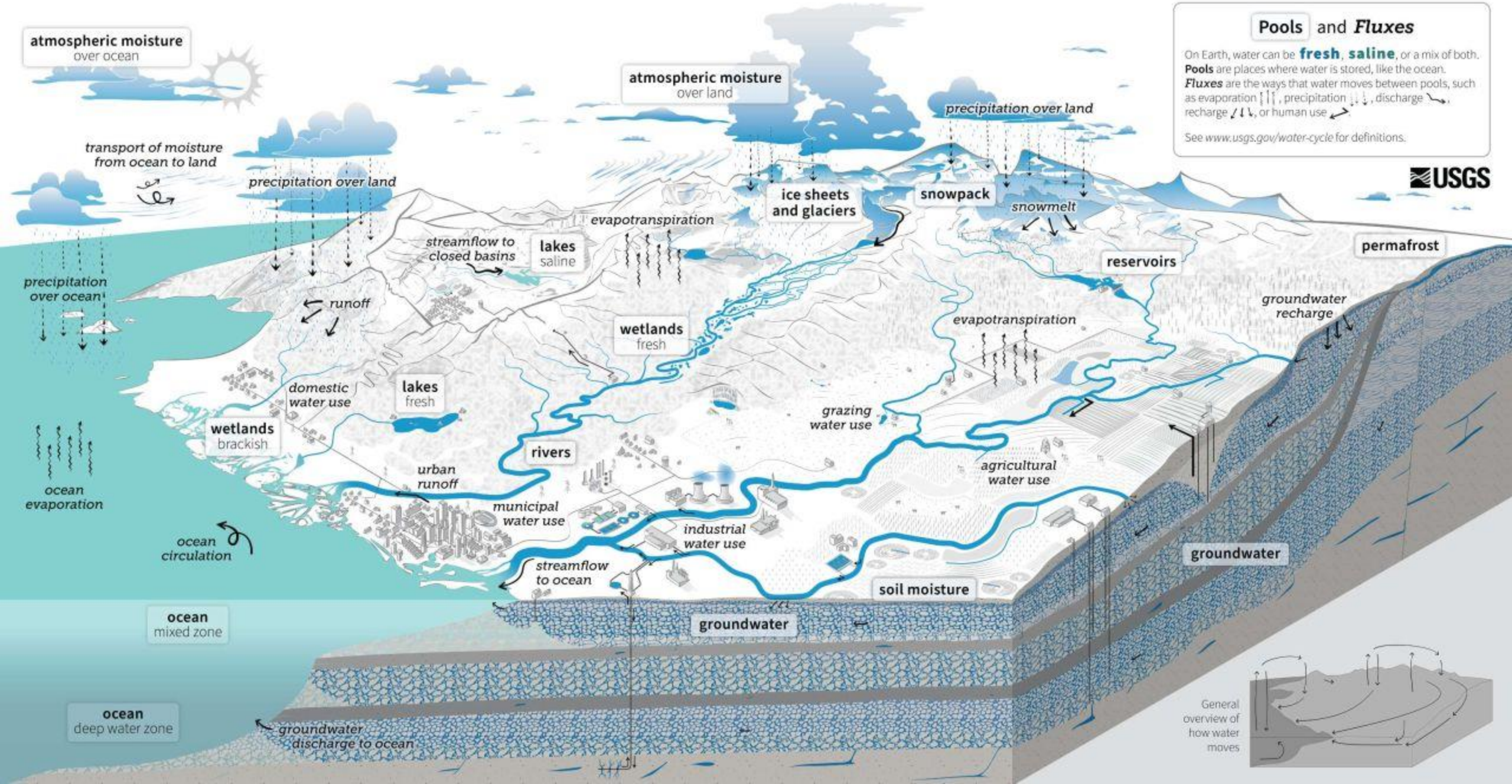
Public diagrams include those made for advertising, advocacy, government outreach and primary or secondary education, whereas scientific diagrams were made for higher education textbooks and peer-reviewed publications.

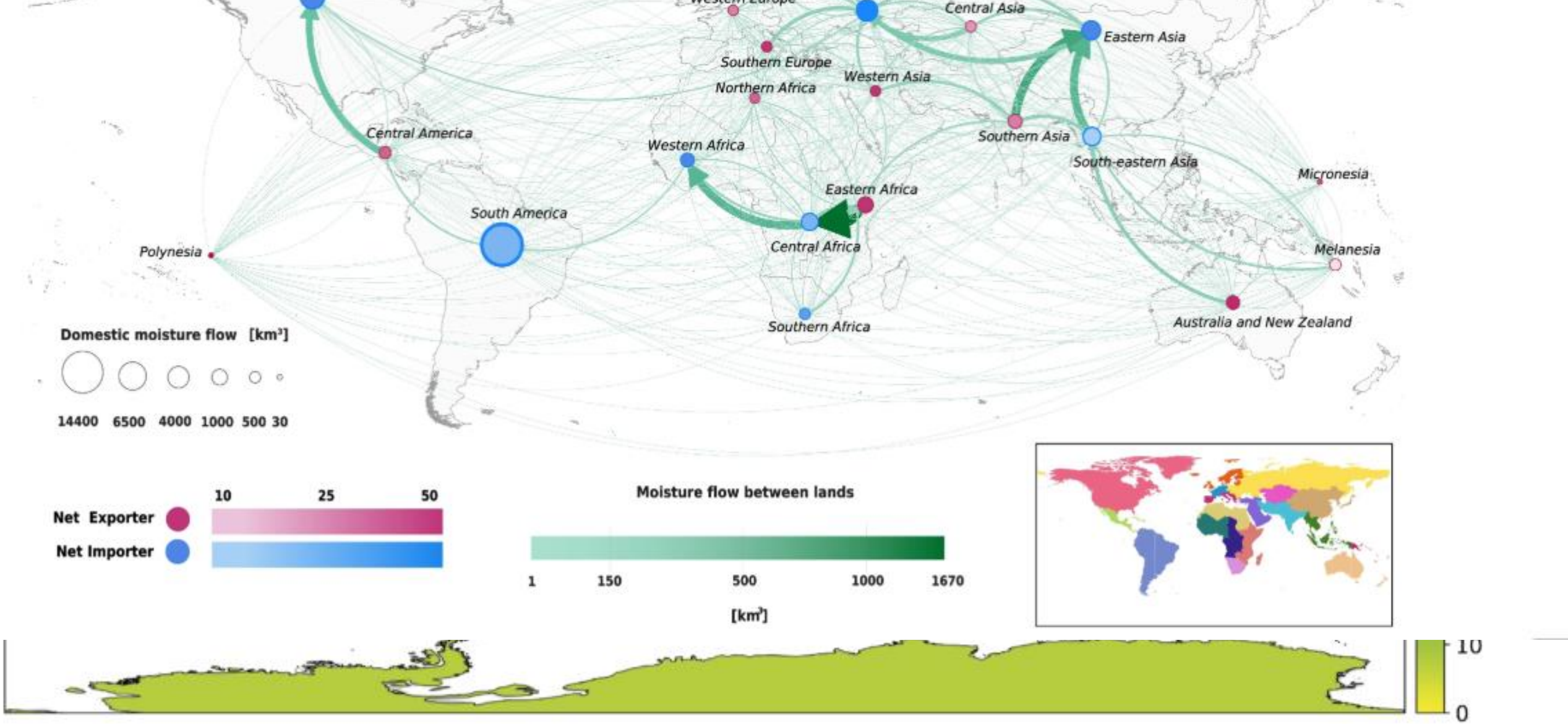
We compared the diagrams made before and after 1 January 2006, which corresponds with the publishing of several high-profile papers that advocated increased integration of social and hydrological systems. The grey bar between points is visible for differences greater than 10 percentage points.

Nature Geoscience volume 12, pages533–540 (2019)


Land conversion (agriculture, deforestation, wetland loss) alters continental moisture recycling to downwind catchments
Extreme weather (drought and flood) and overall intensification of hydrological cycle
Flood damage from modified flow regimes (e.g., dykes, dams and drains) and loss of floodplains and wetlands
Discharge from ice sheets, glaciers and permafrost
Volatility of terminal lakes and rivers from agricultural and urban water diversions
Altered ocean currents and associated teleconnections with climate
Increased temperature and intermittency of river flow
Long-distance trade of actual and virtual water
Known and novel pollutants from agriculture, industry and domestic activity
Depletion and contamination of renewable groundwater at the same time that reliance on subsurface water increases
Water scarcity from socioeconomic inequality, land degradation or poor water governance
Expansion of dead zones from nutrient loading and warmer water
Sea-level rise and saltwater intrusion
Primary dimension of human interference
Land use
Climate change
Water use

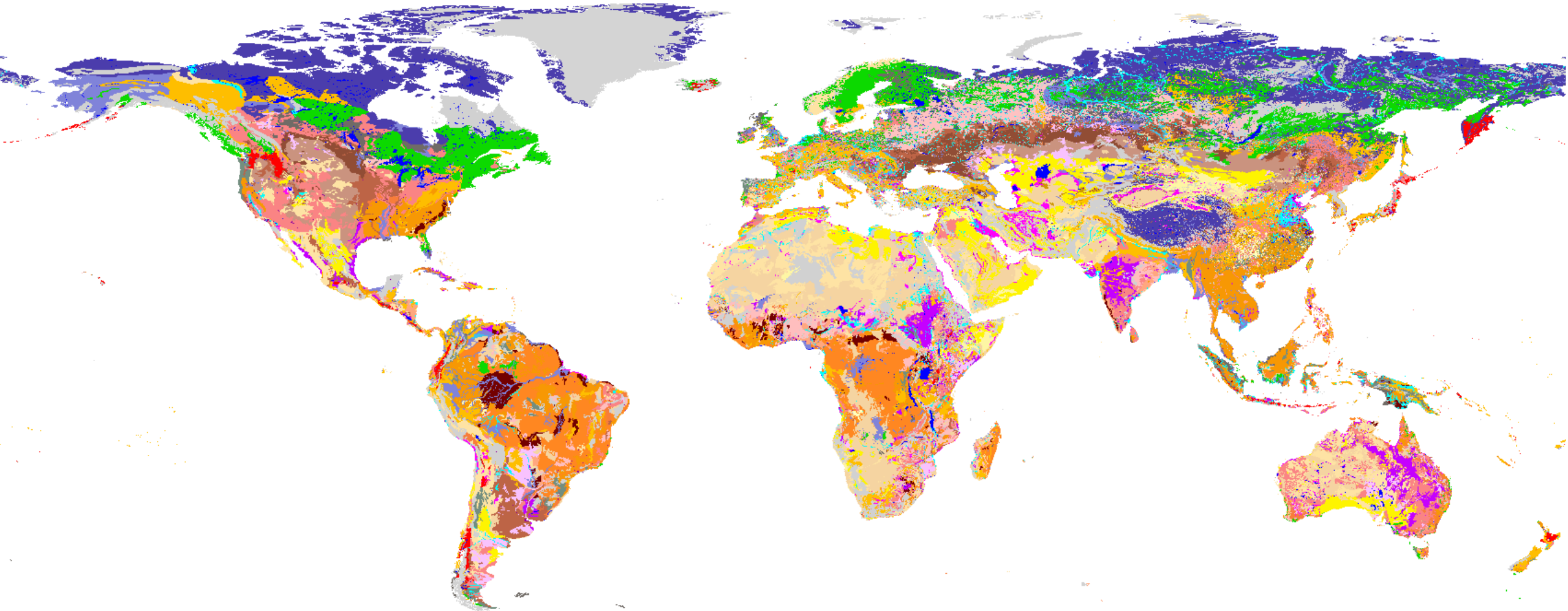

B. W. Abbott et al., ‘Human domination of the global water cycle absent from depictions and perceptions.’ Nature Geoscience.


atmospheric moisture
over ocean
atmospheric moisture
over land
transport of moisture
from ocean to land
precipitation over land
precipitation over land
ice sheets
and glaciers
snowpack
snowmelt
permafrost
reservoirs
evapotranspiration
streamflow to
closed basins
lakes
saline
precipitation
over ocean
runoff
wetlands
fresh
groundwater
recharge
evapotranspiration
domestic
water use
lakes
fresh
wetlands
brackish
grazing
water use
rivers
urban
runoff
agricultural
water use
ocean
evaporation
municipal
water use
industrial
water use
ocean
circulation
streamflow
to ocean
groundwater
soil moisture
ocean
mixed zone
groundwater
ocean
deep water zone
groundwater
discharge to ocean
Pools and Fluxes
On Earth, water can be fresh, saline, or a mix of both.
Pools are places where water is stored, like the ocean.
Fluxes are the ways that water moves between pools, such as evaporation, precipitation, discharge, recharge, or human use.
See www.usgs.gov/water-cycle for definitions.
USGS
General overview of how water moves



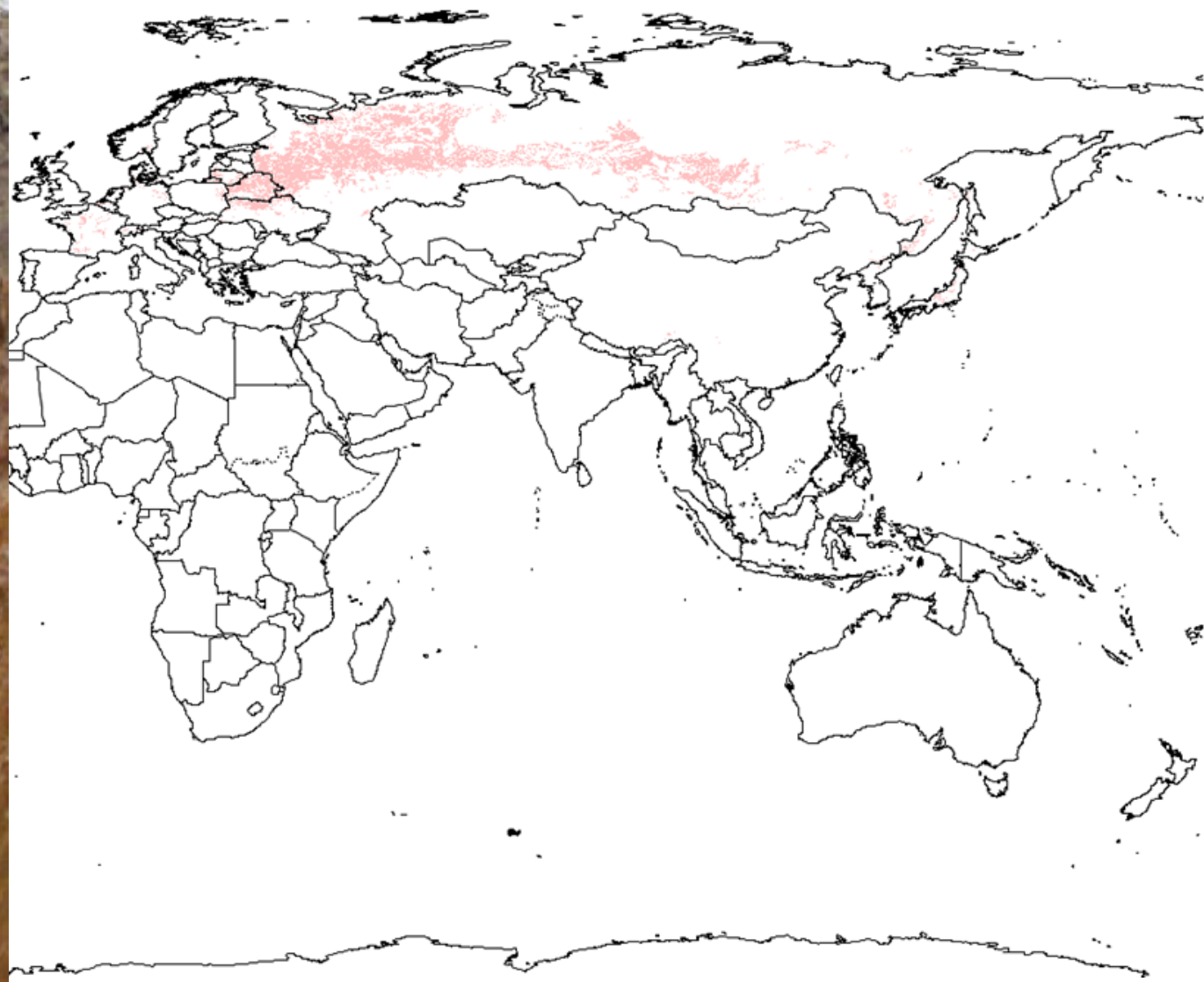

Terrestrial moisture recycling (i.e., precipitation percentage from terrestrial evaporative sources, TMR) obtained at the country scale https://www.nature.com/articles/s43247-025-02289-y

Atmospheric moisture connections among subcontinental lands regions and oceans https://www.nature.com/articles/s43247-025-02289-y

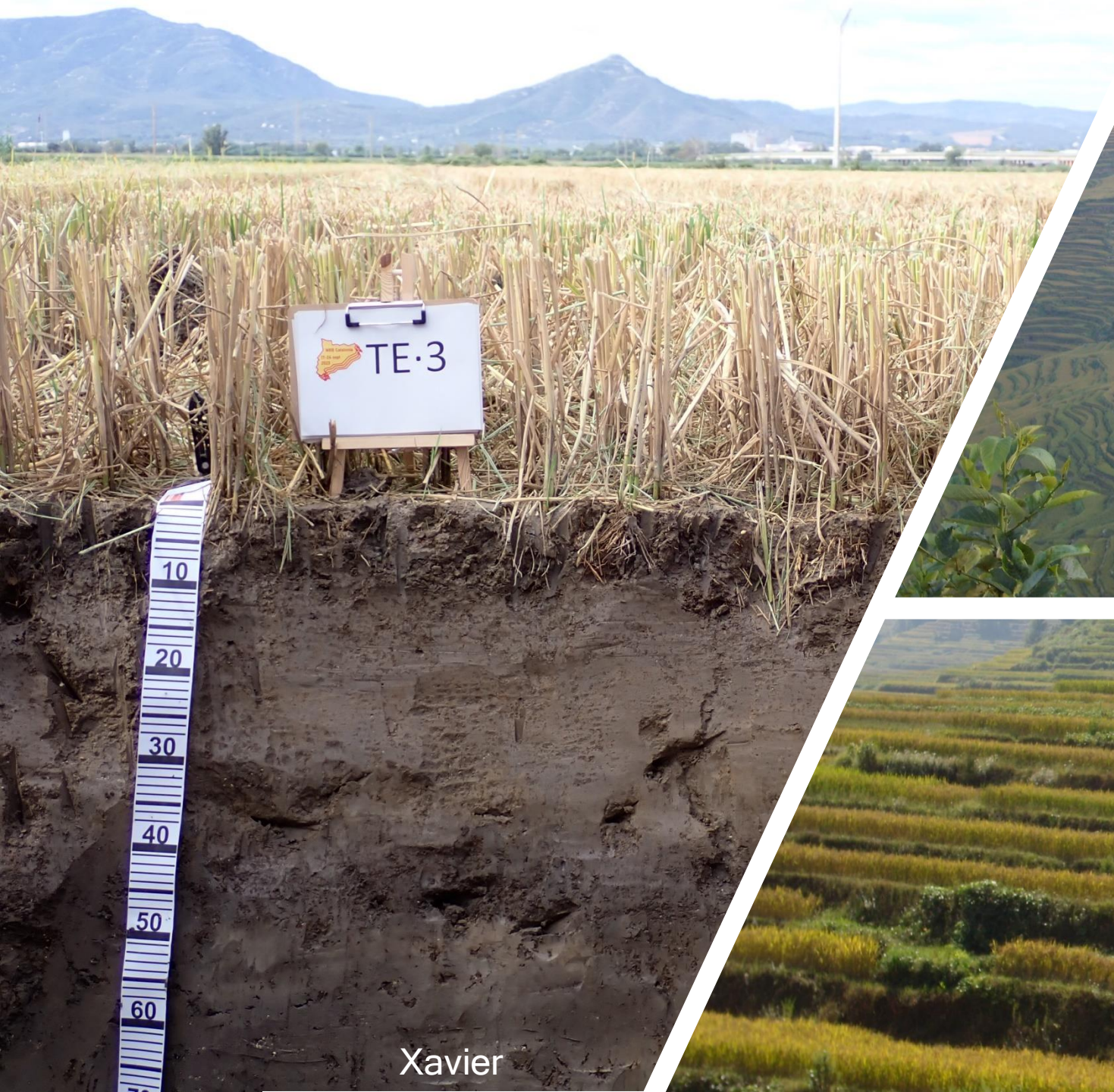


FAO : harmonized world soil database v2.0


Xavier Legrain



FAO : harmonized world soil database v2.0

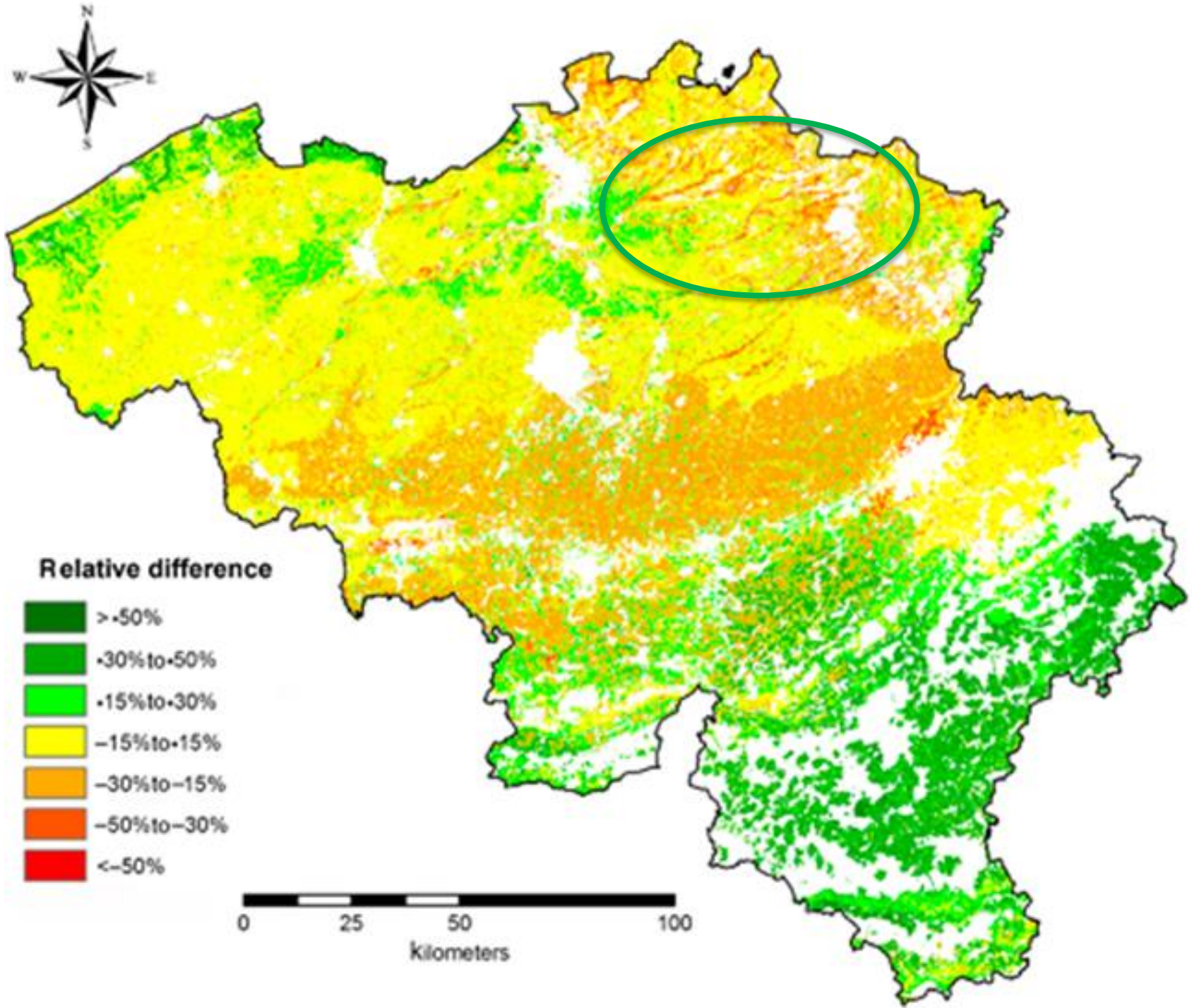


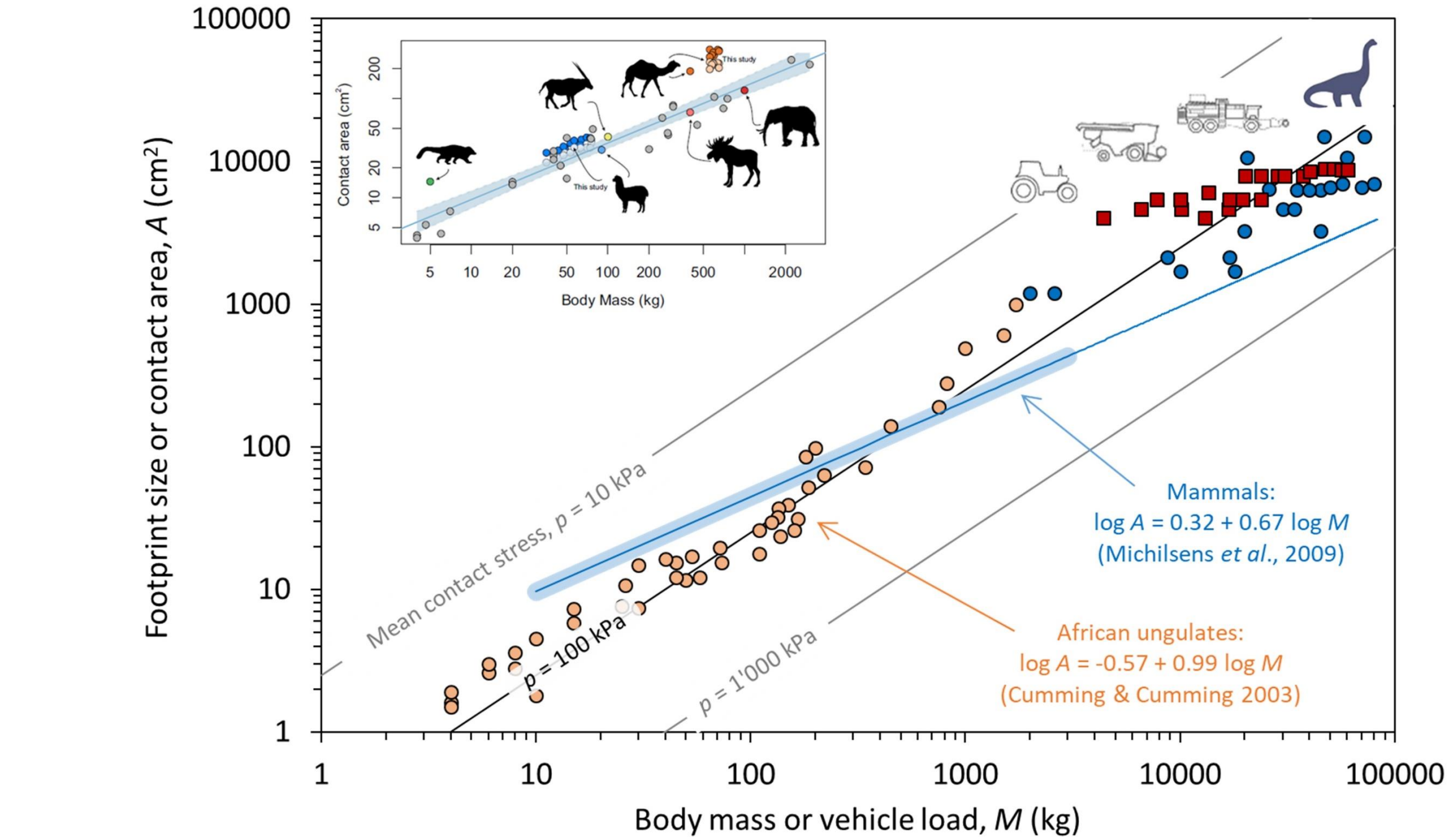
Xavier


Gilles Colinet


Gilles Colinet

Modification du stock de carbone organique du sol entre 1960 et 2006 (Meersmans et al, 2011)






https://www.pnas.org/doi/10.1073/pnas.2117699119

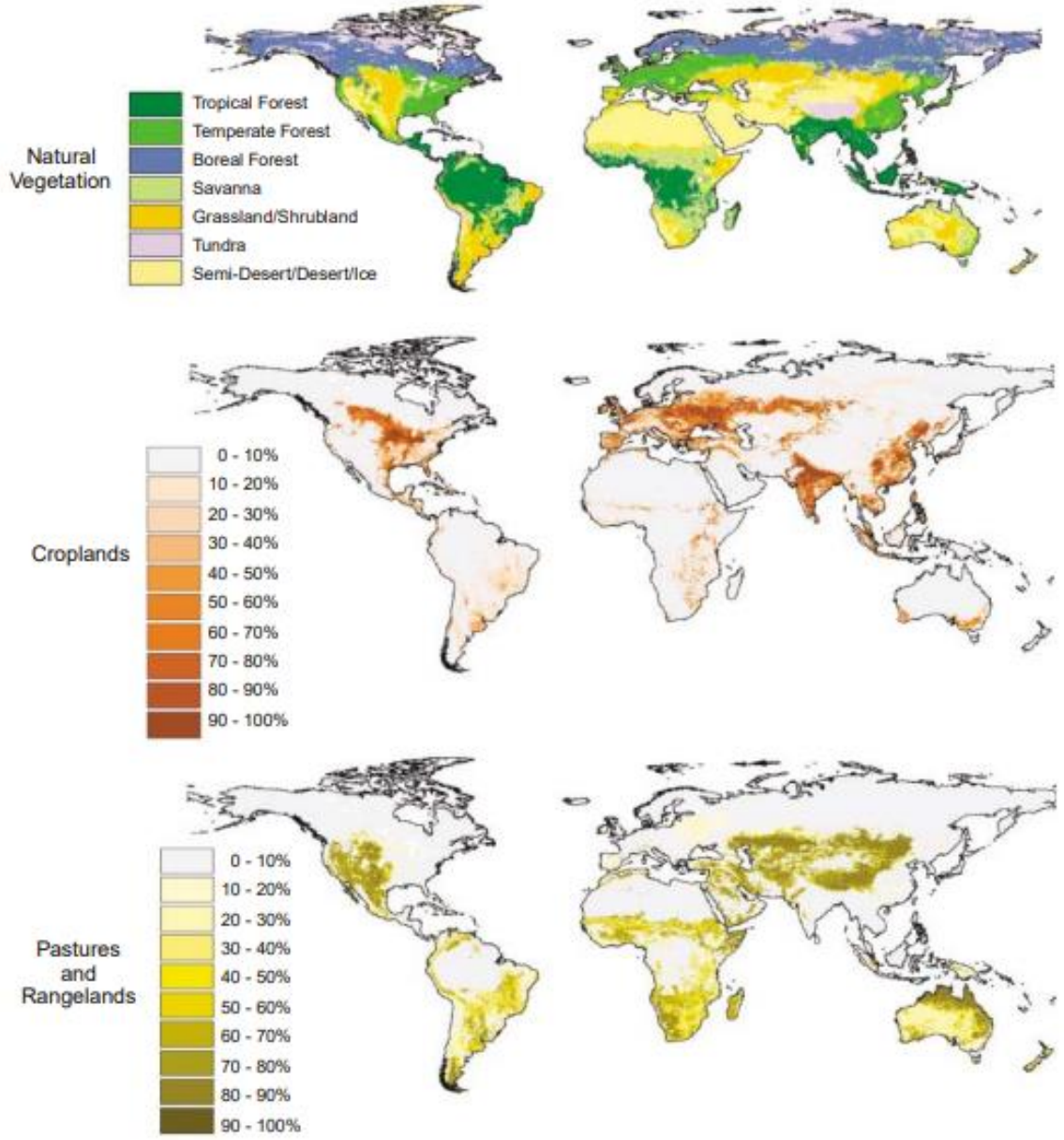



**Fig. 2.** Worldwide extent of human land-use and land-cover change. These maps illustrate the geographic distribution of "potential vegetation" (top), vegetation that would most likely exist in the absence of human land use, and the extent of agricultural land cover (including croplands and pastures) (middle and bottom) across the world during the 1990s. [Adapted from (*17*) and (*18*)]

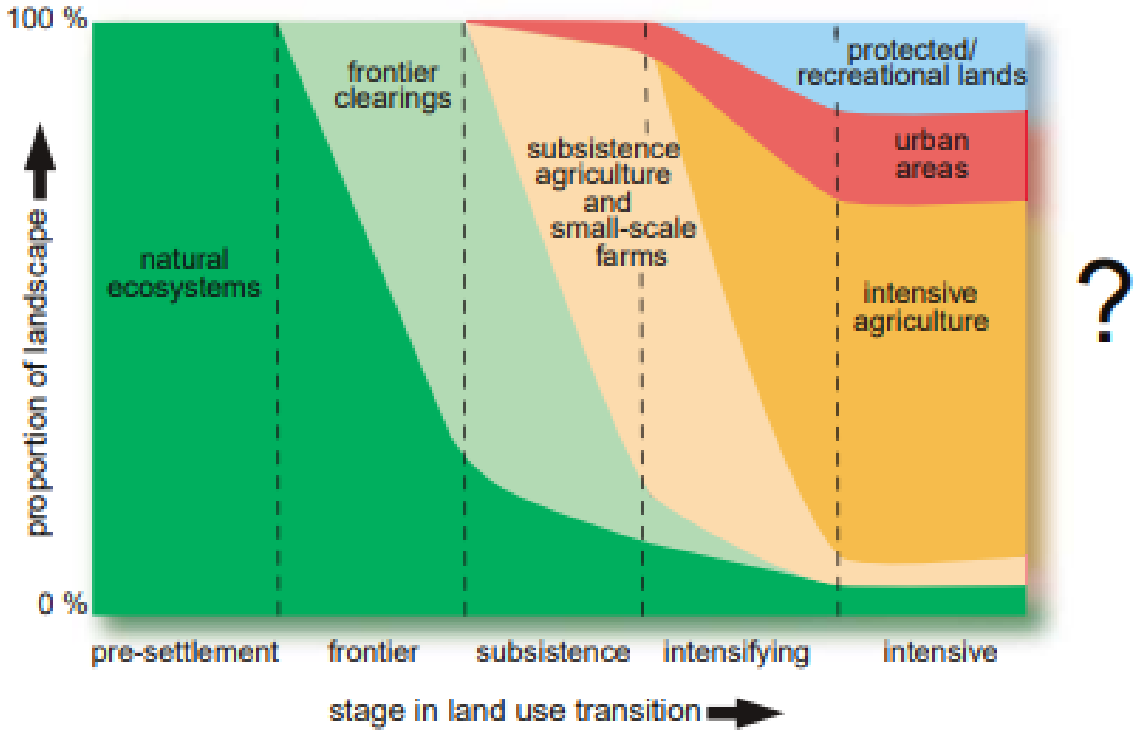
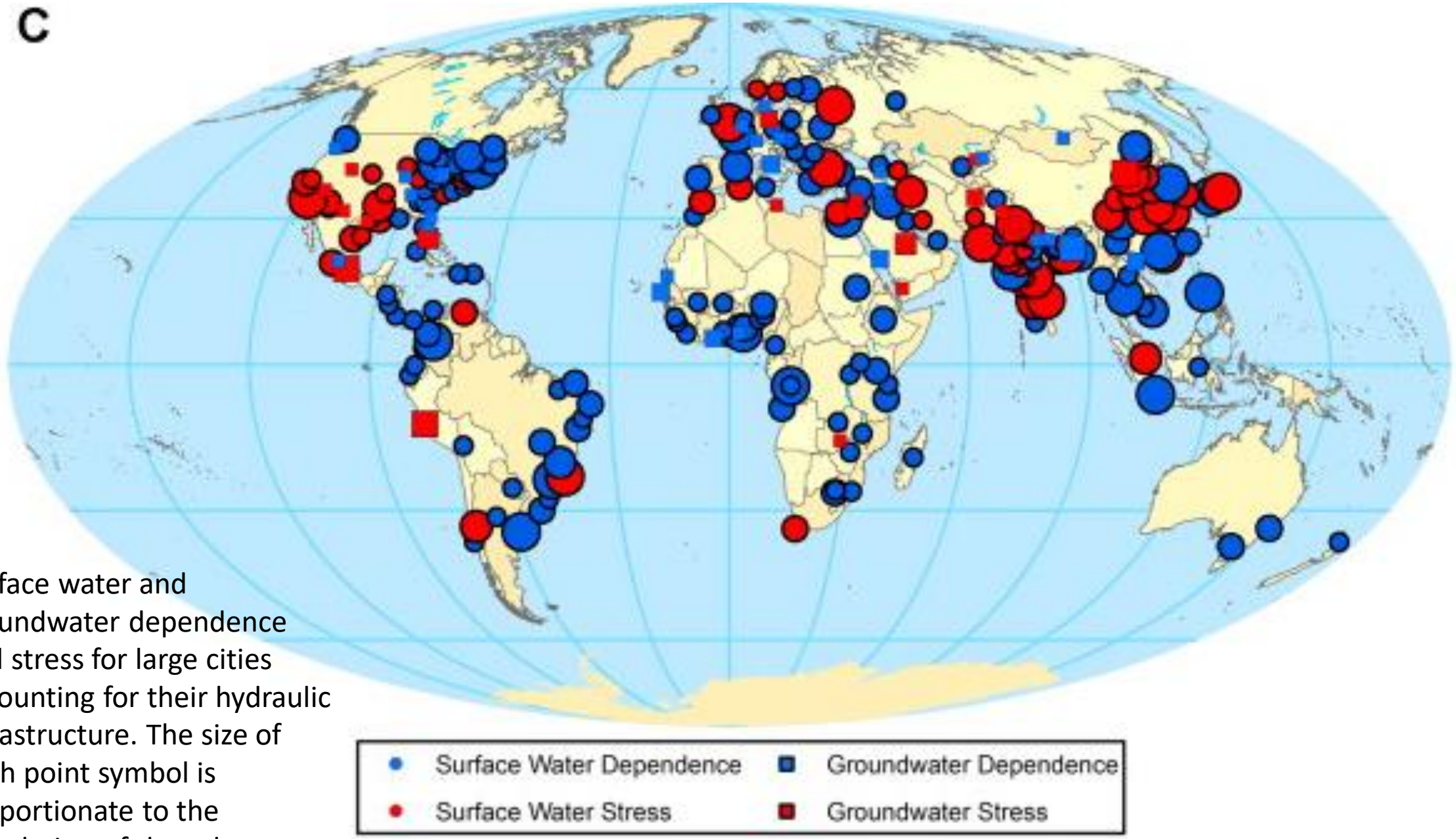


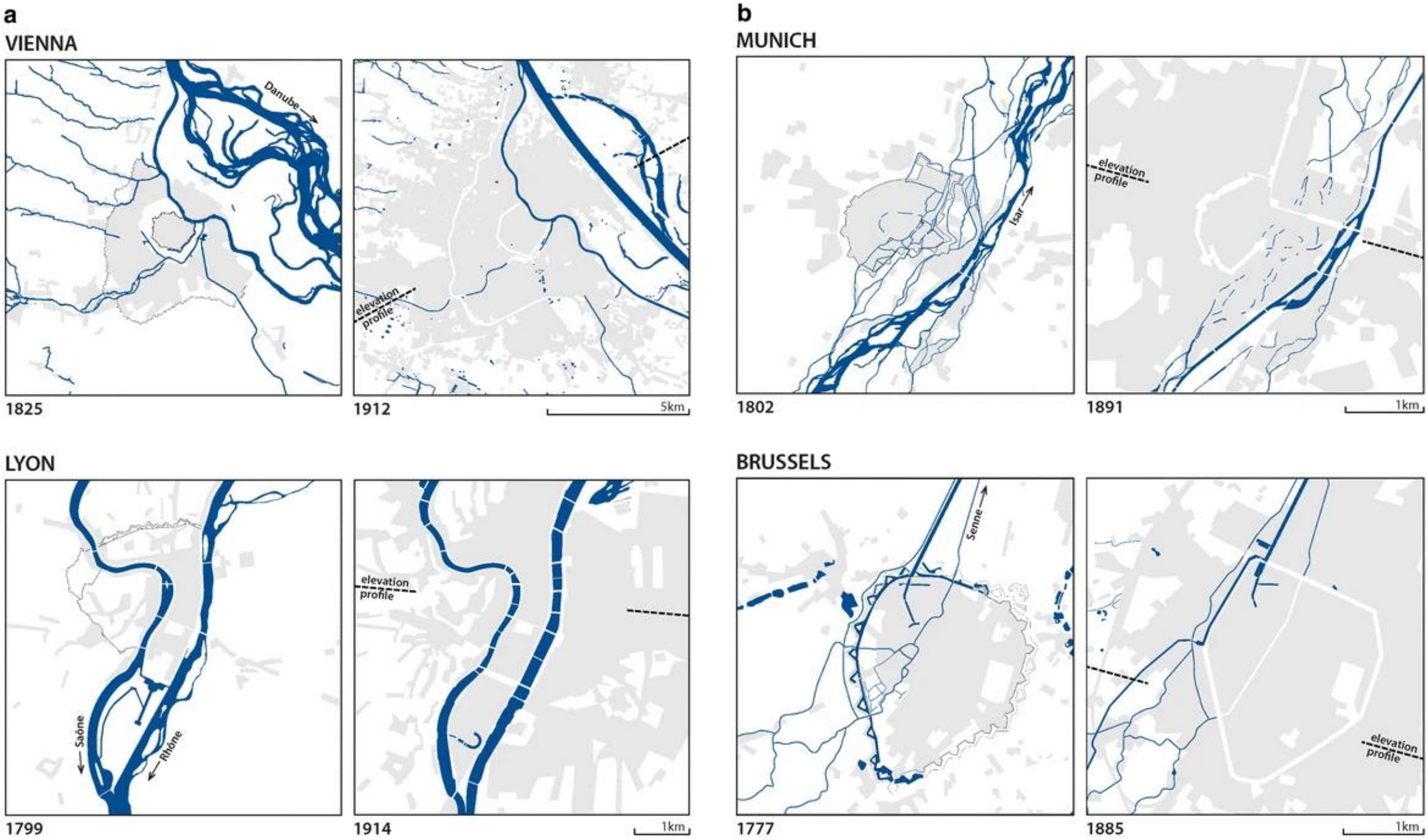

**Fig. 1.** Land-use transitions. Transitions in land-use activities that may be experienced within a given region over time. As with demographic and economic transitions, societies appear also to follow a sequence of different land-use regimes: from presettlement natural vegetation to frontier clearing, then to subsistence agriculture and small-scale farms, and finally to intensive agriculture, urban areas, and protected recreational lands. Different parts of the world are in different transition stages, depending on their history, social and economic conditions, and ecological context. Furthermore, not all parts of the world move linearly through these transitions. Rather, some places remain in one stage for a long period of time, while others move rapidly between stages. [Adapted from (*1*) and (*2*)]

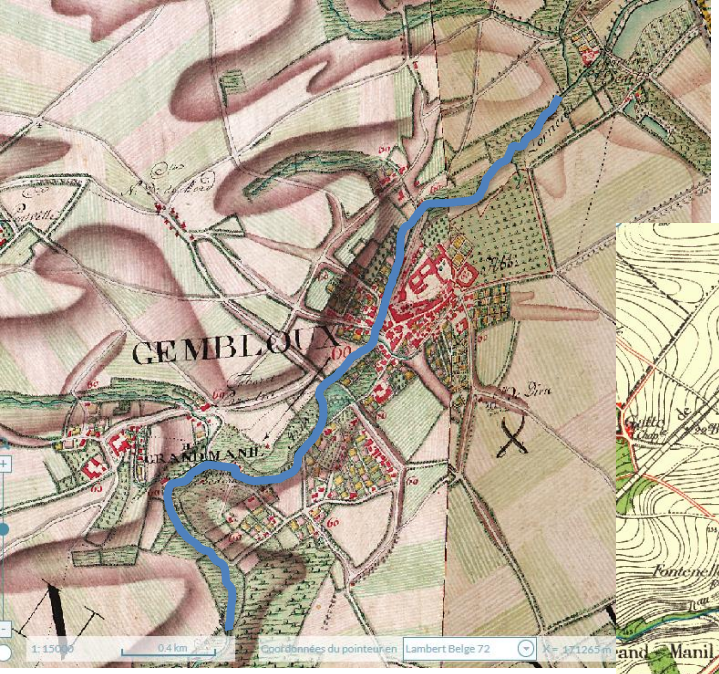
https://www.science.org/doi/pdf/10.1126/science.1111772



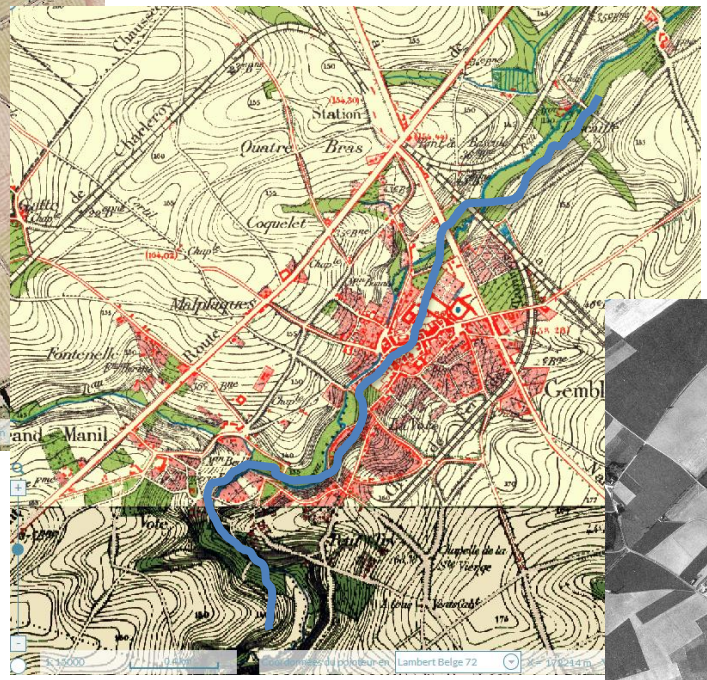

Surface water and groundwater dependence and stress for large cities accounting for their hydraulic infrastructure. The size of each point symbol is proportionate to the population of the urban agglomeration.

https://doi.org/10.1016/j.gloenvcha.2014.04.022



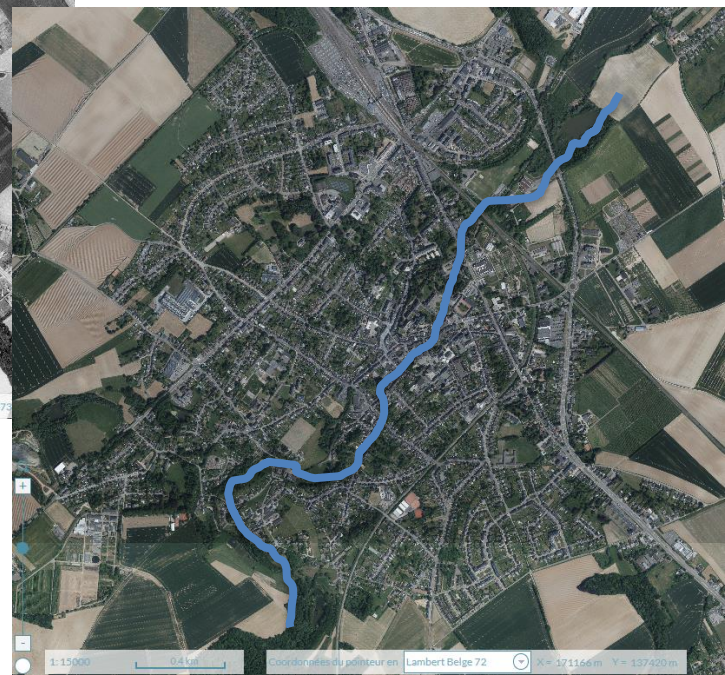



1777



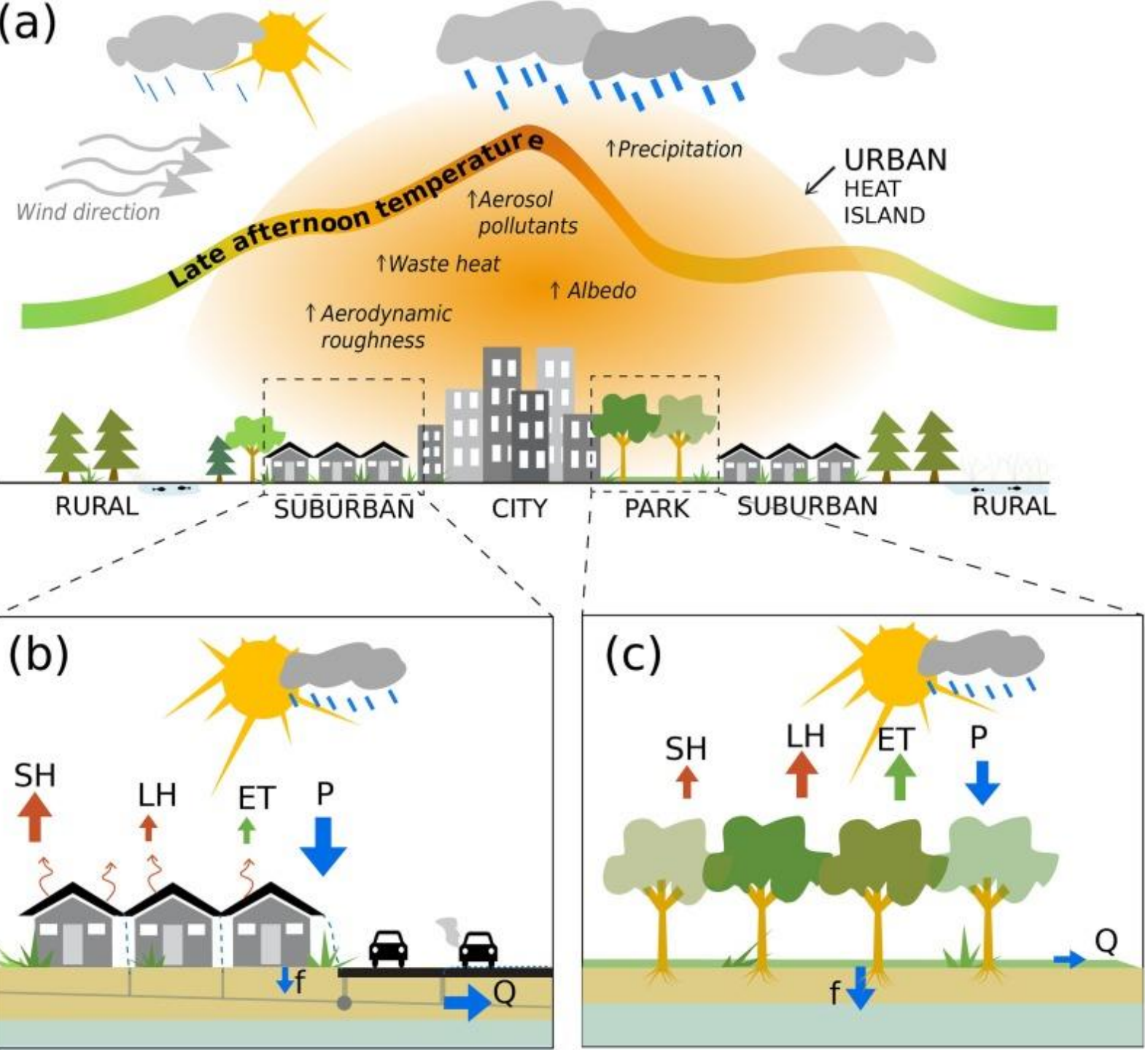

1865

1971



2023

Walonmap, voyage dans le temps




ELSEVIER

Journal of Hydrology
Volume 618, March 2023, 129188

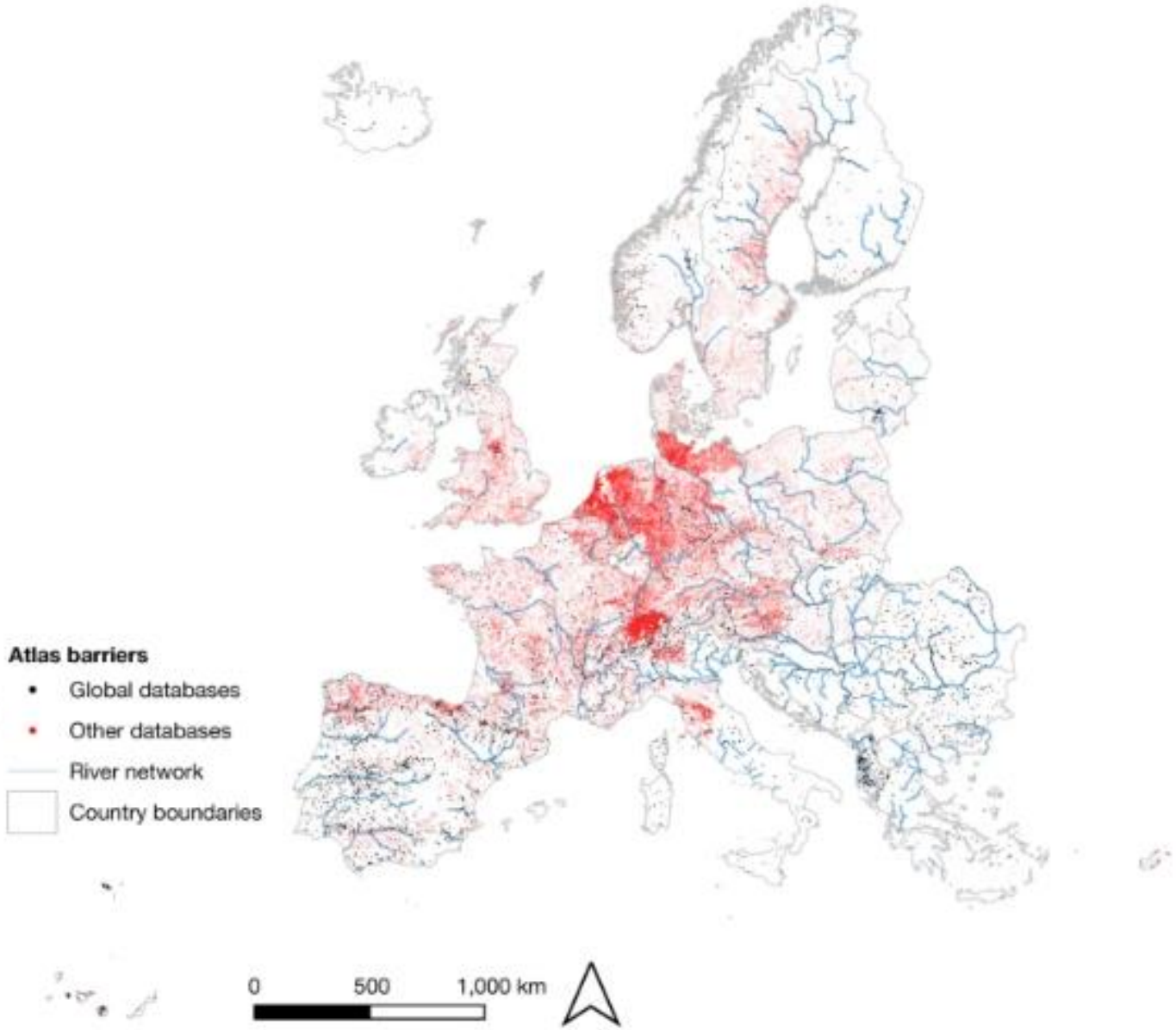
Review papers

# Integrating urban water fluxes and moving beyond impervious surface cover: A review

Claire J. Oswald [a], Christa Kelleher [b], Sarah H. Ledford [c], Kristina G. Hopkins [d], Anneliese Sytsma [e], Doerthe Tetzlaff [f], Laura Toran [g], Carolyn Voter [h]

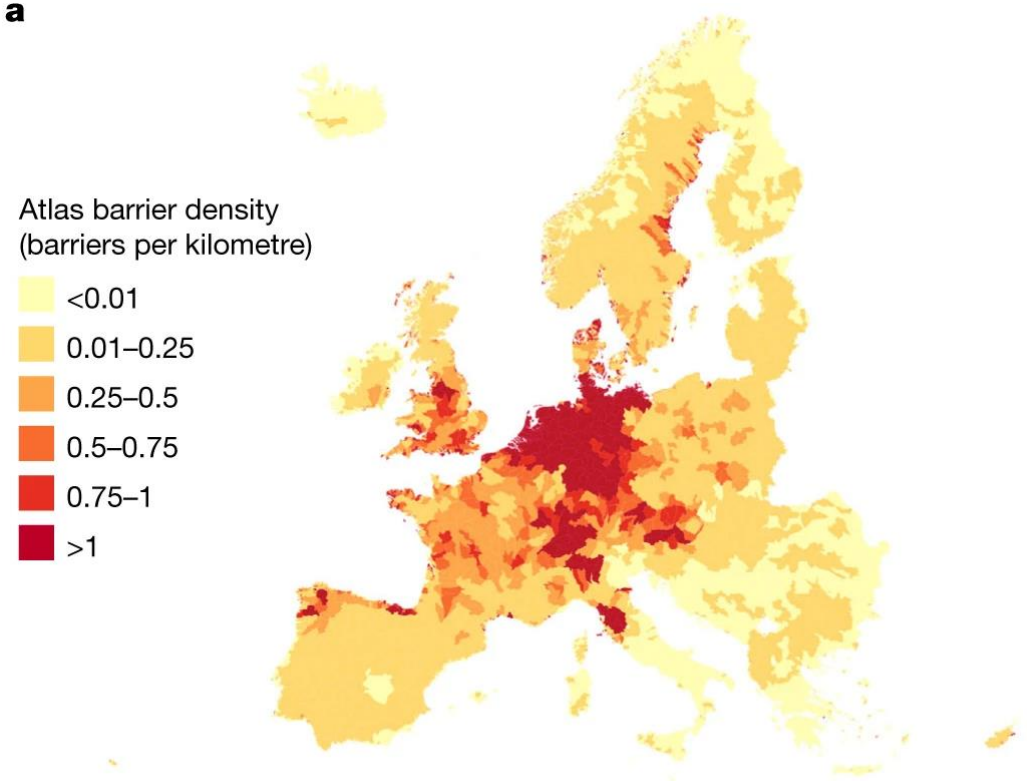
# The broken rivers

Fig. 1: Artificial instream barriers in Europe (from the AMBER Barrier Atlas).




The maps show the barrier density (barriers per kilometre) in ECRINS sub-catchments (n = 8,467) across Europe based on existing barrier records (AMBER Barrier Atlas)
European Environment Agency

**a**



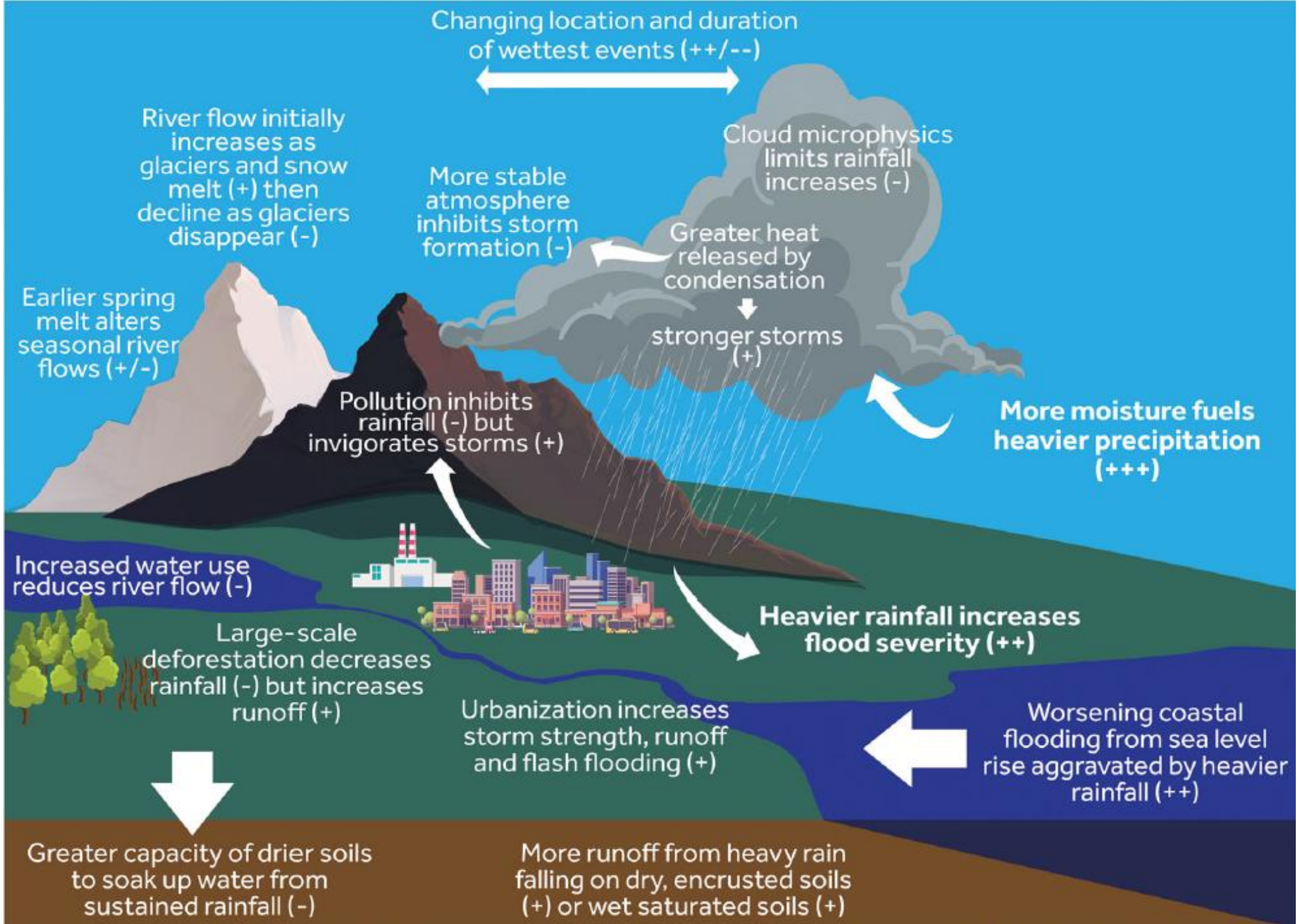

https://www.nature.com/articles/s41586-020-3005-2


A
300m
B
600m
C
2000m
D
400m

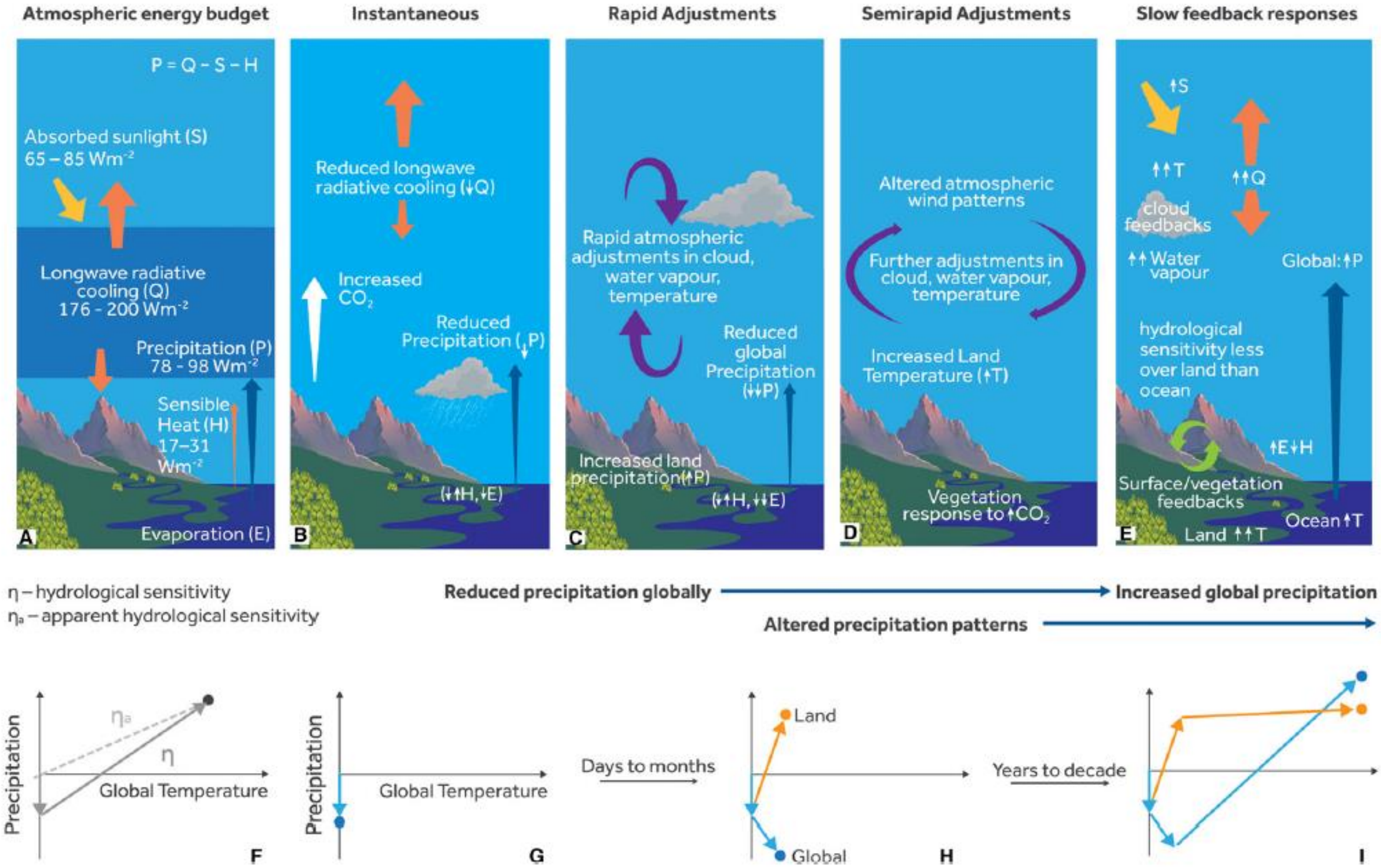

*“An emerging challenge is to manage these waterways in a multifunctional manner; that is, maximizing positive synergies whilst minimizing trade-offs, in order to deliver multiple ecosystem services at the same time”*

Ditches in the Netherlands (52.20°N 5.12°E) show a wedge-shaped structure, and point towards the top of the (now missing) dome of a destroyed raised bog.
Maps data: Google Earth, Maxar Technologies.

https://www.nature.com/articles/s43247-025-02699-




Allan et al., 2020
doi: 10.1111/nyas.14337




η – hydrological sensitivity
$\eta_a$ – apparent hydrological sensitivity

**Reduced precipitation globally** → **Increased global precipitation**

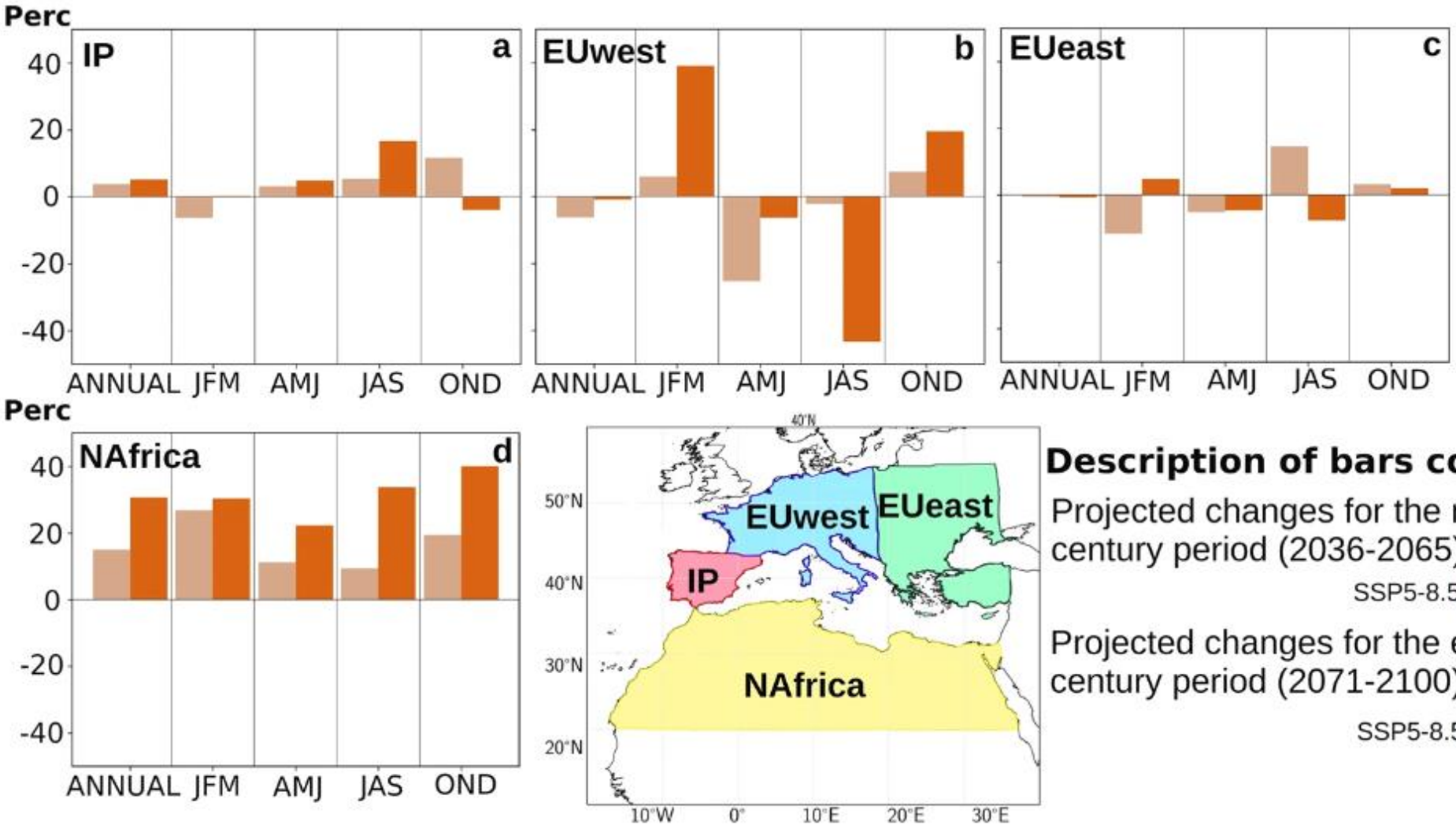
**Altered precipitation patterns** →




Allan et al., 2020
doi: 10.1111/nyas.14337

# Fig. 4: Future changes in the relative contribution of precipitation (in %) to moisture sinks from the Mediterranean source.

From: Projected changes in atmospheric moisture transport contributions associated with climate warming in the North Atlantic




Percentage of projected future changes in precipitation contribution over: (**a**) Iberian Peninsula (IP), (**b**) Western Europe (EUwest), (**c**) Eastern Europe (EUeast) and (**d**) North Africa (Nafrica) associated with the Mediterranean Sea (MED) source.


nature › nature communications › articles › article

Article | Open access | Published: 14 October 2023

**Projected changes in atmospheric moisture transport contributions associated with climate warming in the North Atlantic**

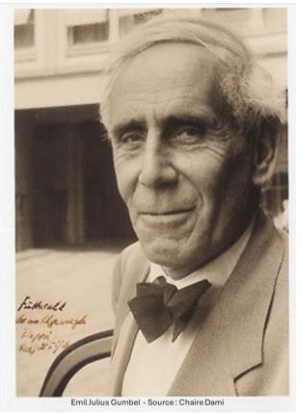
José C. Fernández-Alvarez, Albenis Pérez-Alarcón, Jorge Eiras-Barca, Stefan Rahimi, Raquel Nieto & Luis Gimeno

*Nature Communications* **14**, Article number: 6476 (2023) | Cite this article

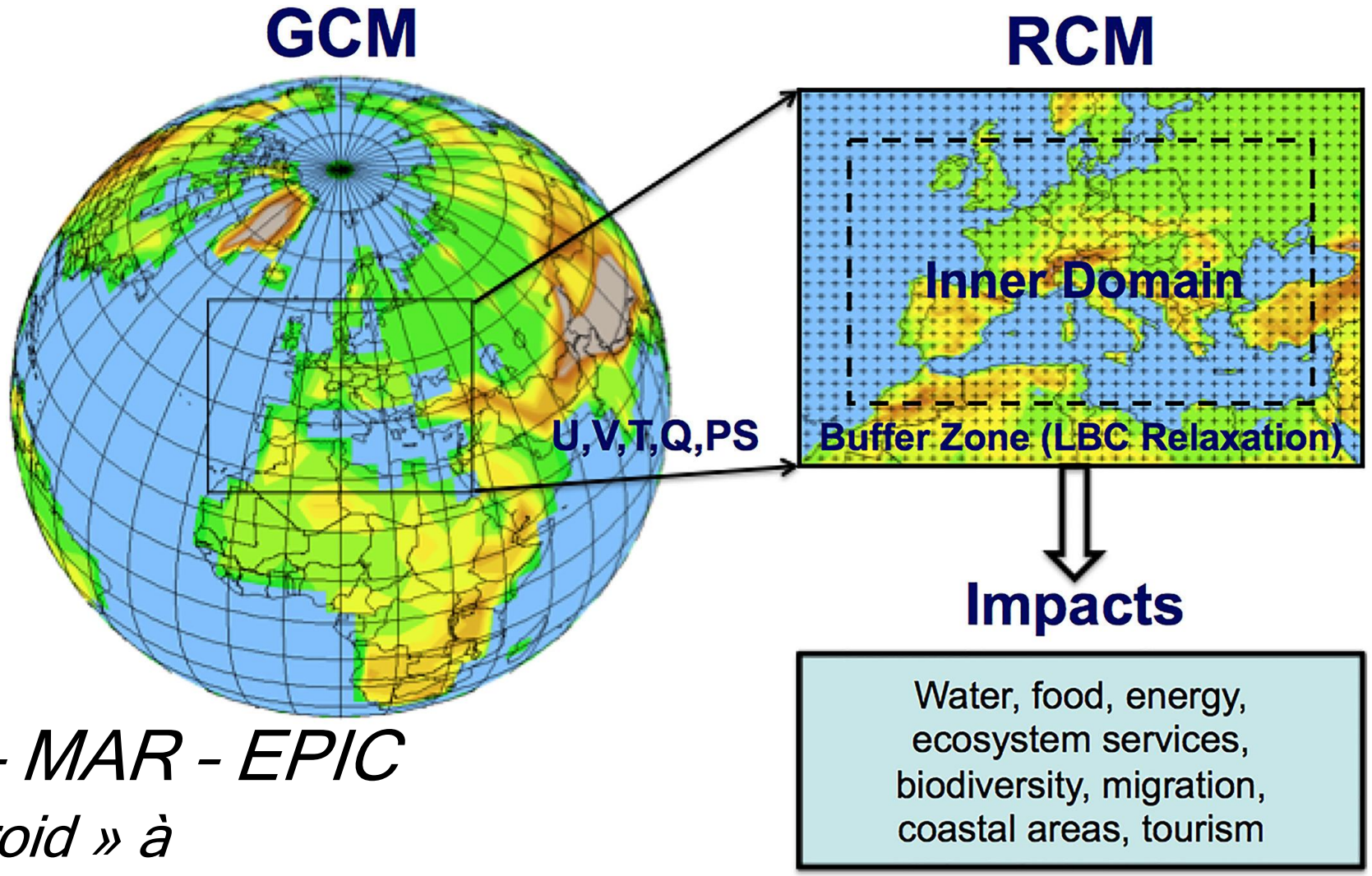
**5465** Accesses | **18** Citations | **12** Altmetric | Metrics

It's impossible that the improbable will never happen

(Gumbel)

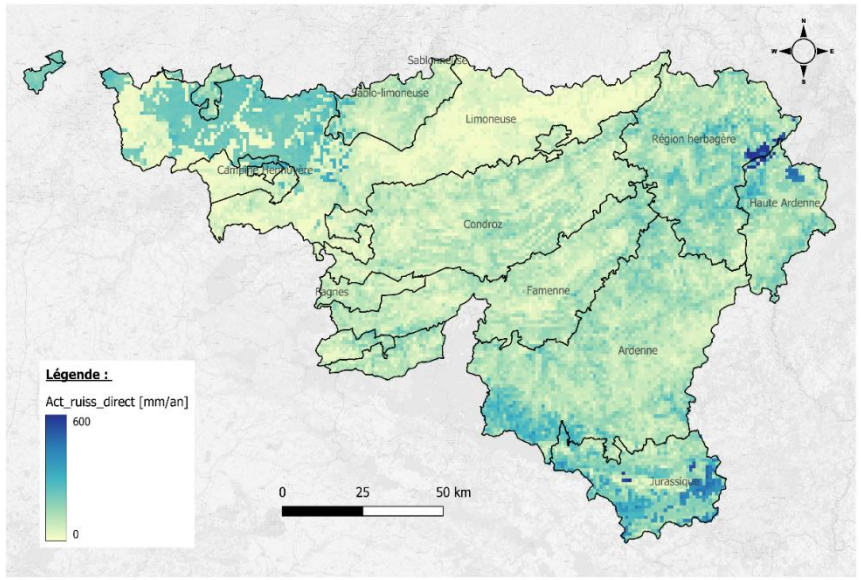



*Belgique 2021 - France 2022*



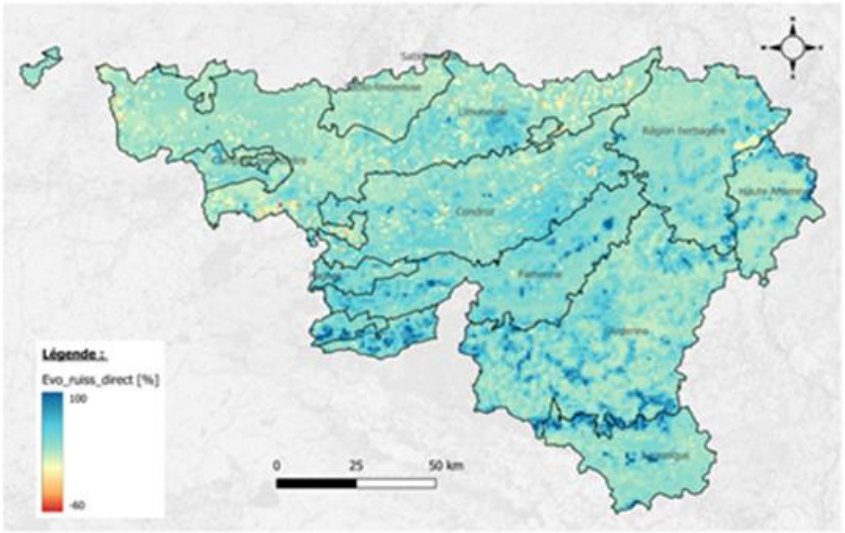

- *6 GCM – MAR – EPIC*
  - *De « froid » à « réchauffiste »*
  - *Approche d'ensemble*
- *Mondes à +2°c; +3°c; +4°c*

# Evolution de la production du ruissellement

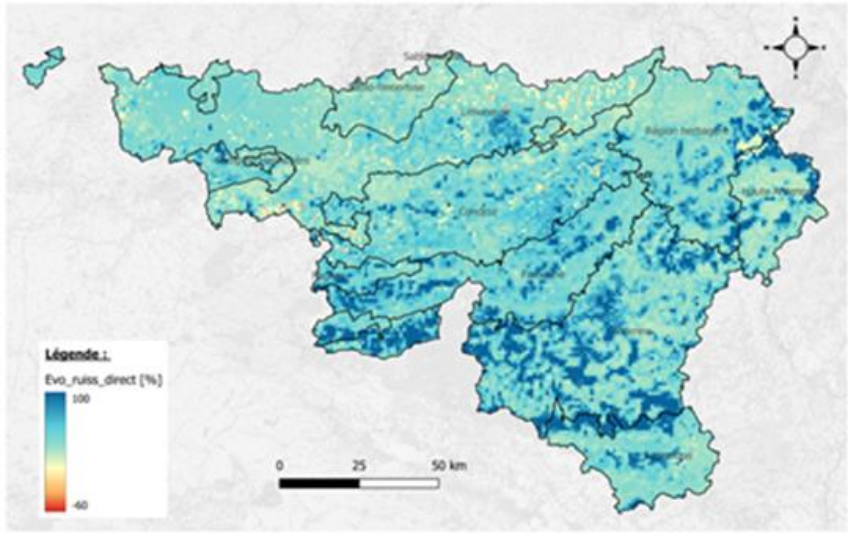



Ruissellement direct actuel pour la période de référence de 1971 à 2022

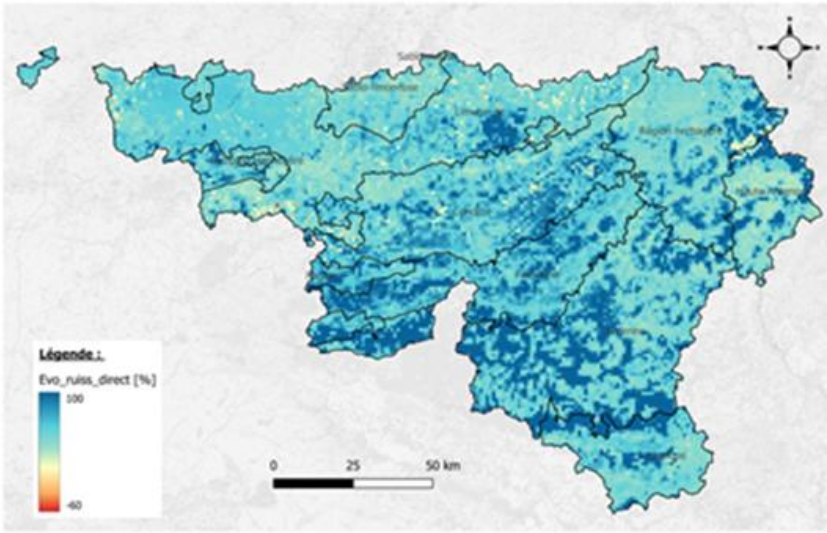
Evolution du ruissellement direct - 2deg - moyenne [%]



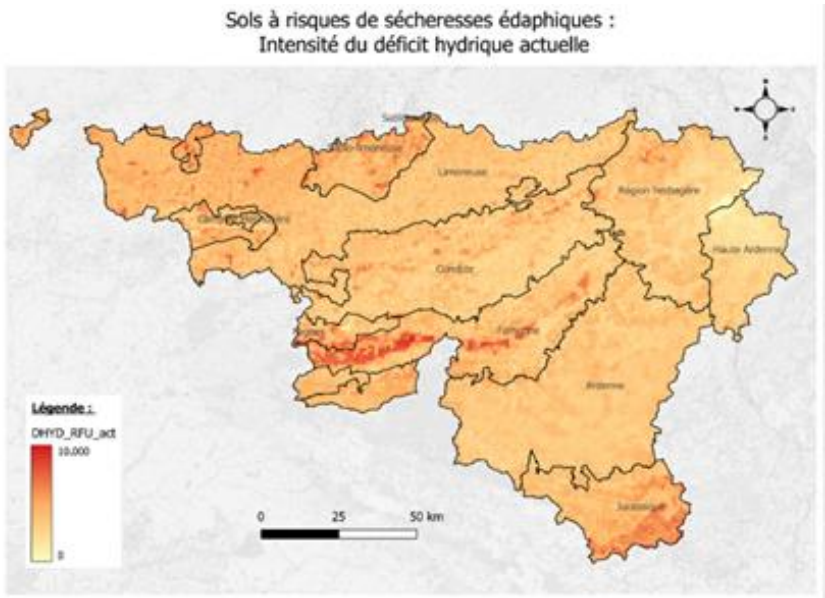

Evolution du ruissellement direct - 3deg - moyenne [%]



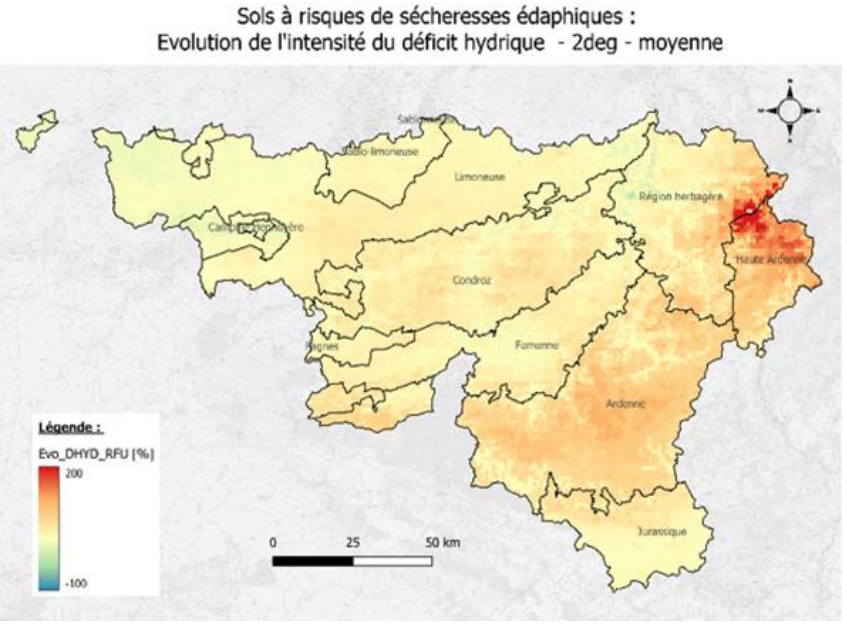

Evolution du ruissellement direct - 4deg - moyenne [%]

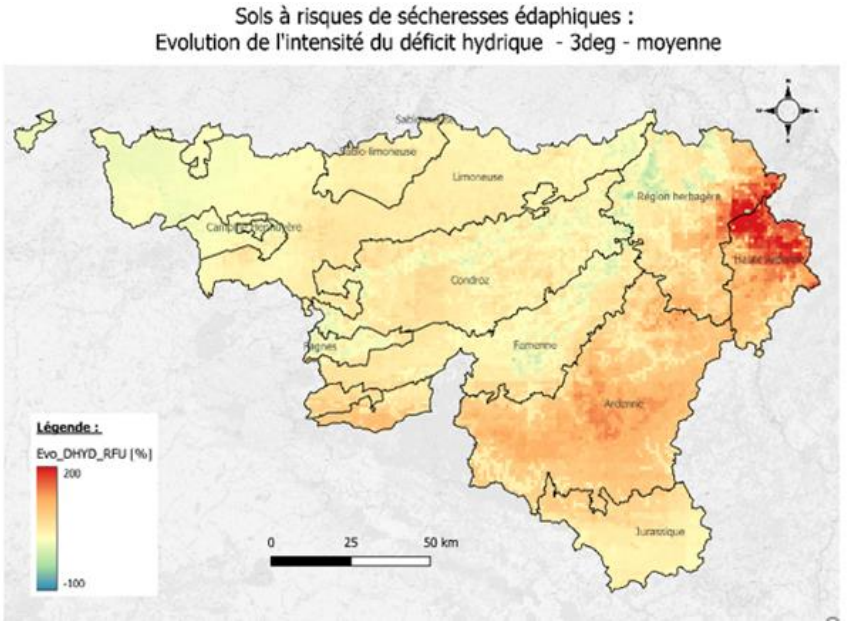


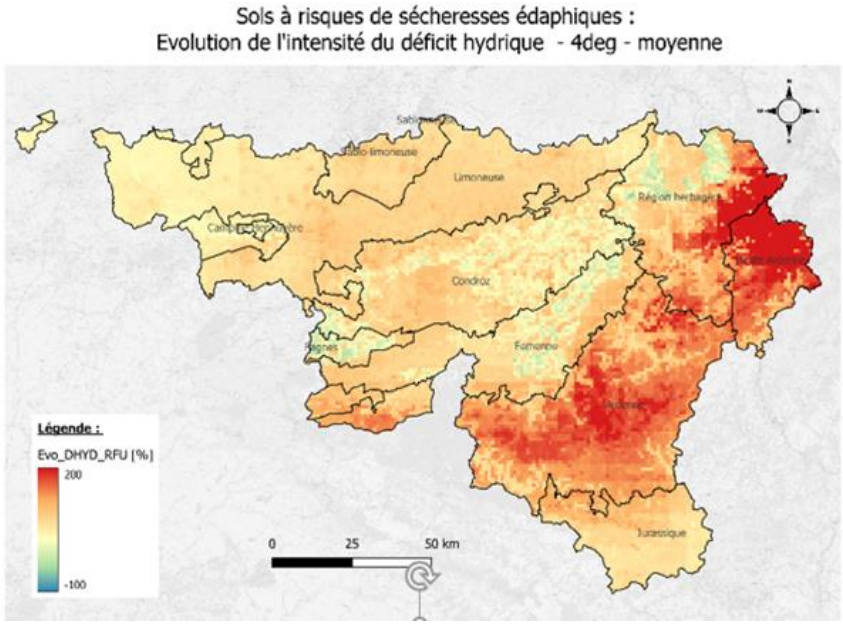
# Evolution des sécheresses édaphiques



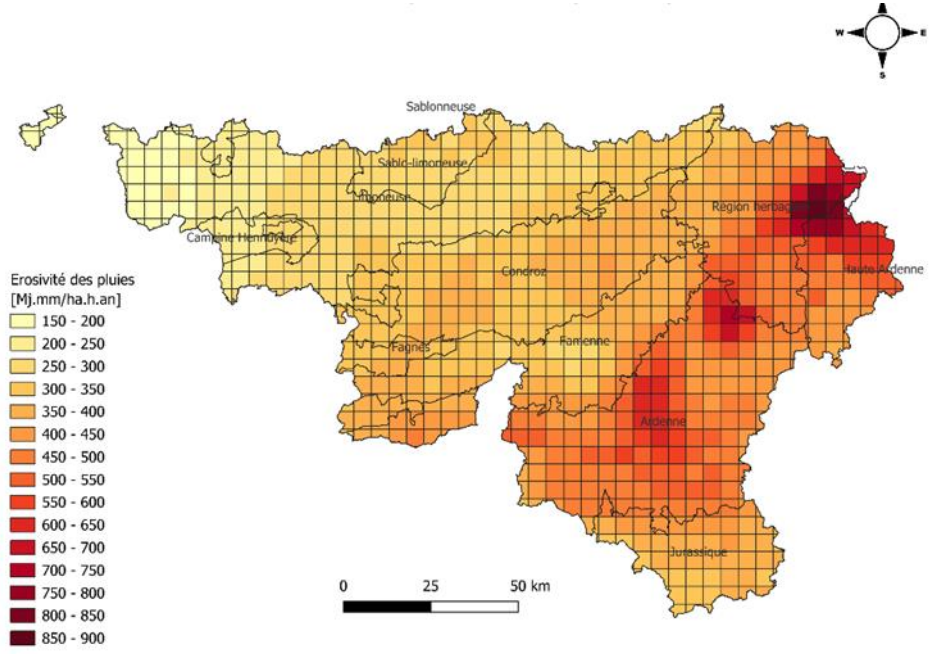

intensité du déficit hydrique actuelles pour la période de référence de 1971 à 2022



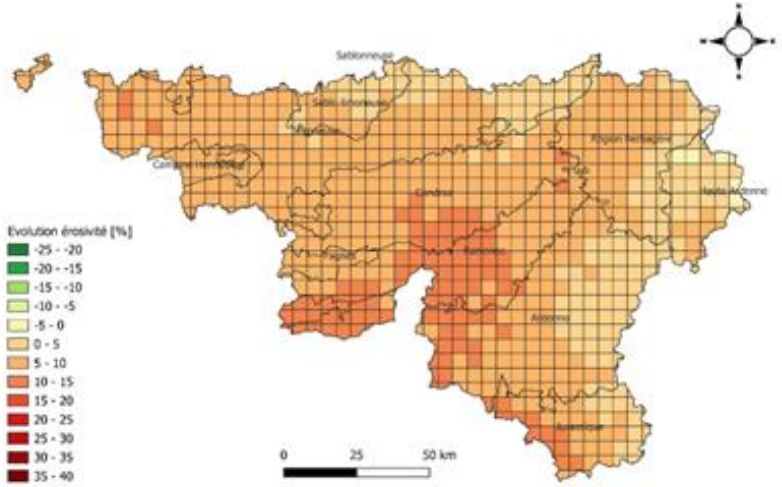
# Evolution de l’érosivité des pluies



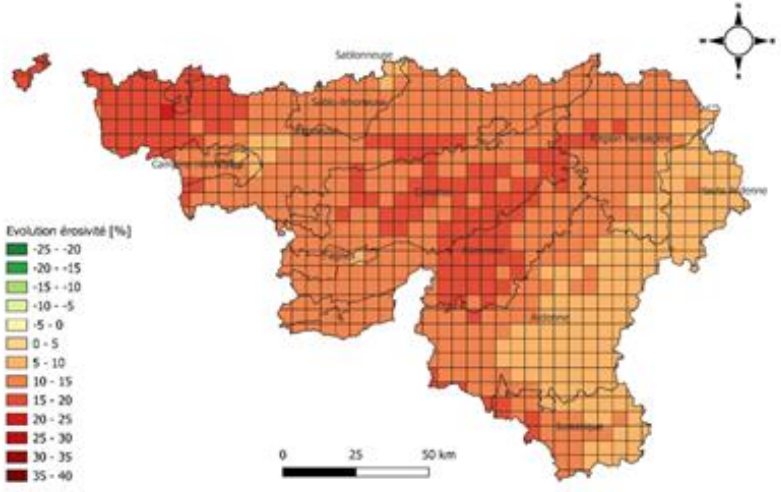

Erosivité actuelle des pluies pour la période de référence de 1981 à 2010 (Données MIROC!)

Evolution relative de l'érosivité des pluies en pourcentage dans un monde à +2, +3 et +4°C pour la moyenne des modèles

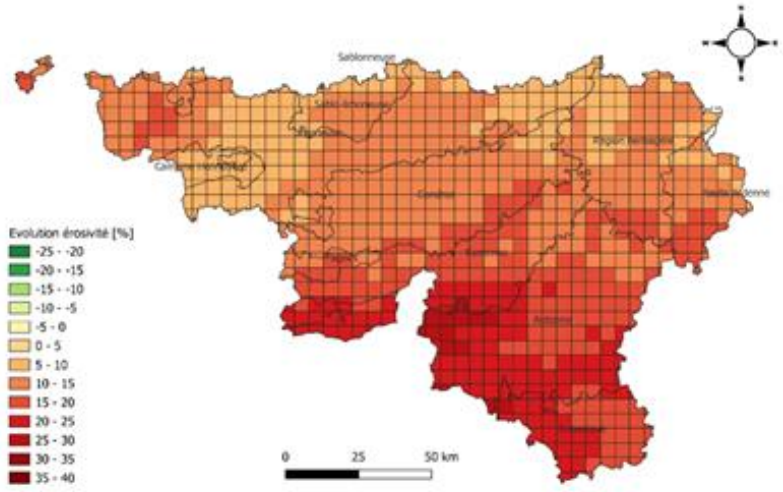
Evolution relative de l'érosivité des pluies moyenne à +2°C [%]




Evolution relative de l'érosivité des pluies moyenne à +3°C [%]

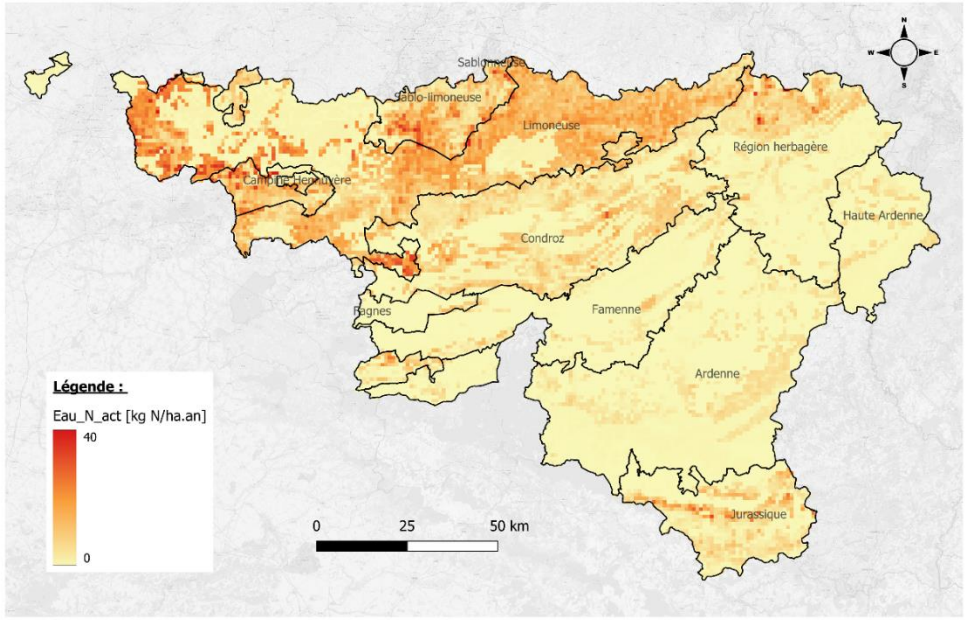



Evolution relative de l'érosivité des pluies moyenne à +4°C [%]



# Evolution de la pression en nitrate sur les ESO

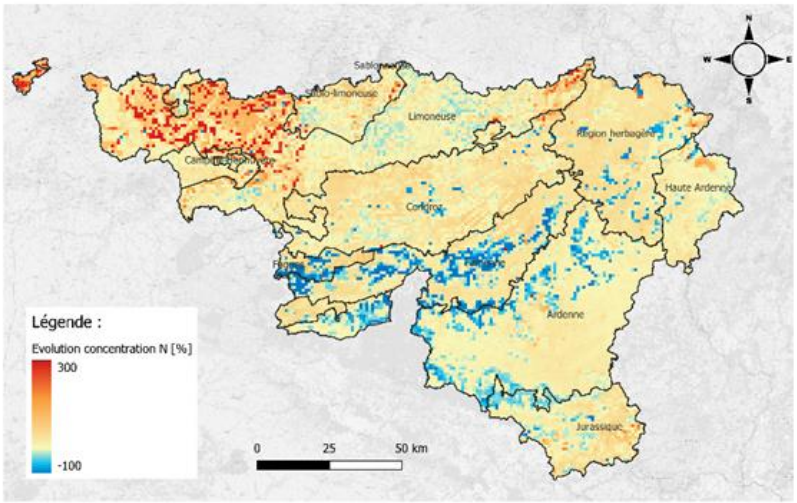
Pollution en nitrate des eaux vers les nappes - actuel [kg N/ha.an]



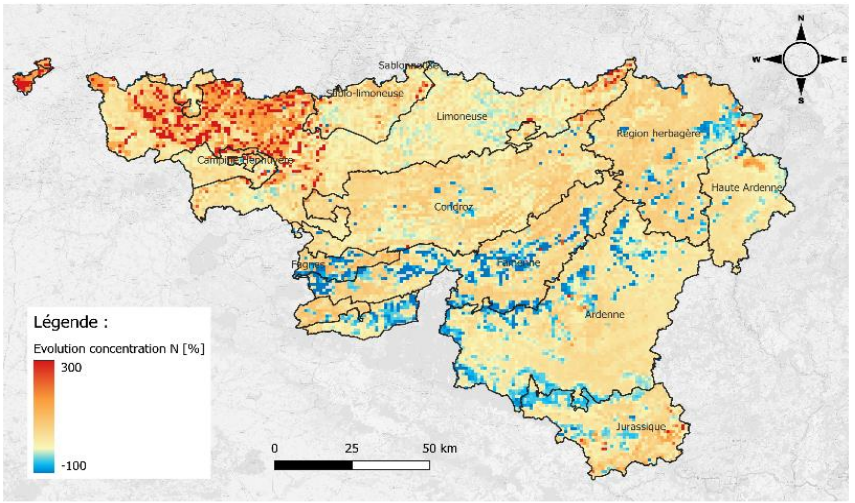

Apport de nitrate aux eaux souterraines pourla période de référence de 1981 à 2010 (Données MIROC!)

Evolution relative de l'apport de nitrate aux eaux souterraines en pourcentage dans un monde à +2, +3 et +4°C - modèle MIROC

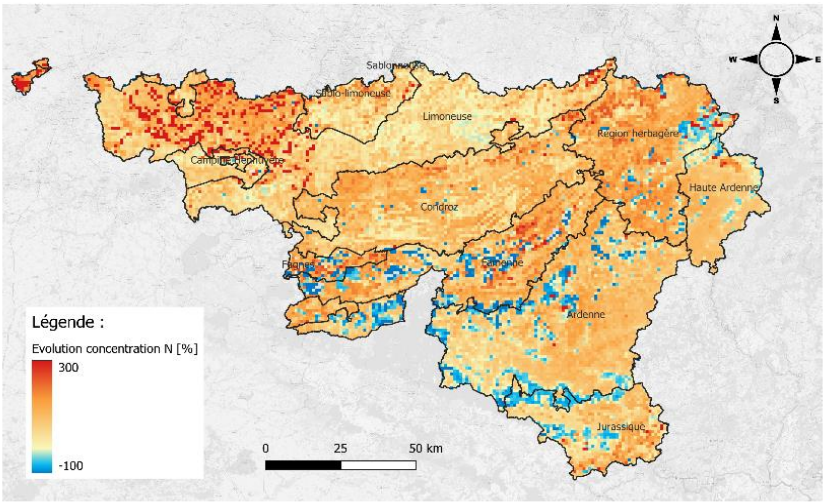
Evolution de la pollution en nitrate vers les nappes - 2 degrés



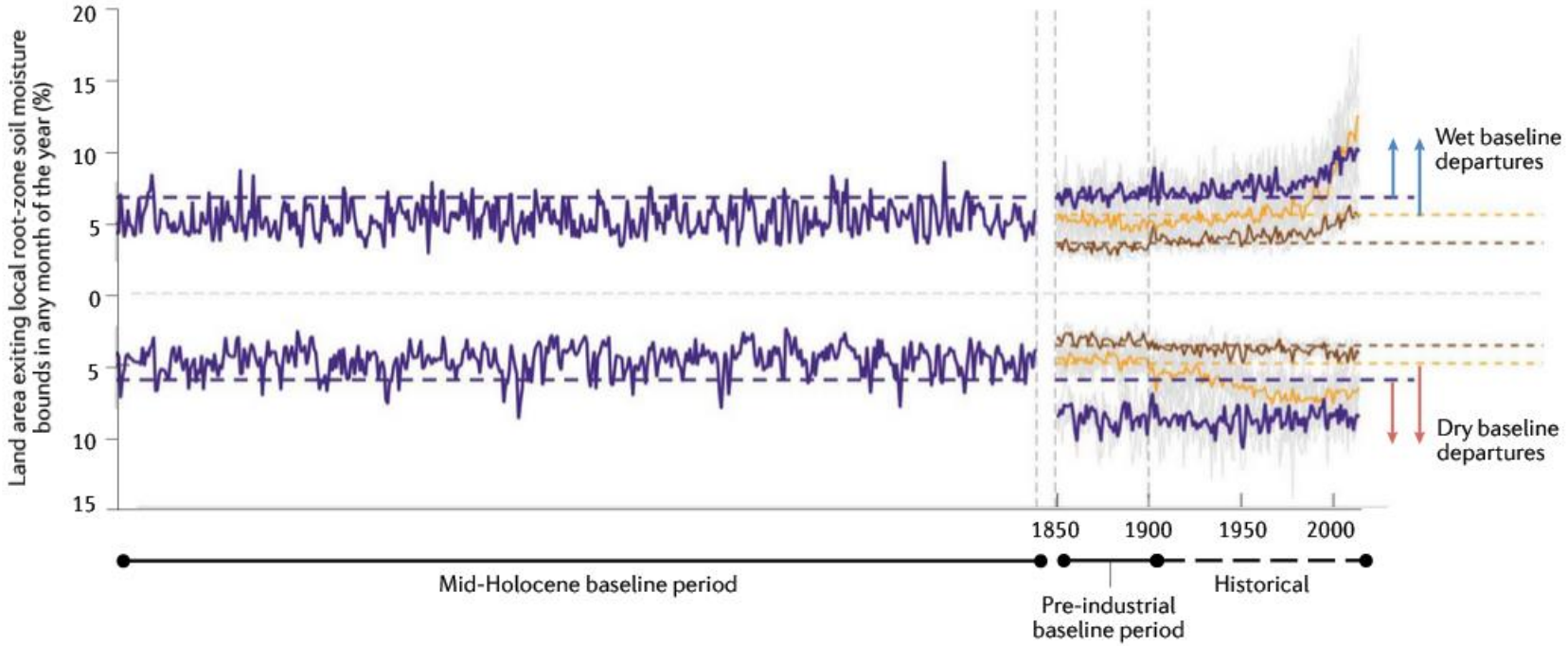

Evolution de la pollution en nitrate vers les nappes - 3 degrés

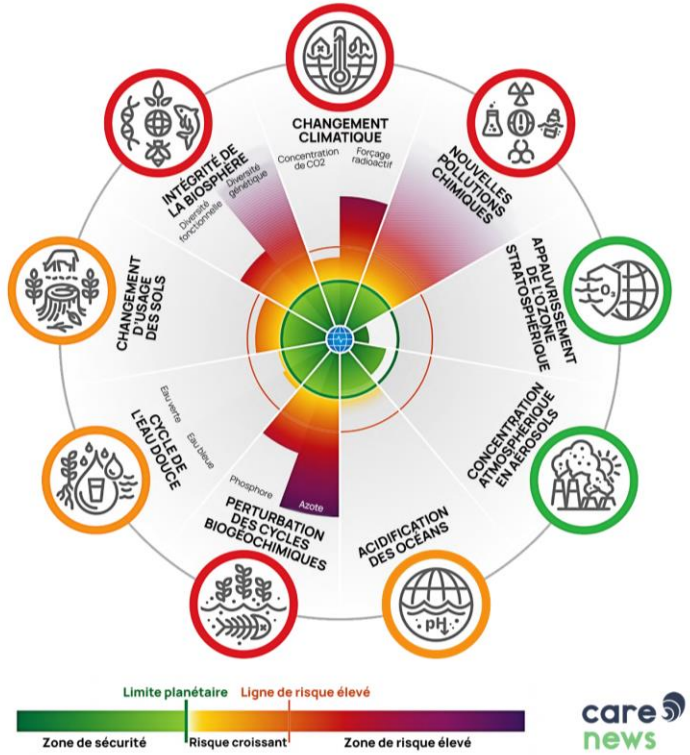



Evolution de la pollution en nitrate vers les nappes - 4 degrés



# Un cycle de l'eau qui s'intensifie



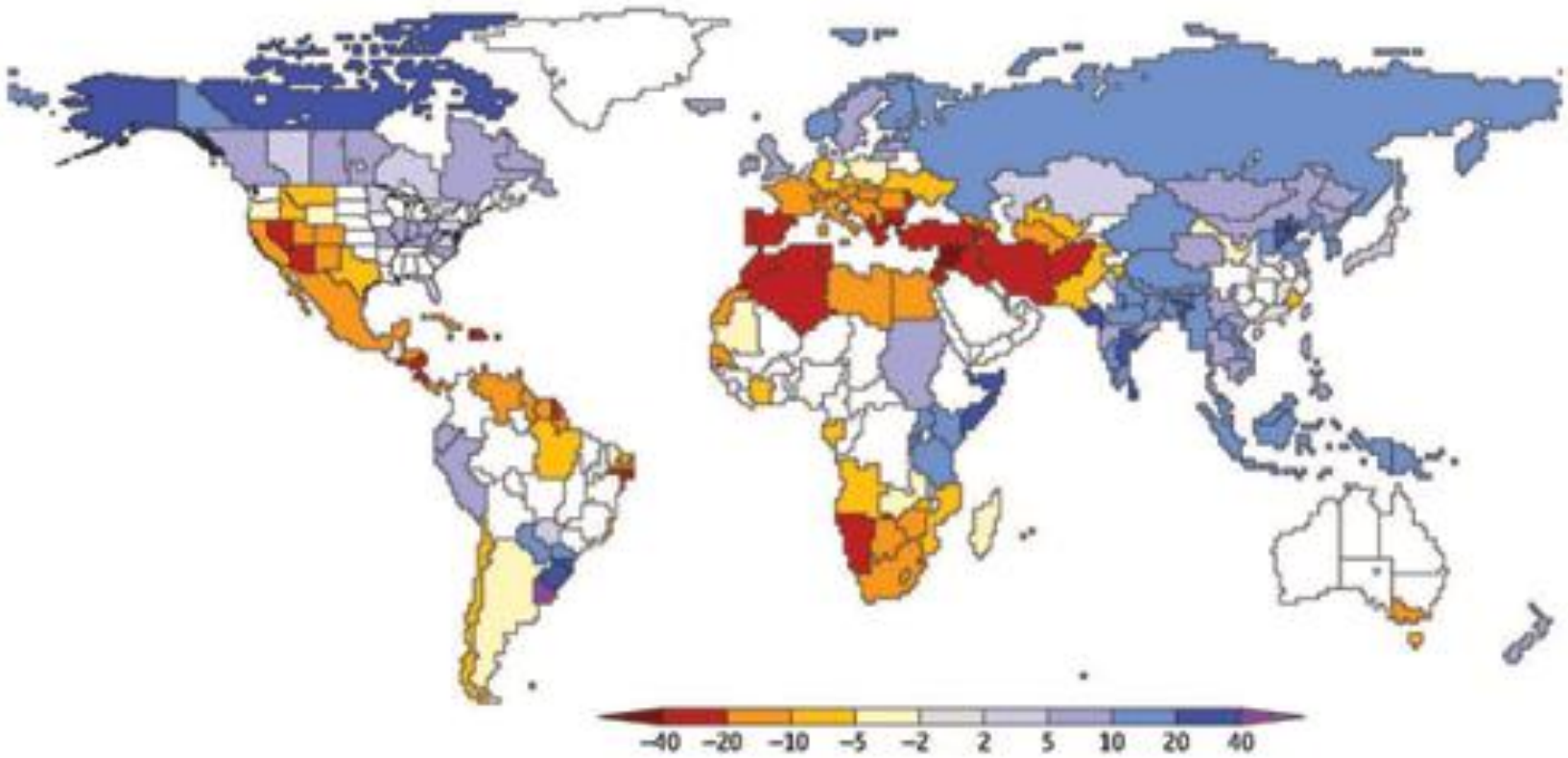

care news

> *"Water is the bloodstream of the biosphere. But we are profoundly changing the water cycle. This is now affecting the health of the entire planet."*
>
> Lan Wang-Erlandsson, lead author

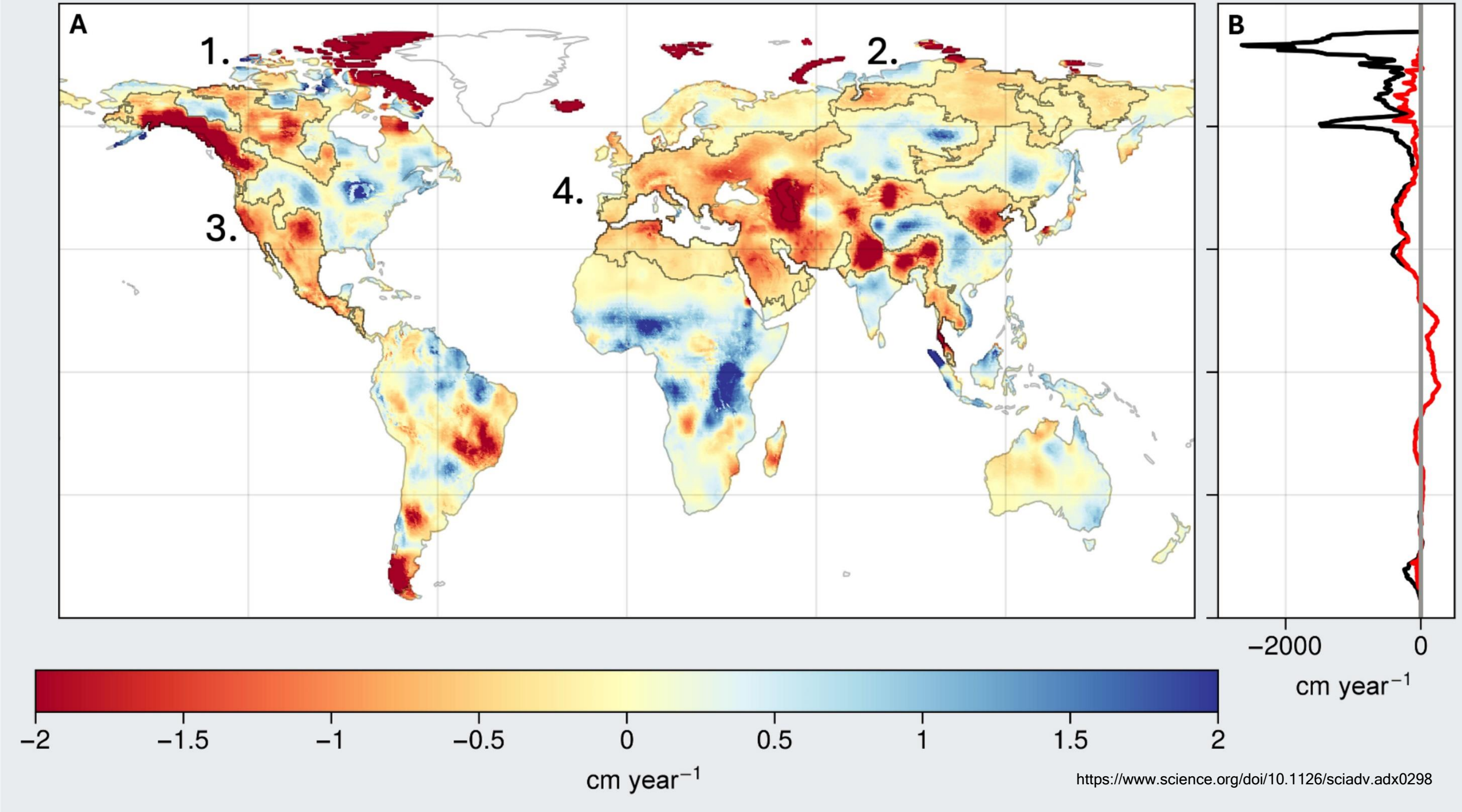
Ici : données pour **l'eau verte**
Pourcentage de la superficie des terres dont les écarts mensuels d'humidité du sol de la zone racinaire dépassent les limites inférieures (écart sec) et supérieures (écart humide) locales. Les limites sèches et humides sont définies comme les 5e et 95e percentiles de l'humidité du sol de la zone racinaire au cours de l'Holocène moyen.

*Wang- Erlandsson et al. 2022*

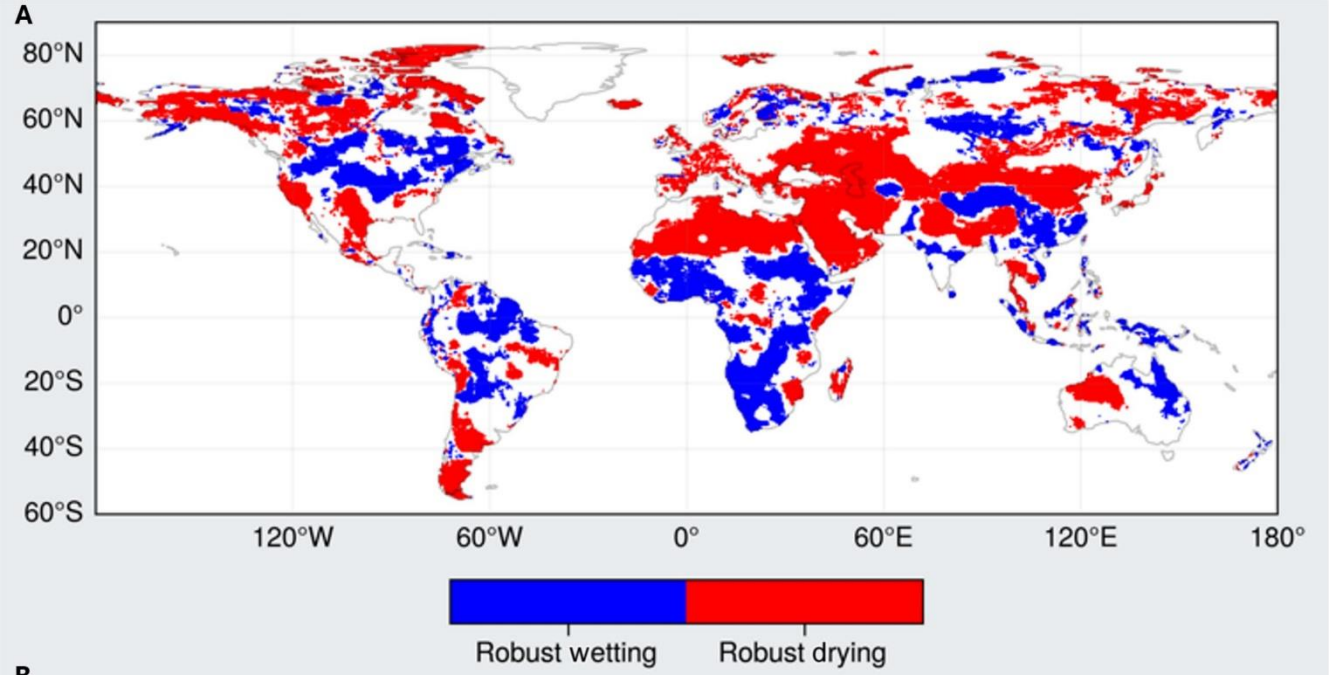
# « Stationnarity is dead (…) » (Milly et al., Science 2008)

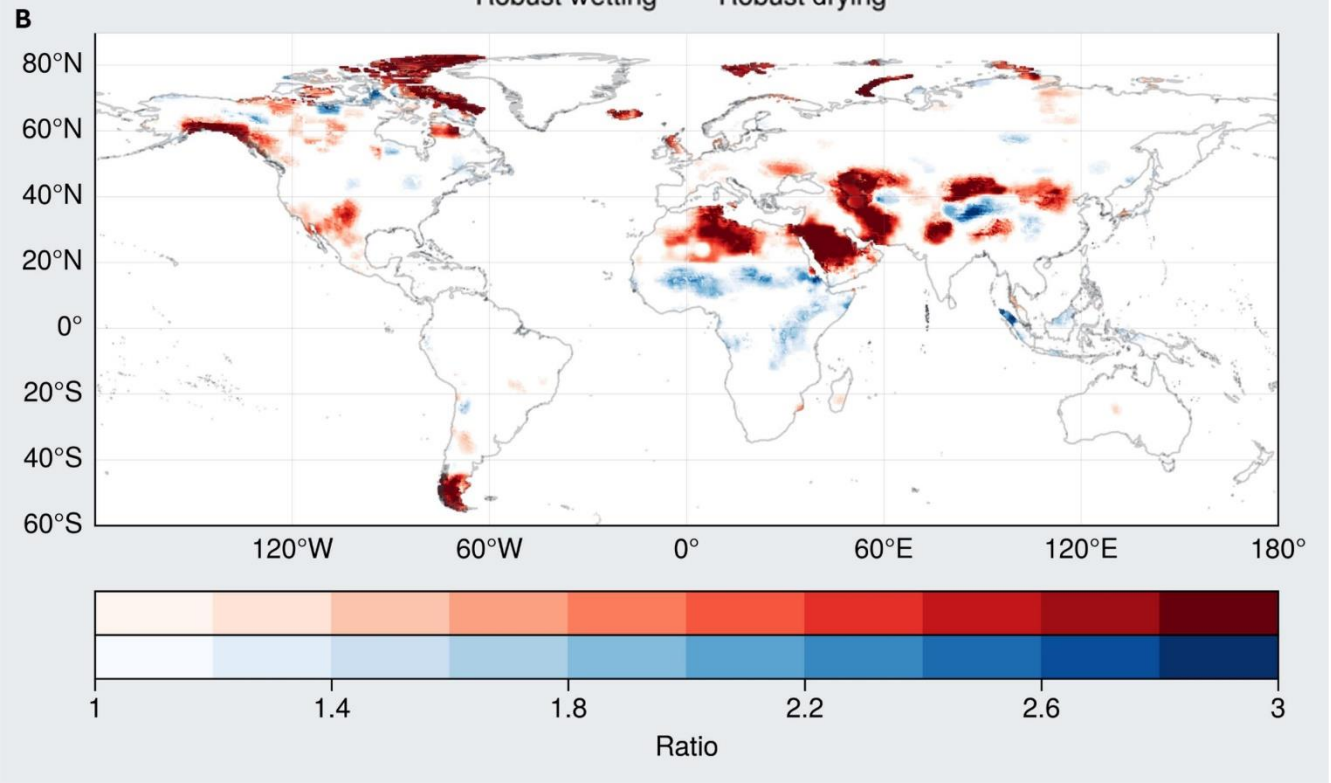



Changes in **runoff volume,** projected by the middle of the 21st century (relative to historical conditions from the 1900 to 1970 period).
Color denotes percentage change (median value from 12 climate models).
Where a region is colored, 8 or more of 12 models agreed on the direction (increase versus decrease) of runoff change under the Intergovernmental Panel on Climate Change's
“SRES A1B” emissions scenario




https://www.science.org/doi/10.1126/sciadv.adx0298



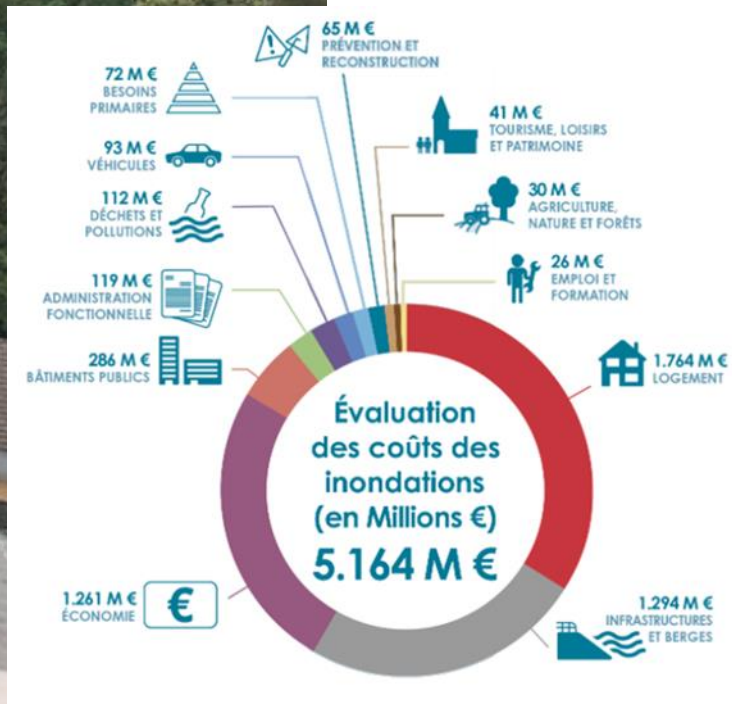





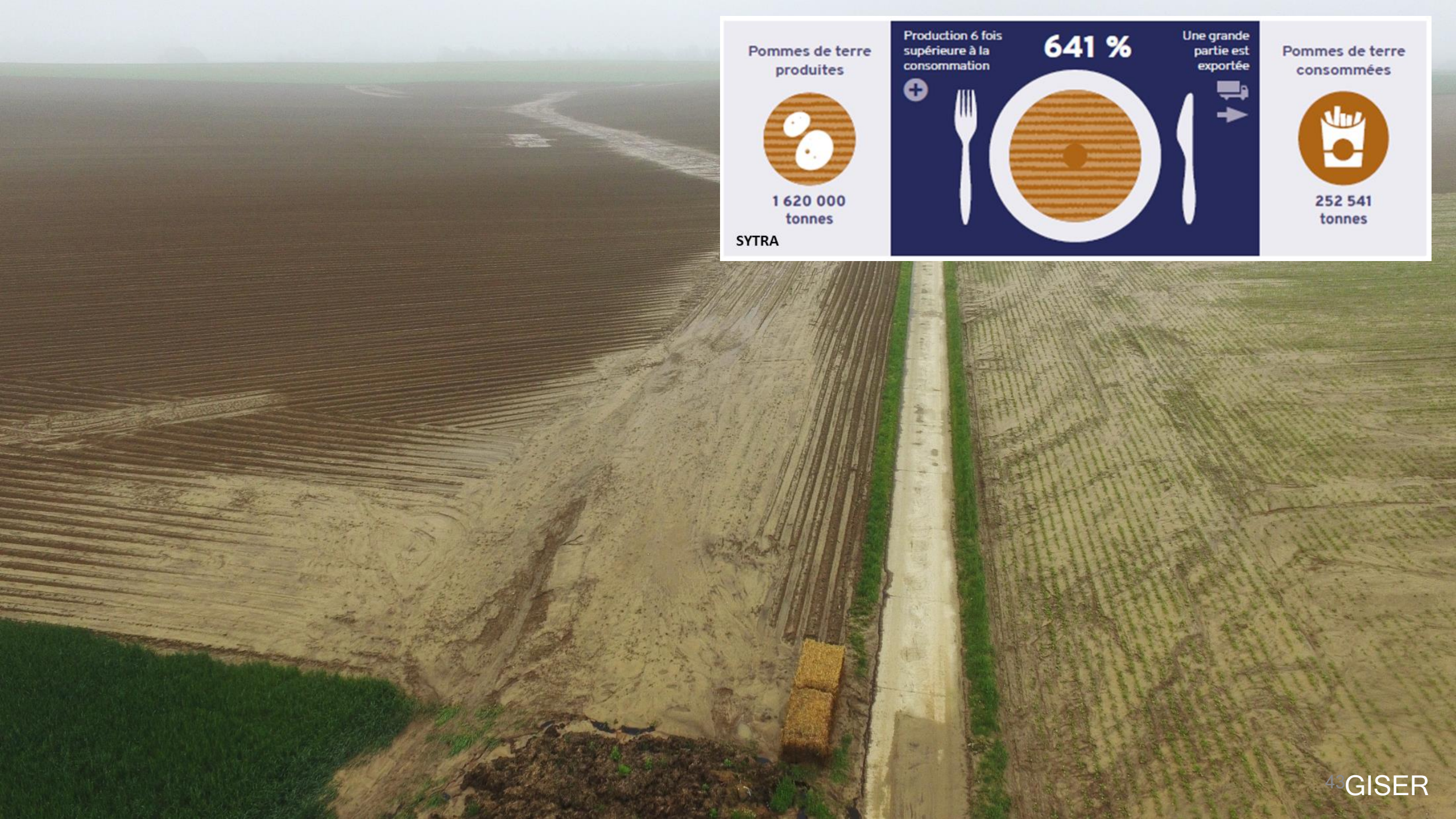
*Global water mass contributions to sea level rise.*
*(A) Time series of water mass anomalies of the major global water reservoirs (Ocean, Antarctica, Greenland, and TWS on the continents) from GRACE/FO from April 2002 to April 2024, in mm SLE.*

*Mapping robustness of TWS trends.*
*(A) Drying and wetting land regions from Fig. 1B where the TWS trend sign has been persistent and less sensitive to the increasing GRACE/FO record length. (B) Ratio of local interannual variability of detrended TWS anomalies to their long-term local trends. The red and blue color bars indicate regions with decreasing TWS trend and increasing TWS trend from Fig. 1B, respectively.*

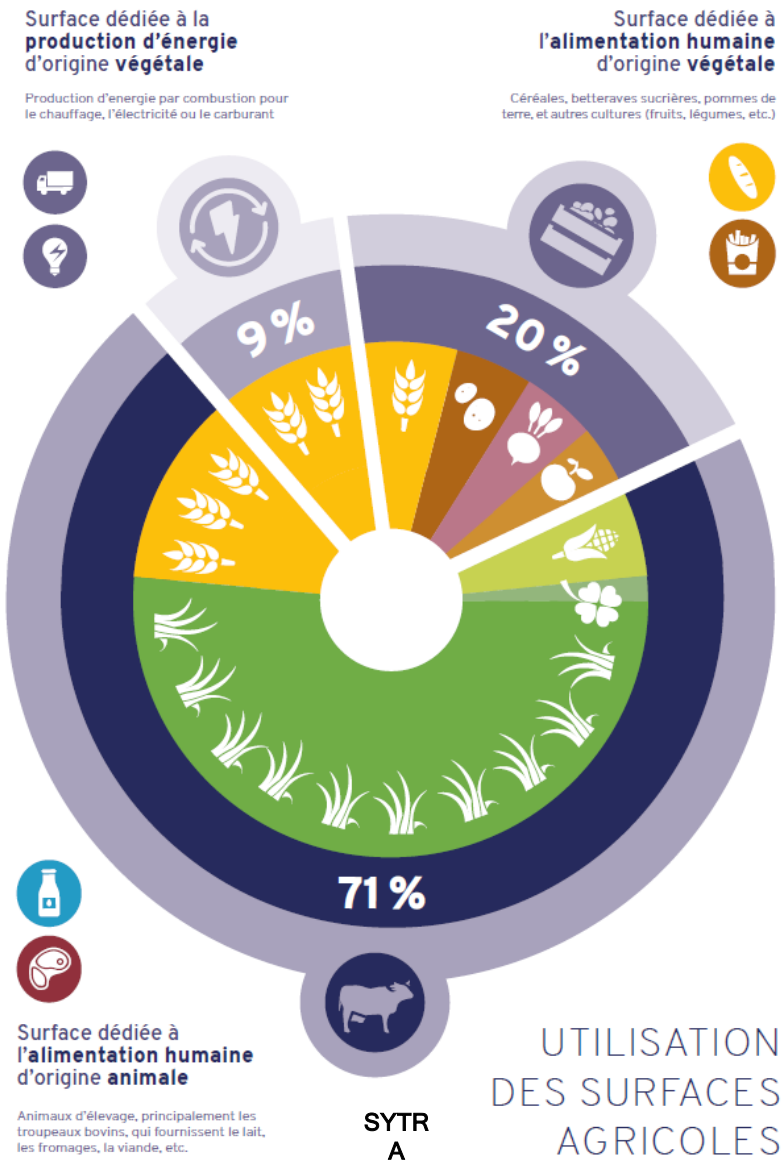
Erftstadt-Blessem, en Allemagne, le 16 juillet 2021




Secrétariat général à la reconstruction,
Evaluation des couts des inondations de 2021
Wallonie


Pommes de terre produites
1 620 000 tonnes
Production 6 fois supérieure à la consommation
641 %
Une grande partie est exportée
Pommes de terre consommées
252 541 tonnes
SYTRA

# Eau, sols & Système alimentaire




nature communications

Article

https://doi.org/10.1038/s41467-023-38906-7

## Risks of synchronized low yields are underestimated in climate and crop model projections

Received: 29 April 2022

Accepted: 17 May 2023

Published online: 04 July 2023

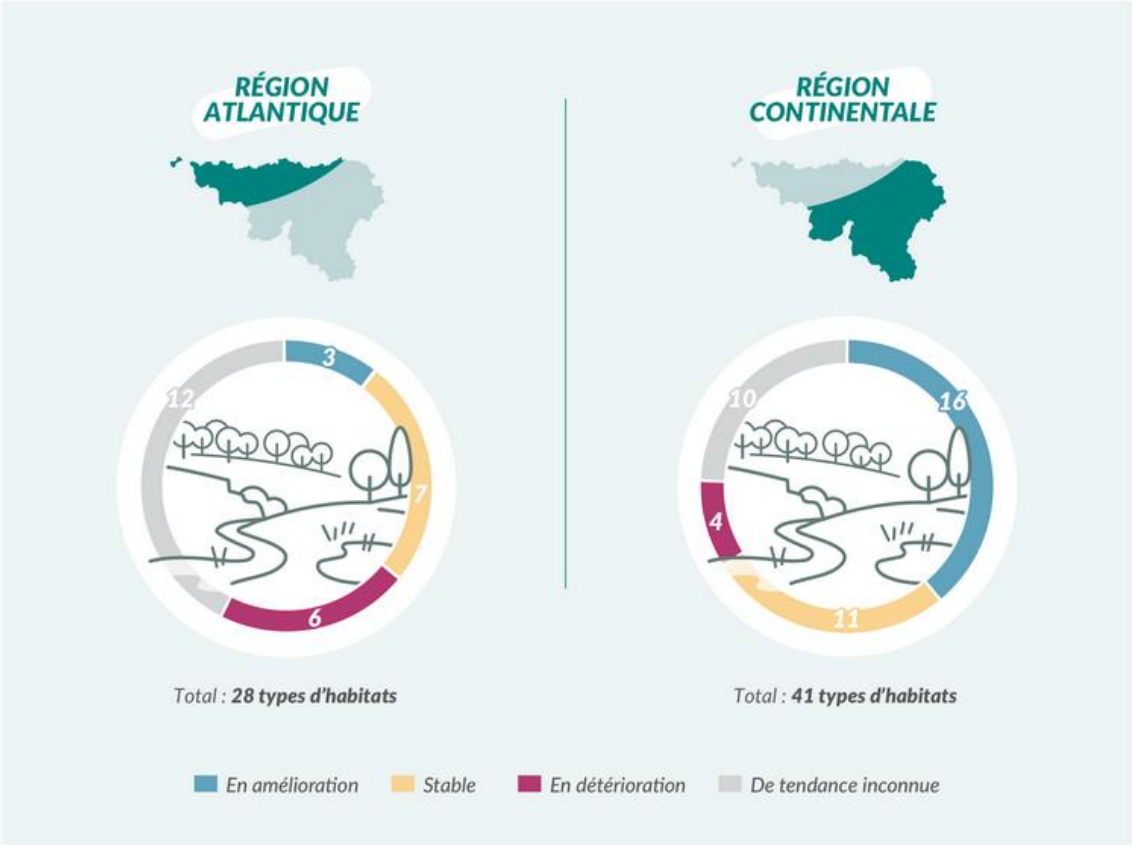
Check for updates

Kai Kornhuber[1,2,3], Corey Lesk[1,4], Carl F. Schleussner[2,5], Jonas Jägermeyr[6,7,8], Peter Pfleiderer[2,5] & Radley M. Horton[1]

Simultaneous harvest failures across major crop-producing regions are a threat to global food security. Concurrent weather extremes driven by a strongly meandering jet stream could trigger such events, but so far this has not been quantified. Specifically, the ability of state-of-the art crop and climate models to adequately reproduce such high impact events is a crucial component for estimating risks to global food security. Here we find an increased likelihood of concurrent low yields during summers featuring meandering jets in observations and models. While climate models accurately simulate atmospheric patterns, associated surface weather anomalies and negative effects on crop responses are mostly underestimated in bias-adjusted simulations. Given the identified model biases, future assessments of regional and concurrent crop losses from meandering jet states remain highly uncertain. Our results suggest that model-blind spots for such high-impact but deeply-uncertain hazards have to be anticipated and accounted for in meaningful climate risk assessments.

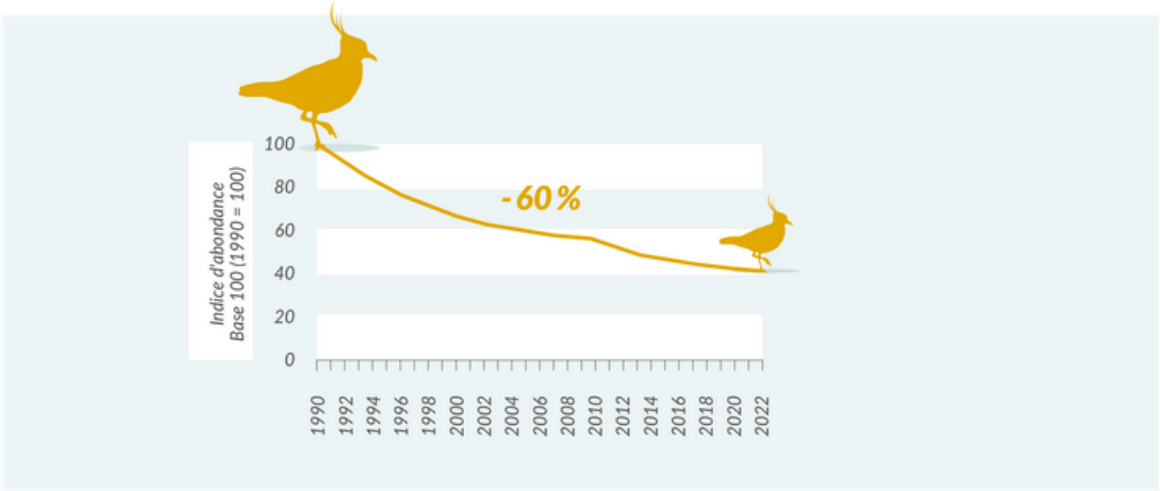
# Eau, sols & Biodiversité

*Tendance des habitats d'intérêt communautaire en Wallonie,*
*tous groupes de types d'habitats confondus (entre les périodes 2007 - 2012 et 2013 - 2018)*




SPW ARNE - DEMNA - DEE (2024)

*Évolution des effectifs des populations d'oiseaux communs en Wallonie, espèces des milieux agricoles (17 espèces) (1990 - 2022)*



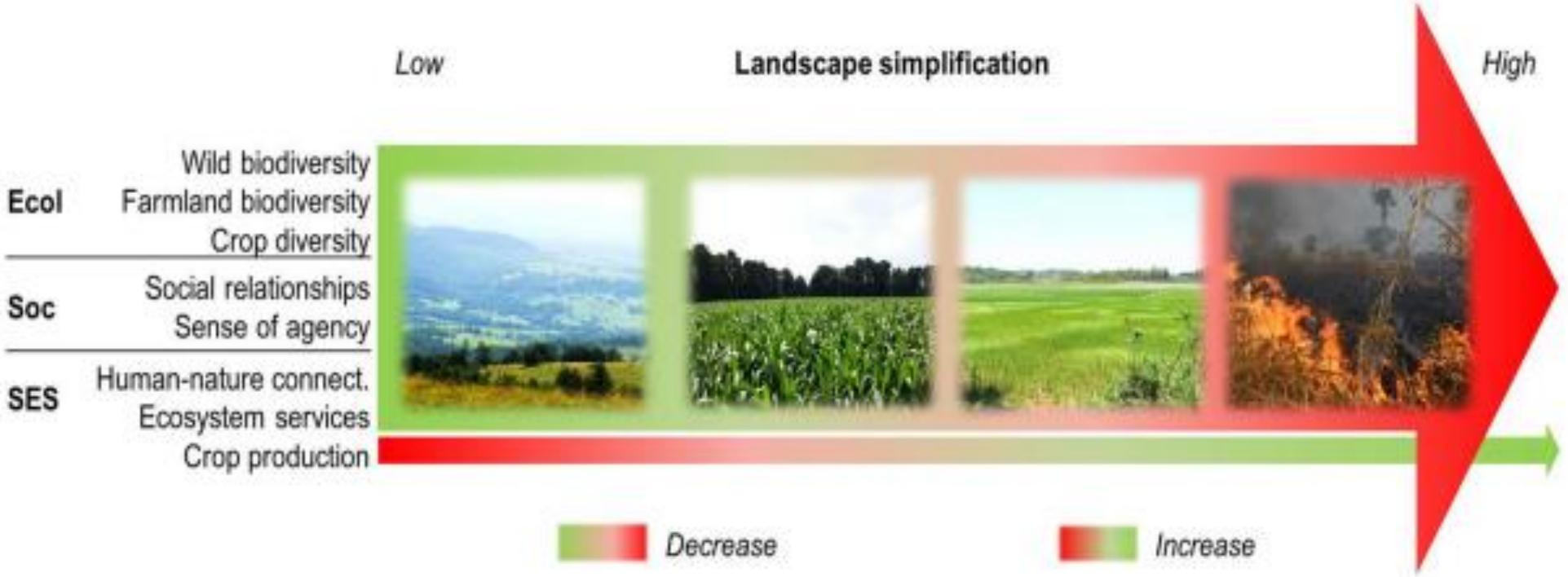

SPW ARNE - DEMNA - DEE (2024)

ELSEVIER
Agriculture, Ecosystems & Environment
Volume 221, 1 April 2016, Pages 198-204

## Agricultural landscape simplification reduces natural pest control: A quantitative synthesis

Adrien Rusch [a b], Rebecca Chaplin-Kramer [c d], Mary M. Gardiner [e], Violetta Hawro [f], John Holland [g], Douglas Landis [h], Carsten Thies [i], Teja Tscharntke [i], Wolfgang W. Weisser [j], Camilla Winqvist [k], Megan Woltz [l], Riccardo Bommarco [k]

# Eau, sols, paysages & Humains…



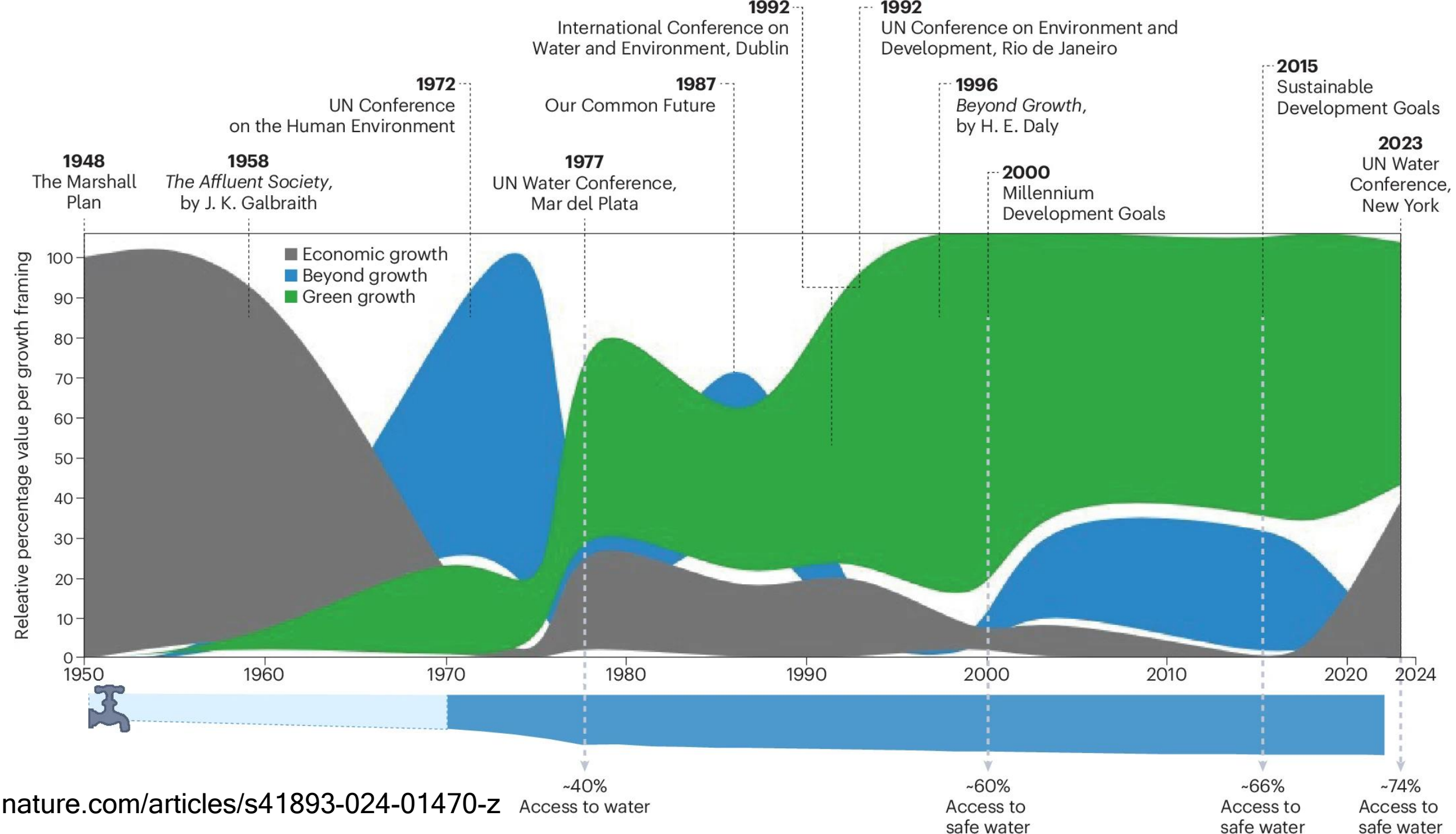

Landscape Ecol (2020) 35:2601–2612
https://doi.org/10.1007/s10980-020-01012-w

RESEARCH ARTICLE

## The erosion of relational values resulting from landscape simplification

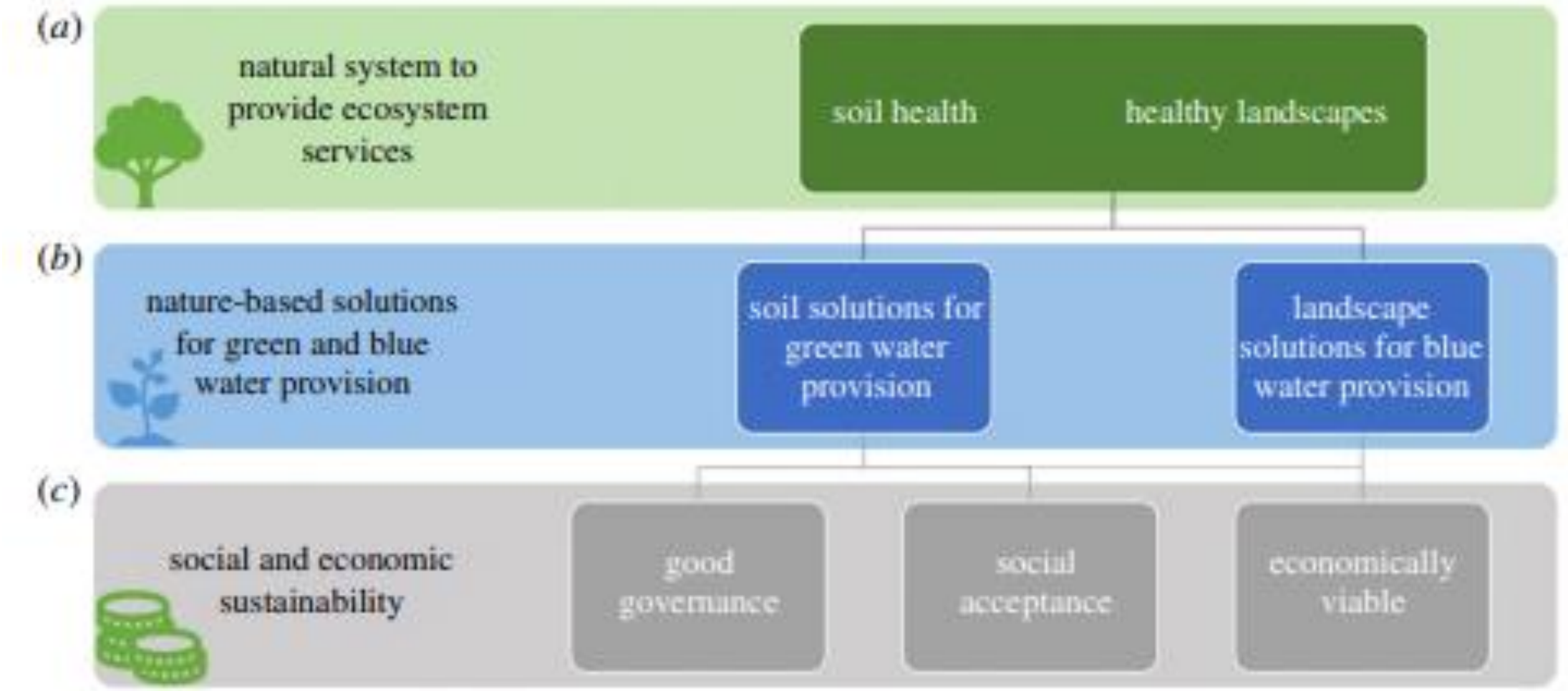
Maraja Riechers · Ágnes Balázsi · Lydia Betz · Tolera S. Jiren · Joern Fischer

https://doi.org/10.1007/s10980-020-01012-w



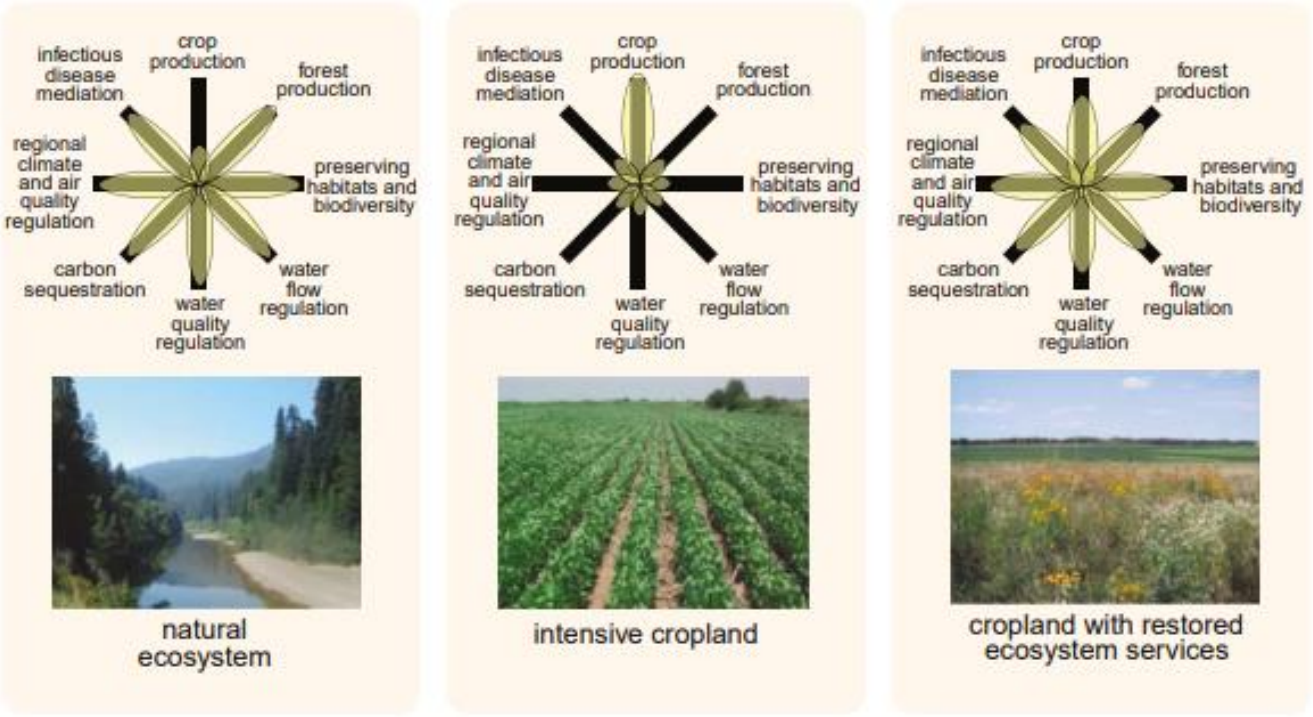

nature.com/articles/s41893-024-01470-z

6 EAU PROPRE ET ASSAINISSEMENT

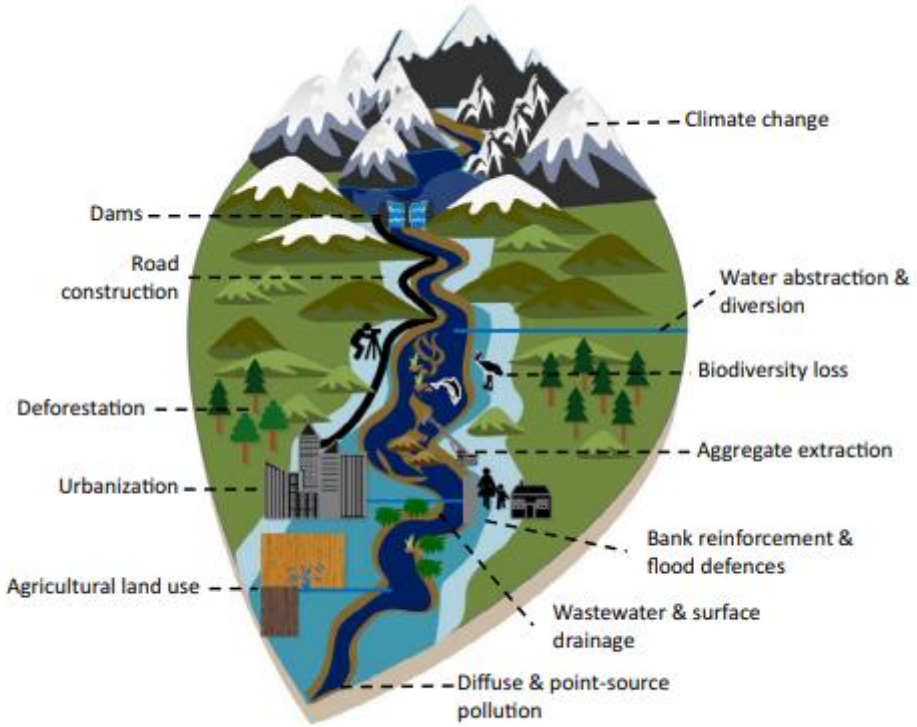



Step-wise approach to achieving social and economic sustainability in provision of green and blue water by nature-based system, with soil as an important component (keestra et al, 2020)

royalsocietypublishing.org/doi/pdf/10.1098/rstb.2020.0175?




royalsocietypublishing.org/doi/pdf/10.1098/rstb.2020.0175




doi.org/10.1007/s11625-022-01150-x

Difficile

Simple

climat

Réorganisation hydrologique du paysage

Restauration du réseau hydrologique

Végétation et vie sauvage

Aggradation des sols

Sélection variétale

Irrigation

ZIT, ZEC

Logique d'adaptation

méthodes « sures » mais palliatives

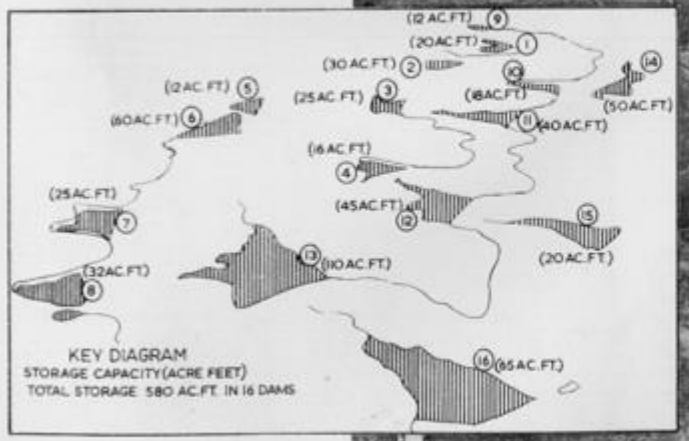
Logique systémique de rééquilibrage

méthodes « innovantes », à la fois préventives et curatives

*Inspiré de l'échelle de permanence de Yeomans et de S. Bonvoisin, 2024*

PLATE 5

*"Yobarnie" photographed from the air, after 17 years of Keyline irrigation development. The property covers about 760 acres and fifteen full farm irrigation dams are visible in this picture. (Photographed by Douglass Baglin.)*



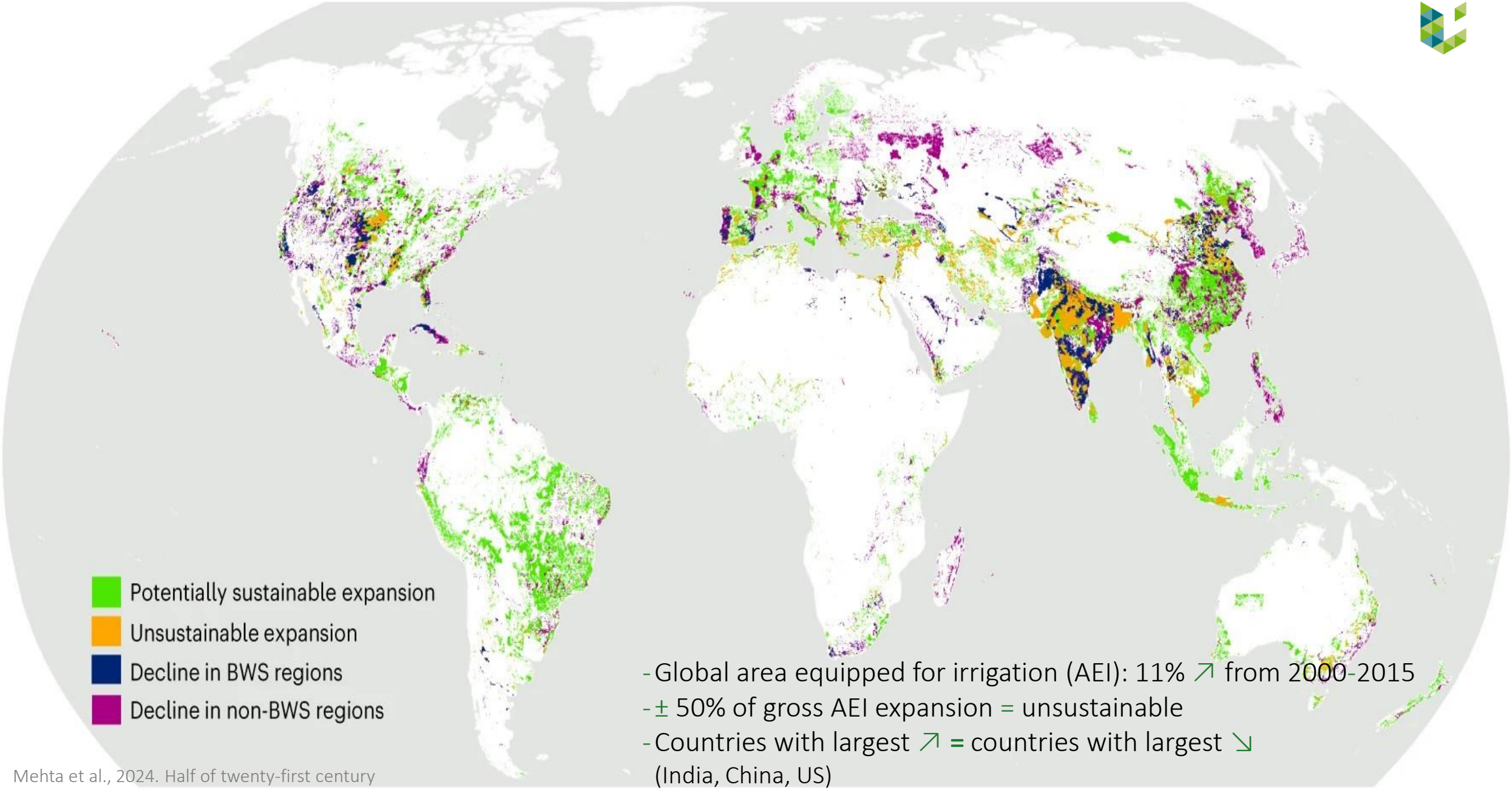

*Sustainable Agriculture creates living soil to adsorb Salt and CO2*

# *Water for Every Farm*

## *Yeomans Keyline Plan*

Compiled, updated and edited by
**Ken B. Yeomans H.D.A.**

*Inspiré de l'échelle de permanence de Yeomans et de S. Bonvoisin, 2024*




- Global area equipped for irrigation (AEI): 11% ↗ from 2000-2015
- ± 50% of gross AEI expansion = unsustainable
- Countries with largest ↗ = countries with largest ↘ (India, China, US)
- Economic drivers !! → cropping pattern → water scarcity !!

Mehta et al., 2024. Half of twenty-first century global irrigation expansion has been in water-stressed regions. Nature Water, 2, 254-261p.

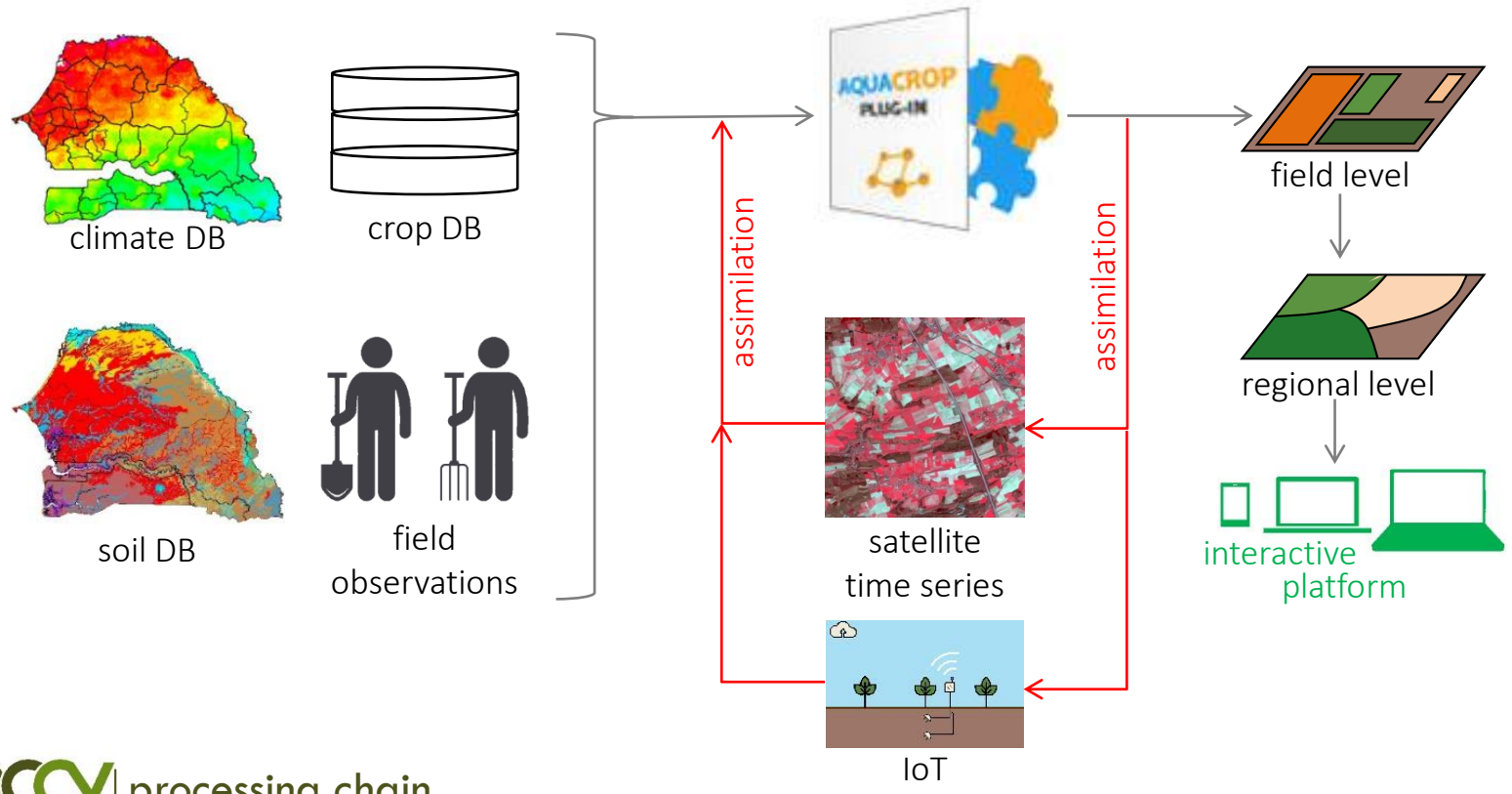
Society’s considerations for improvement:

1) Evolving water & agricultural policy landscape
2) Consumer awareness = water footprint

Practitioners' considerations for improvement:

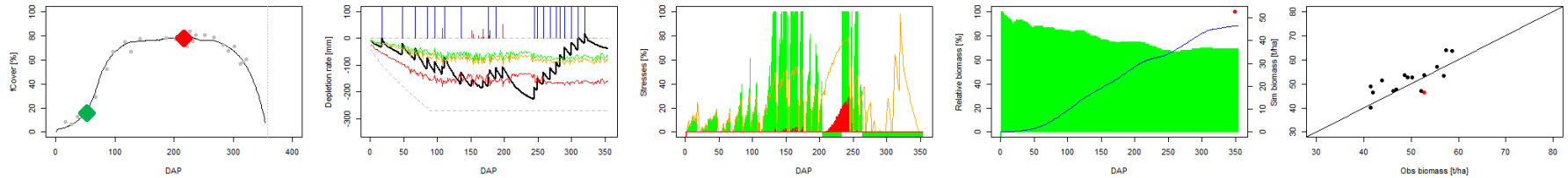
1) Technical investments
2) Management shortcomings
   - participation in decision-making
   - mutual exchanges of knowledge & learning
3) Irrigation = more & more individual ‘business’

Cvejic et al., 2021. Advancing irrigation development in the European Union. Irrigation and Drainage, 70, 887-899
Makin, 2020. ICID Vision 2030 – The present status and prospects for irrigated agriculture. Irrigation and Drainage, 68, 208-217
Hrorencik et al., 2025. The development and current challenges of irrigated agriculture in the western U.S. Agricultural Water Management, 315, 109474




# preccy processing chain dashboard

processing chain for parcel & regional crop yield modelling

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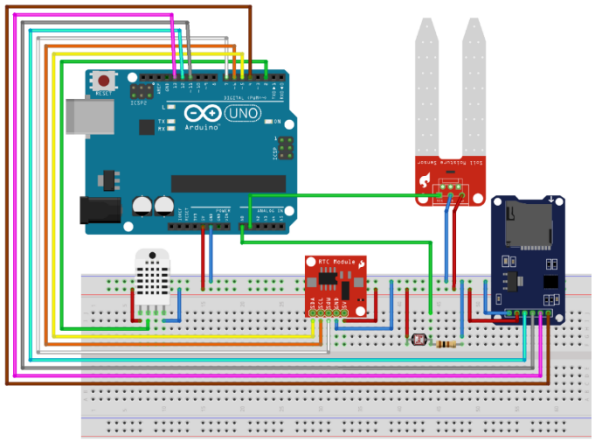
NADIRA | EU







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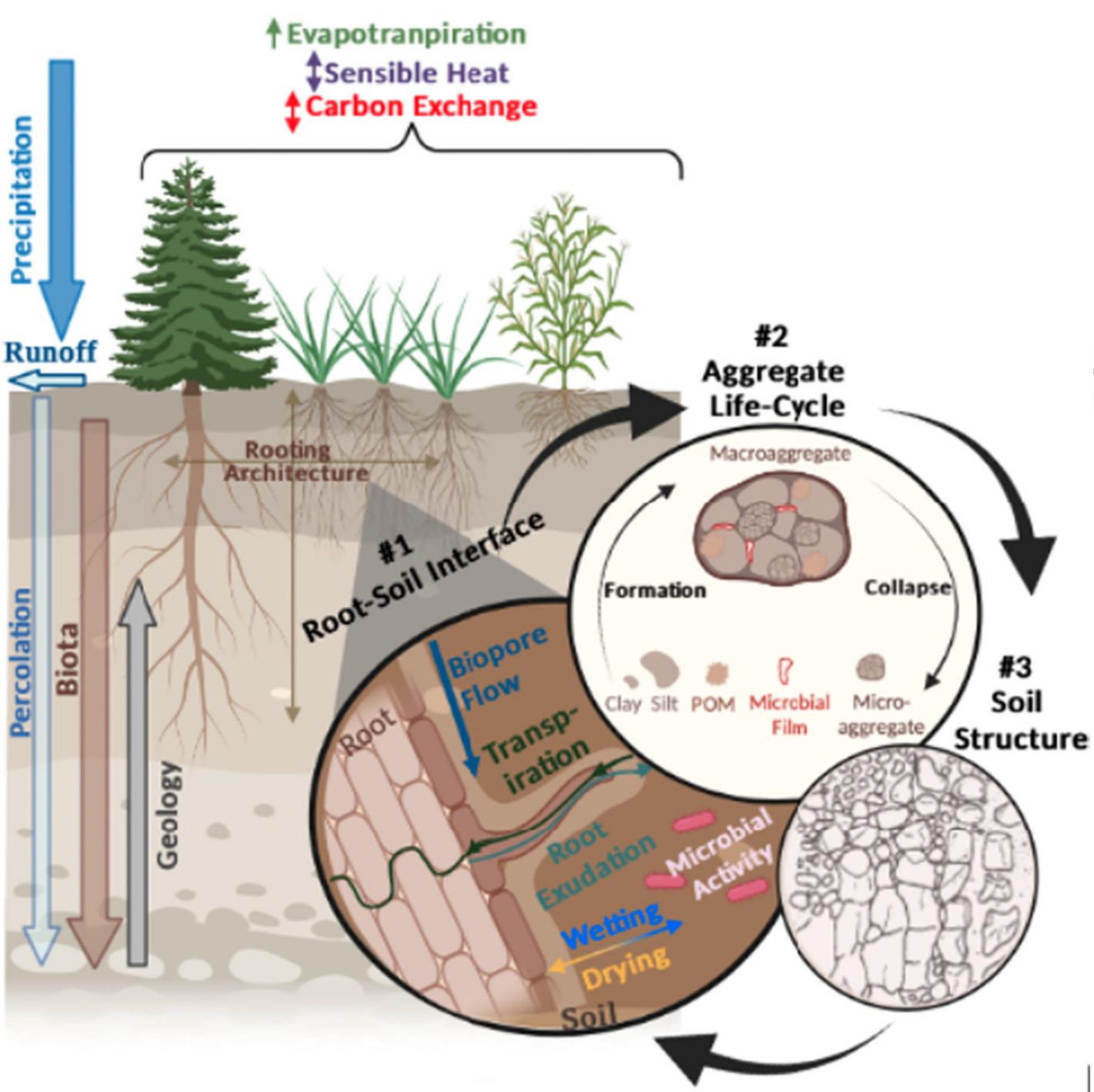
projet IrriLux: “Etude scientifique et son application portant sur les possibilités résilientes d’accès à et d’utilisation d’eau d’irrigation dans l’agriculture / horticulture”. 2022-2025, Financement Gouvernement du Grand-Duché de Luxembourg, coordinateur GxABT.

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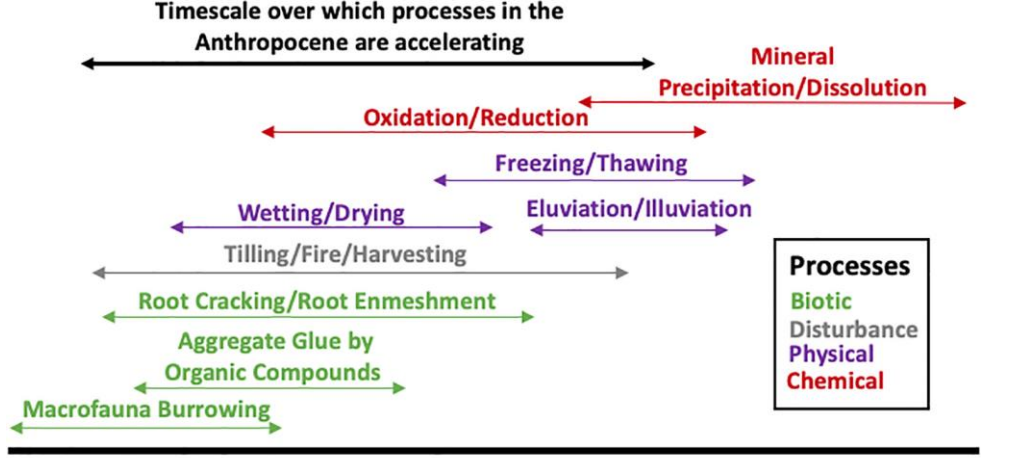
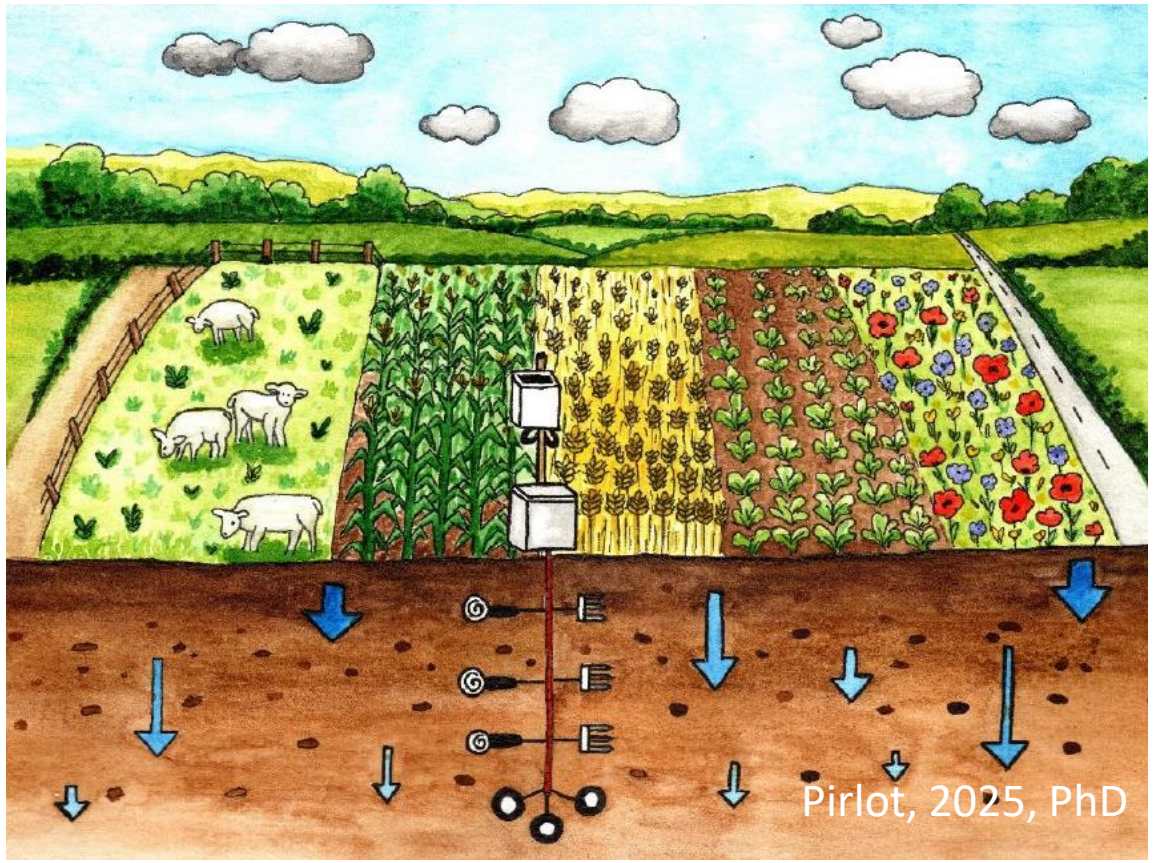



Temporal scale of meaningful influence on soil structure

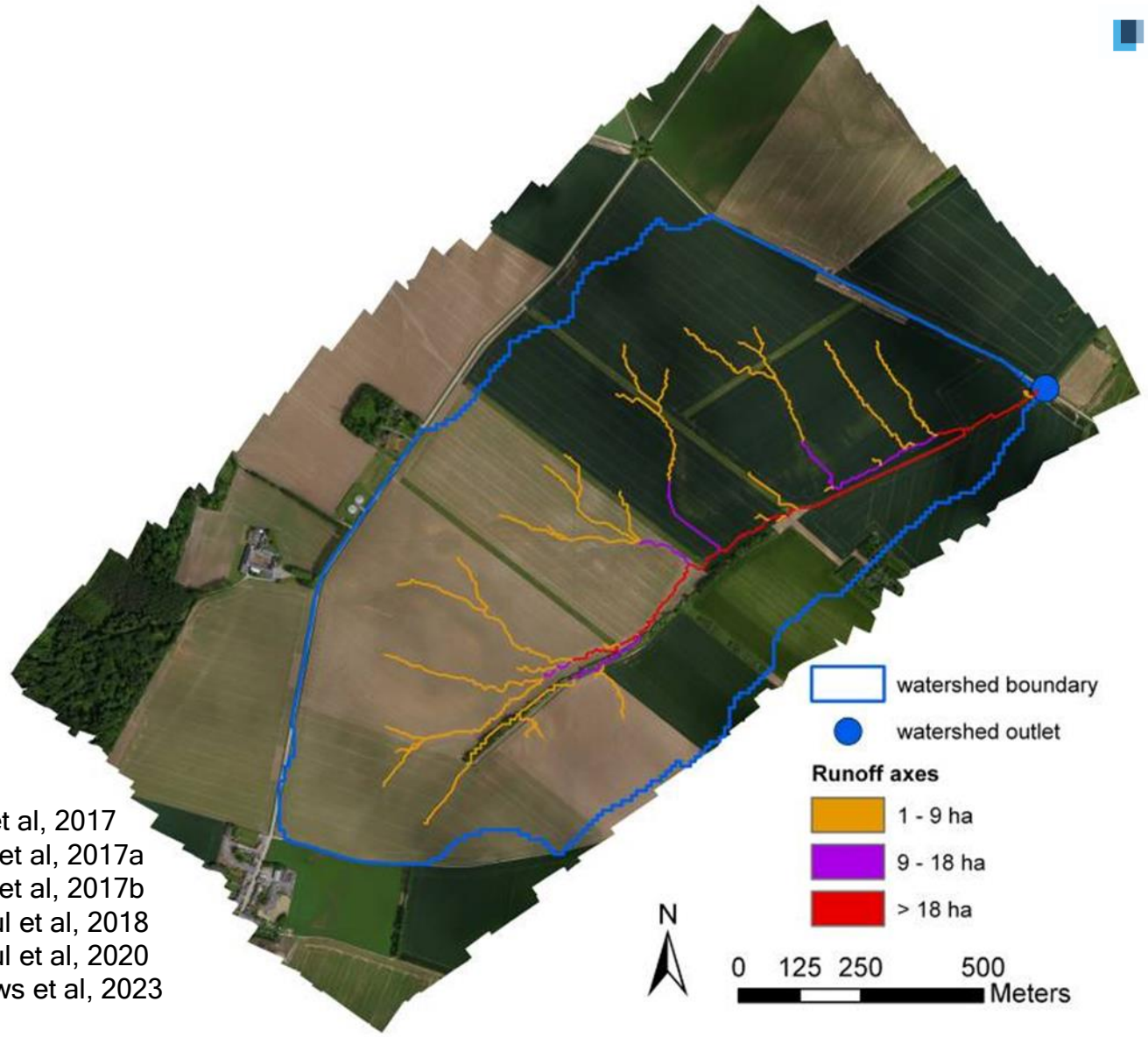


Pirlot, 2025, PhD

# Observations de long terme : Chastre (2012-…)

| vitesse d'infiltration en sol saturé [mm/h] | | Encroutage du sol | | | |
|---|---|---|---|---|---|
| Rugosité | Couverture végétale | F0 | F11 | F12 | F2 |
| R5 | C3 | 75 | | | |
| | C2 | | | | |
| | C1 | | | | |
| R4 | C3 | | 75 | | |
| | C2 | 74 | | | |
| | C1 | 50 | | | |
| R3 | C3 | | | 25 | |
| | C2 | | 18 | | |
| | C1 | 25 | 18 | 15 | |
| R2 | C3 | | | 18 | |
| | C2 | | 18 | 12 | |
| | C1 | 18 | 10 | 9 | 6 |
| R1 | C3 | | 18 | 15 | 10 |
| | C2 | | 14 | 11 | |
| | C1 | 15 | 8 | 6 | 6 |
| R0 | C3 | | 10 | 10 | 4 |
| | C2 | | 8 | 5 | 4 |
| | C1 | | | 6 | 4 |

(Cantreul, 2020, PhD)




Lisein et al, 2017
Pineux et al, 2017a
Pineux et al, 2017b
Cantreul et al, 2018
Cantreul et al, 2020
Matthews et al, 2023

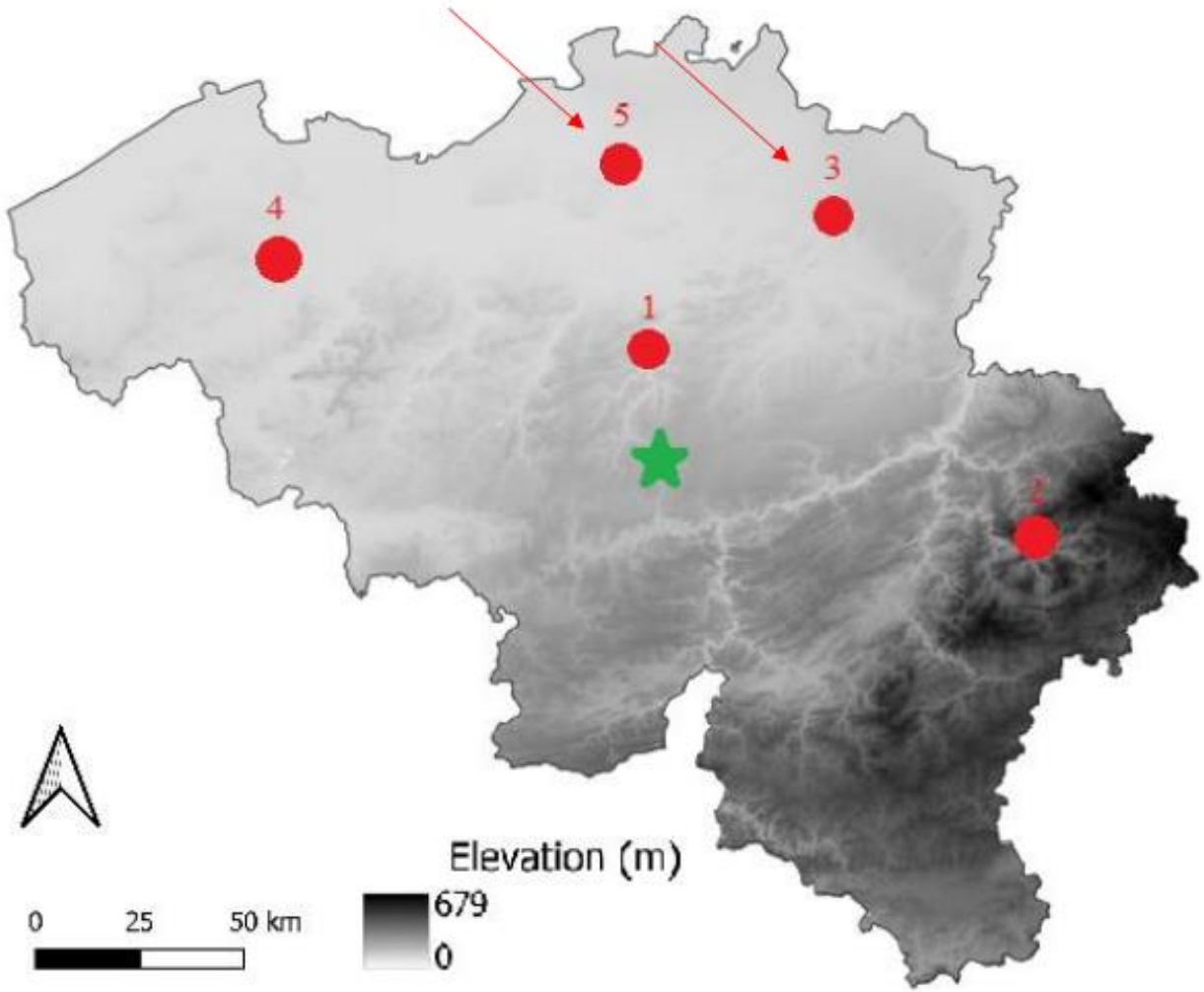
# projet RECARBON

belspo

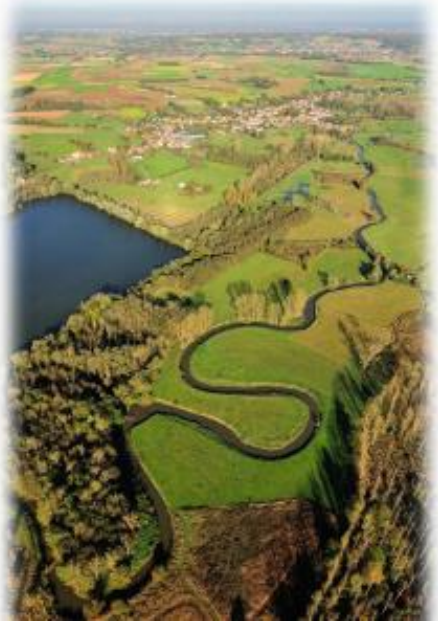
KU LEUVEN

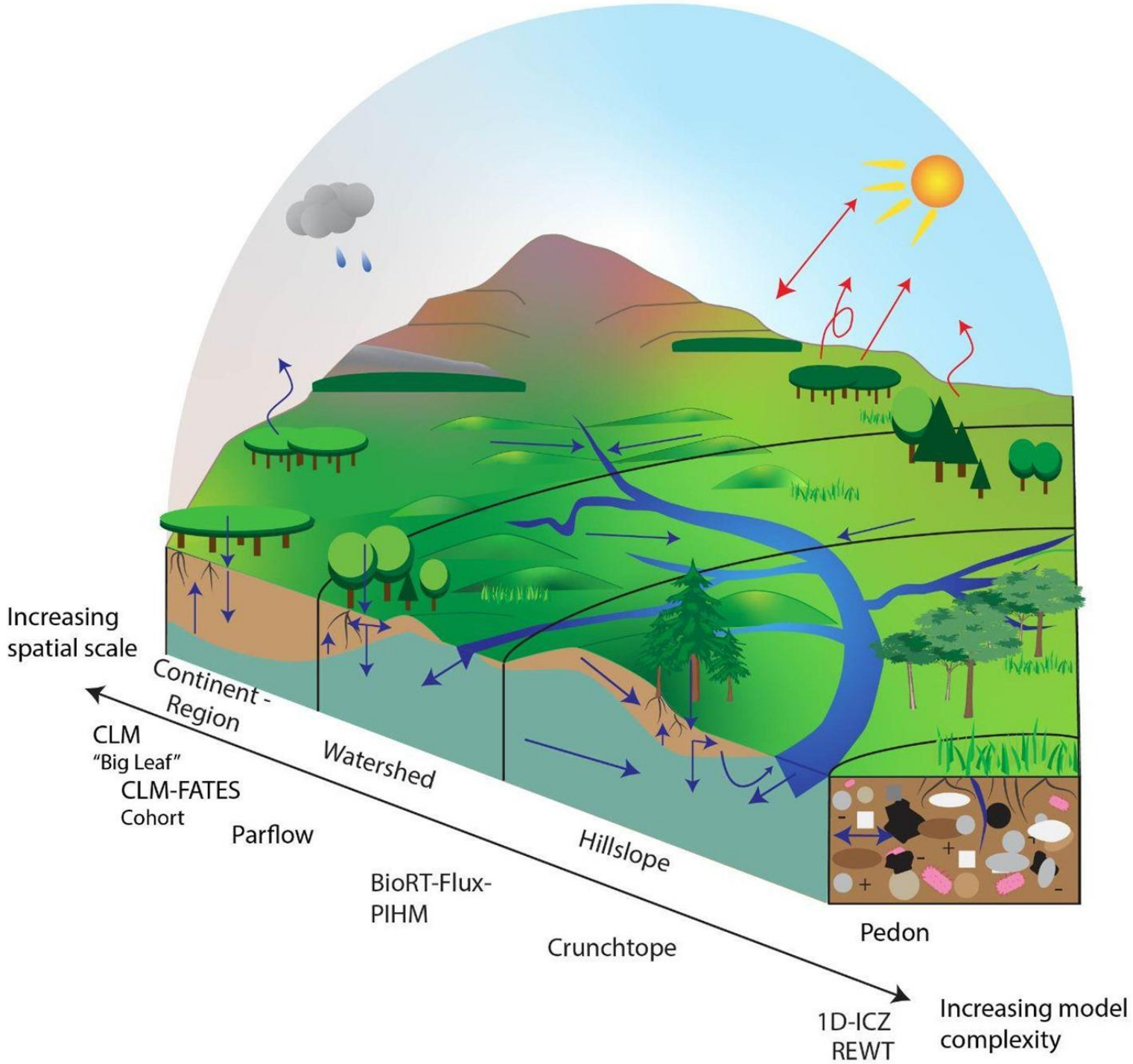
LIÈGE université Gembloux Agro-Bio Tech

INSTITUUT NATUUR- EN BOSONDERZOEK




1. Dyle
2. Amblève
3. **Zwarte Beek**
4. Zeverenbeek
5. **Grote Nete**






Albrechts et al. City Territ Archit (2020) 7:1
https://doi.org/10.1186/s40410-019-0111-2

City, Territory and Architecture

RESEARCH ARTICLE Open Access

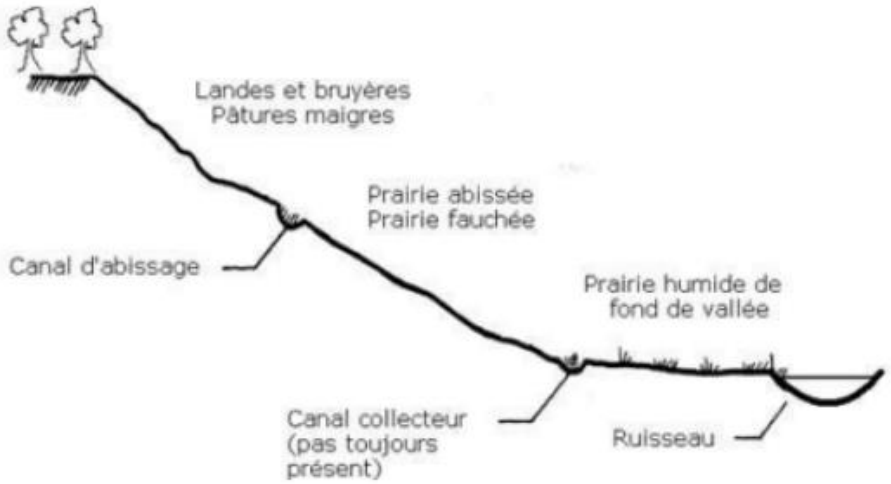
# Practicing transformative planning: the territory-landscape plan as a catalyst for change

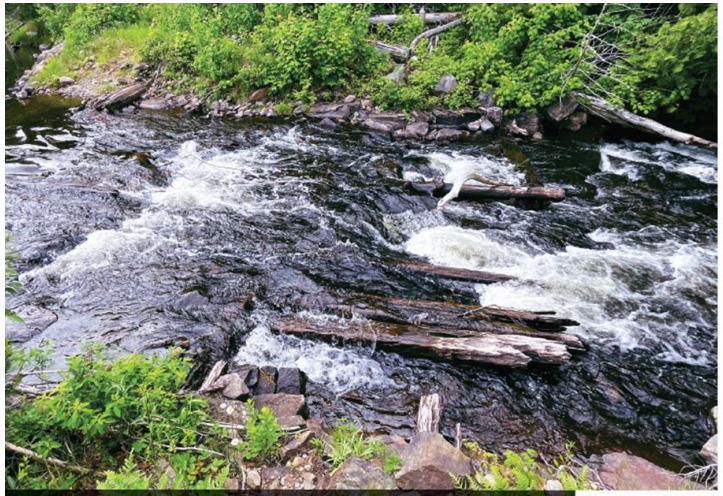
Louis Albrechts[1], Angela Barbanente[2*] and Valeria Monno[2]

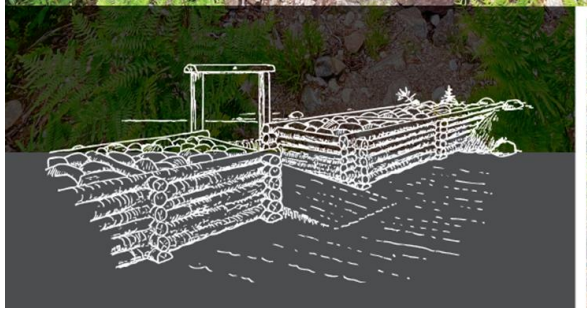
**Abstract**

This paper advocates the need for transformative planning practices to cope with contemporary crises of climate change and intensifying economic inequality that regions, city-regions, and cities are increasingly confronted with. In-depth examination of planning processes is useful to grasp some crucial promises and problems of transformative planning and open up new possibilities for practice. Accordingly, the paper includes an investigation into the Territory-Landscape plan-making process developed in the Apulia region, Italy. This explicitly and intentionally aimed at promoting a radical discontinuity in regional planning culture and practice by changing the well-established relationship between territory-landscape protection and spatial planning. The process revealed that 'landscape' could function as a constructive picklock for proposing an alternative to the development-as-growth model firmly entrenched in the region, and envisioning desirable futures focused on the concept of 'local self-sustainable development'. This implies subverting the hegemony of the 'economic' that has reduced dwellers to consumers, and the territory to a mere physical support for any kind of land transformation and urban development which exclude dwellers participation. Using the lens of transformative theory and building on an interpretive research approach that included also direct experience, the paper provides insights on changes in vision and concepts, discourses and practices, approach and instruments experienced in such a planning process. In conclusion, it reflects on lessons learned, and highlights some difficulties and contradictions with which the way towards transformative planning is paved for researchers engaged in turning their ideas into significant achievements in the real world.

**Keywords:** Transformative planning practices, Territory-landscape, Situated planning processes, Self-sustainable local development, Planning vision and concepts





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LIÈGE université Gembloux Agro-Bio Tech
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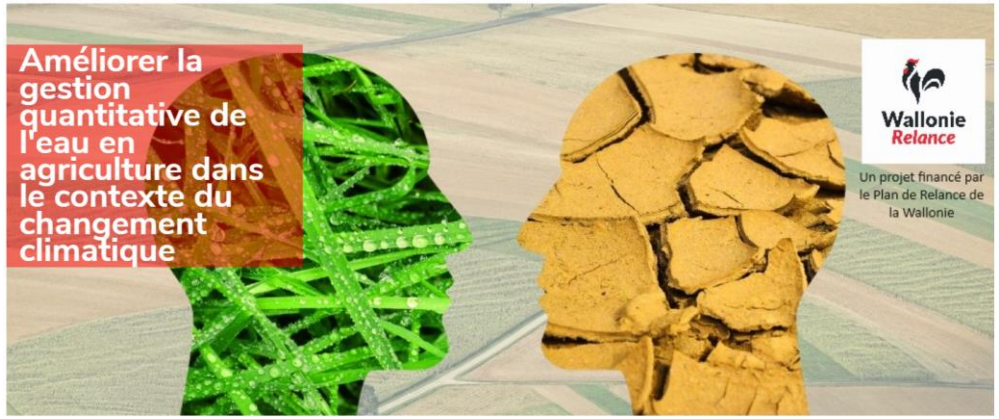
UQAR



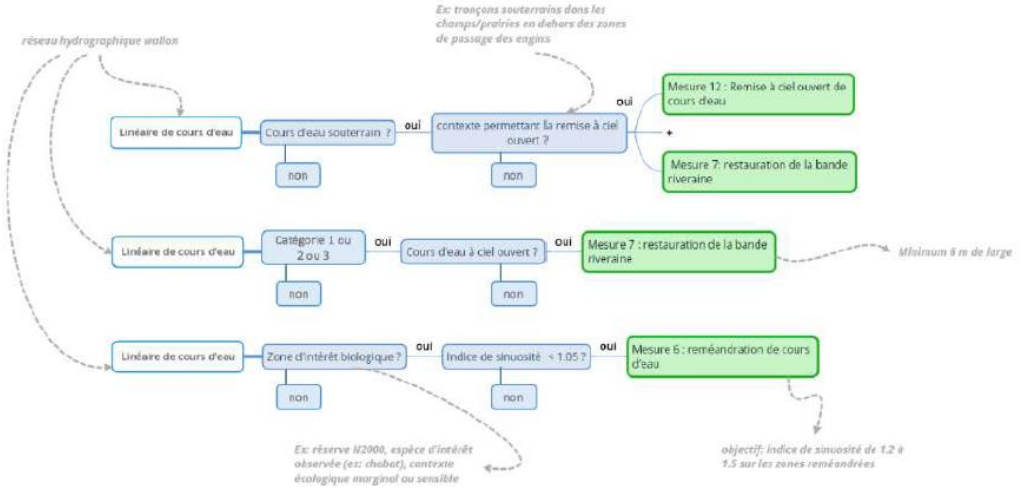



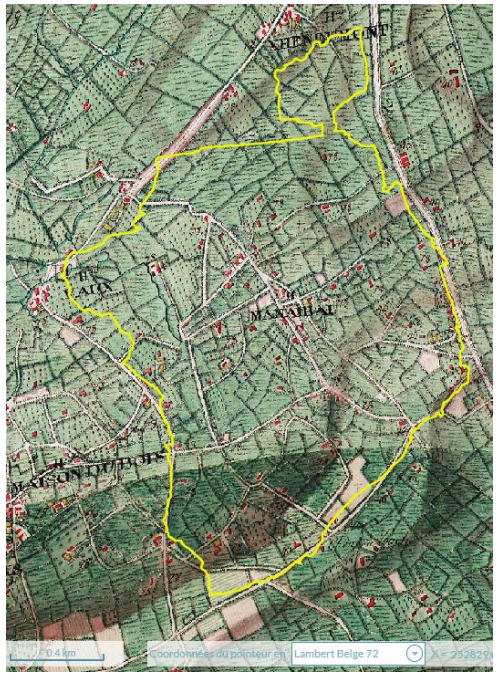

***Figure 1** : Arbre de décision pour les linéaires de cours d'eau.*
*Source : TER-Consult (2024).*

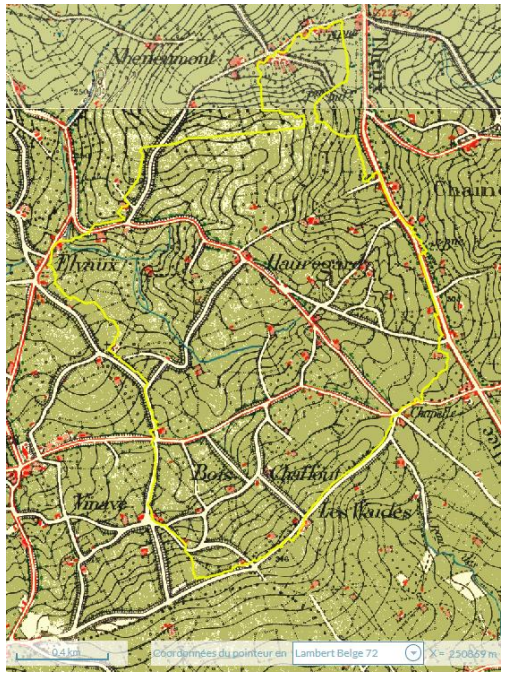

Projet DAFOR

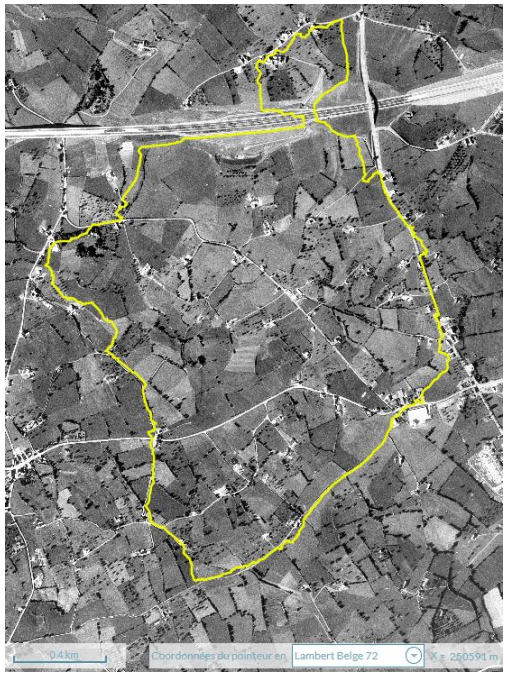
- Keylines (fossé suivant courbes de niveau)
- Reméandration du cours d'eau
- Détournement du fossé
- Plantation de haies
- Restauration de prairie alluviale
- Restauration de forêt alluviale
- Restauration de la bande riveraine
- Découpage parcellaire selon les keylines
- Implantation de fossés infiltrants et de noues

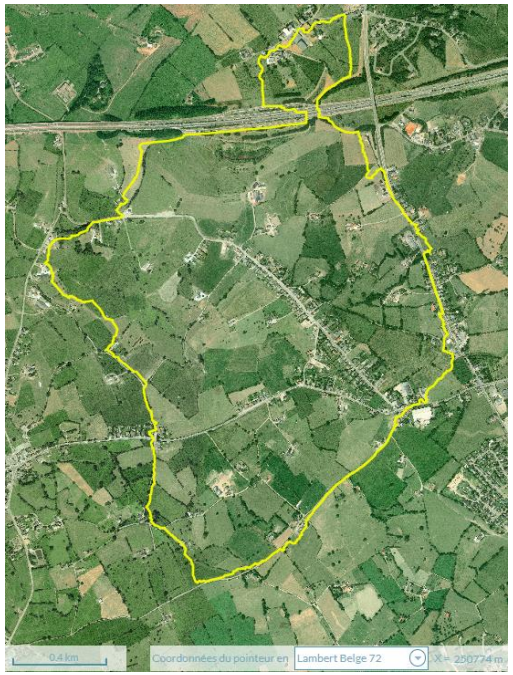
# Manaihant-Ourcy
# Co-construire un paysage d'avenir

1771 | 1865 | 1971 | 1994 | 2006



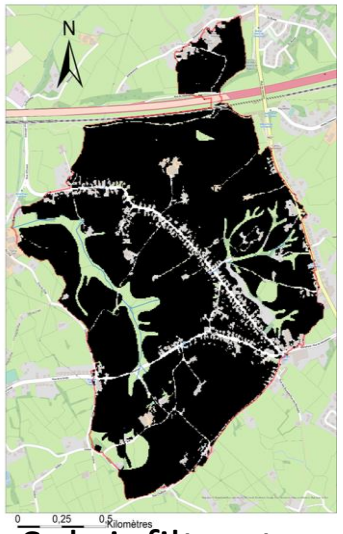





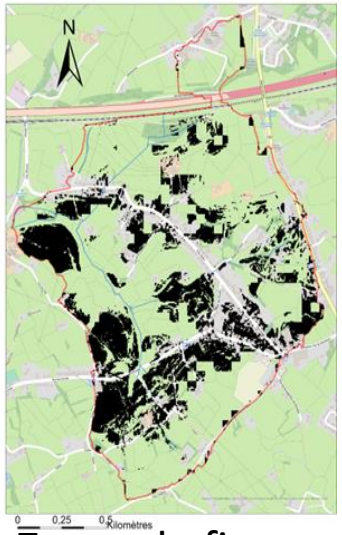
Changement du parcellaire, reduction des haies, drainage artificiel

Développement des infrastructures et urbanisation

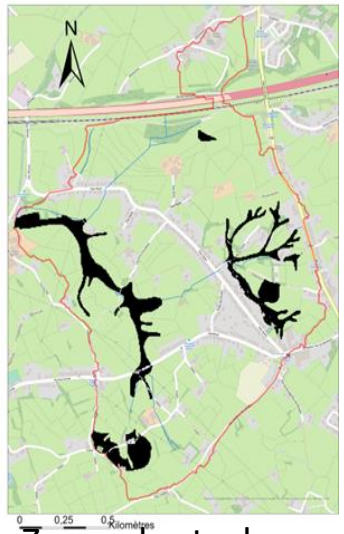
# Imaginer… avec réalisme



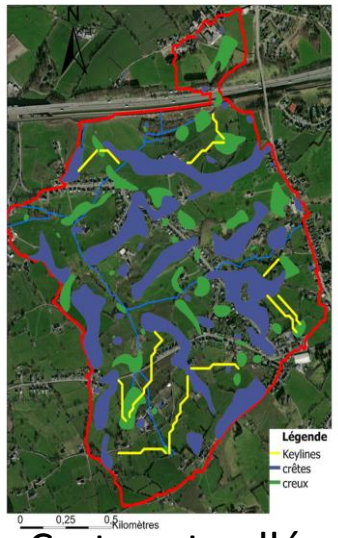

Sols infiltrants



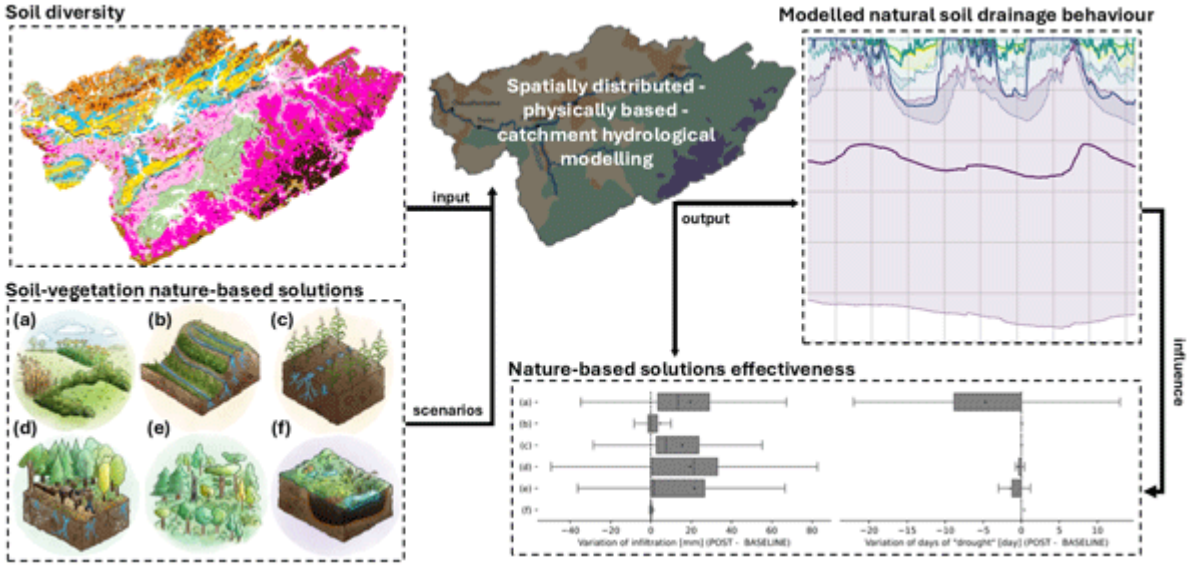

Zones de fissures



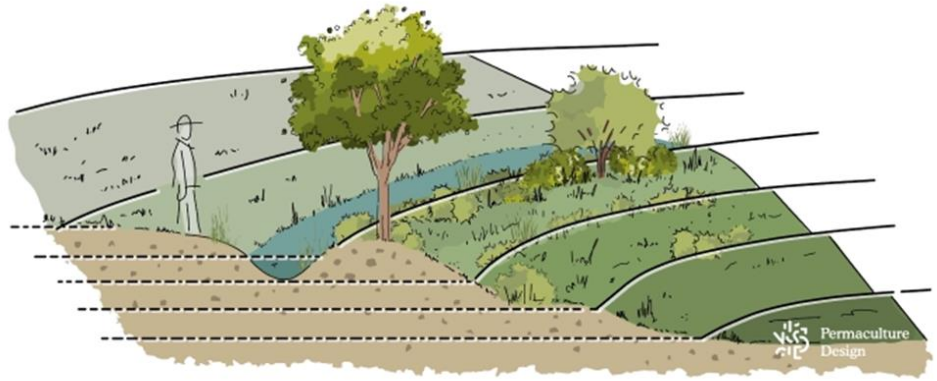

Zones de stockage

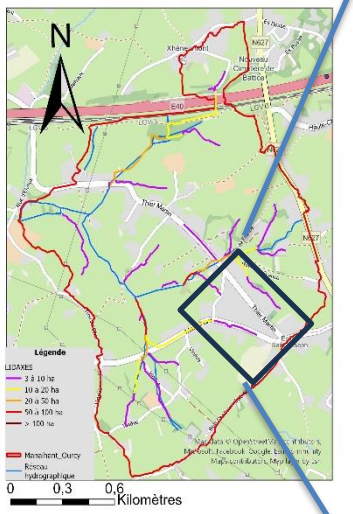


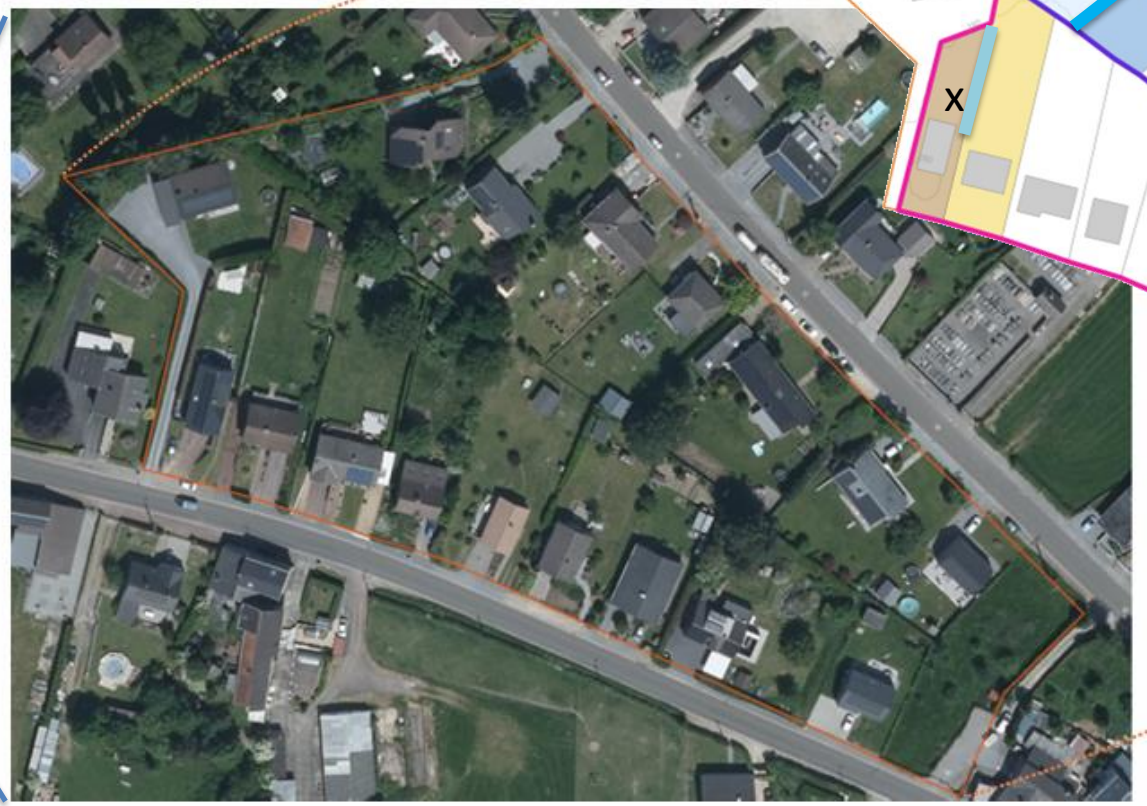

Cretes et vallées

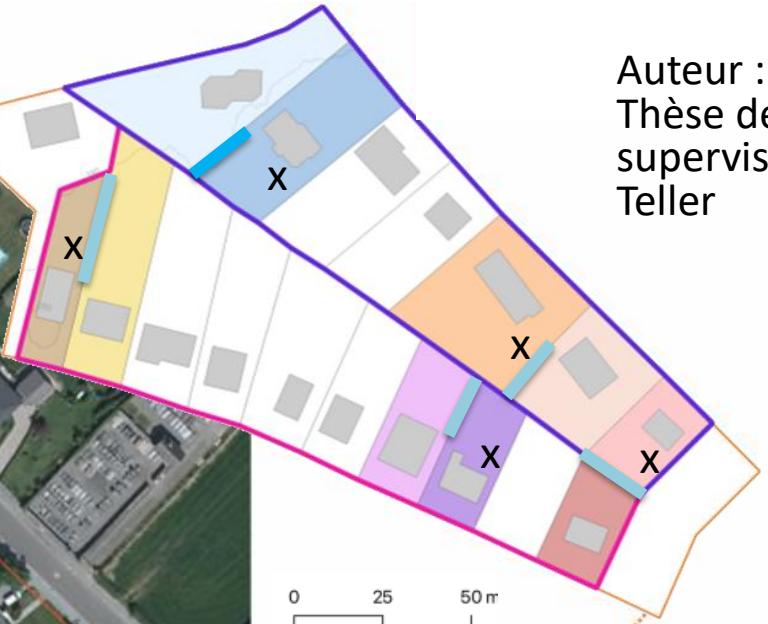




Guillaume et al., 2025





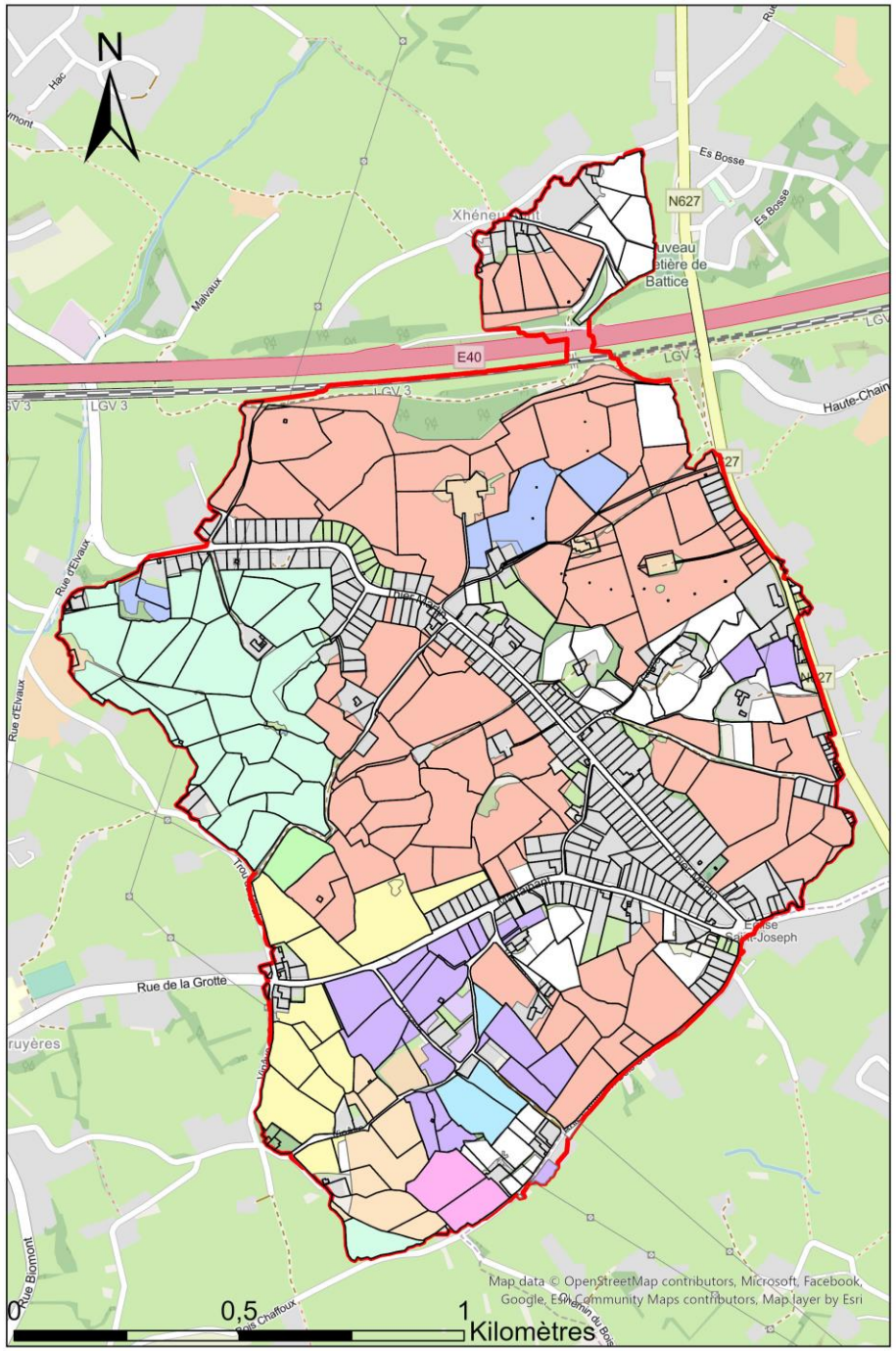



Auteur : Clotilde Bourdoux
Thèse de master sous la supervision de Pr. Jacques Teller

| | |
|---|---|
| | Noue d'infiltration à front de voirie |
| | Noue en copropiété |
| X | Bassin sec |

# Manaihant-Ourcy
# Co-construire un paysage d'avenir


Illustration sur photo : Guillaume Debue



# Et si?
# 2030 : La Wallonie suit l'exemple du Danemark

Reuters World Business Markets Sustainability Legal Breakingviews Technology Investigations More

## Denmark to convert 15% of farmland to forest to cut fertilizer use

By **Reuters**

November 18, 2024 12:33 PM GMT+1 · Updated 4 months ago

COPENHAGEN, Nov 18 (Reuters) - Denmark will convert 15% of its farmland into forest and natural habitats in an effort to reduce fertilizer usage, which has resulted in severe oxygen depletion in Danish waters as well as the loss of marine life, lawmakers said on Monday.

Denmark, among the most intensively cultivated countries in the world with almost two-thirds of its territory farmed, set aside 43 billion Danish crowns ($6.1 billion) to acquire land from farmers over the next two decades.

> *"I would not hesitate to call this a historic achievement. With this agreement, we are now allocating EUR 5.76 billion to carry out a significant transformation of Denmark's land use. Danish nature will be changed in a way not seen since the drainage of wetlands in 1864. Denmark will become the first country in the world to introduce a CO2e tax on agriculture. And with the new agreement, we are launching an ambitious nitrogen reduction effort to ensure the return of fish to our coasts and fjords."*
>
> *Jeppe Bruus, Denmark's Minister for Green Transition*

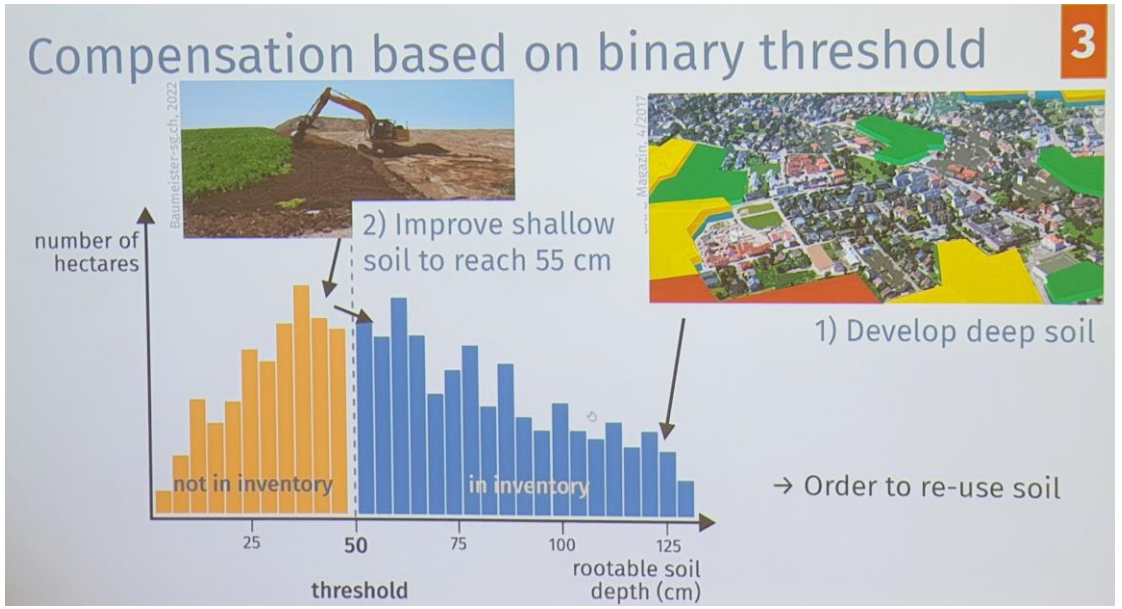
*-- Ceci est une fiction… ou pas? --*

# Et si?
# 2030 : La Wallonie suit l'exemple de la Suisse

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

**Office fédéral de l'environnement OFEV**

**Sa gestion des sols n'étant pas durable, la Suisse perd des opportunités de produire des denrées alimentaires et de l'eau potable, d'utiliser des espaces pour des activités de loisirs, de réduire ses émissions de gaz à effet de serre, de préserver la biodiversité ou de lutter contre l'intensification des fortes chaleurs. Si la croissance urbaine s'est quelque peu ralentie grâce au développement urbain vers l'intérieur, l'imperméabilisation des sols s'est quant à elle accélérée de nouveau au cours de la dernière décennie. Par ailleurs, des sols sont encore compactés et chargés de polluants, et d'autres s'érodent.**




*-- Ceci est une fiction … ou pas? --*

# Et si?
# 2030 : la Wallonie suit l'exemple des Pays-Bas?


*Wipproject in Malburgen*



*-- Ceci est une fiction … ou pas? --*

# Et si ?
# 2030 : la Wallonie suit l'exemple de la Biovallée (F)

## Une association au service du territoire

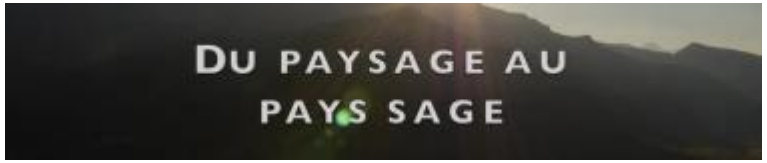
L'association Biovallée s'inscrit dans la continuité d'une longue histoire locale. Depuis mai 2012, elle oeuvre à **soutenir** et **valoriser** les initiatives locales au service de la **transition écologique et sociale**, à en **impulser** de nouvelles pour atteindre collectivement les objectifs de la Biovallée. Télécharger les orientations stratégiques 2023/24 et le rapport d'activité 2023.

> **L'association Biovallée stimule la coopération entre et au service des acteurs qui s'engagent pour une transition écologique et sociale du territoire.**

Comment le vivant peut-il guider la régénération des territoires ?

territory lab
Recherche-Action-Transmission

AGORA
DE LA BIO-INSPIRATION TERRITORIALE




*-- Ceci est une fiction … ou pas? --*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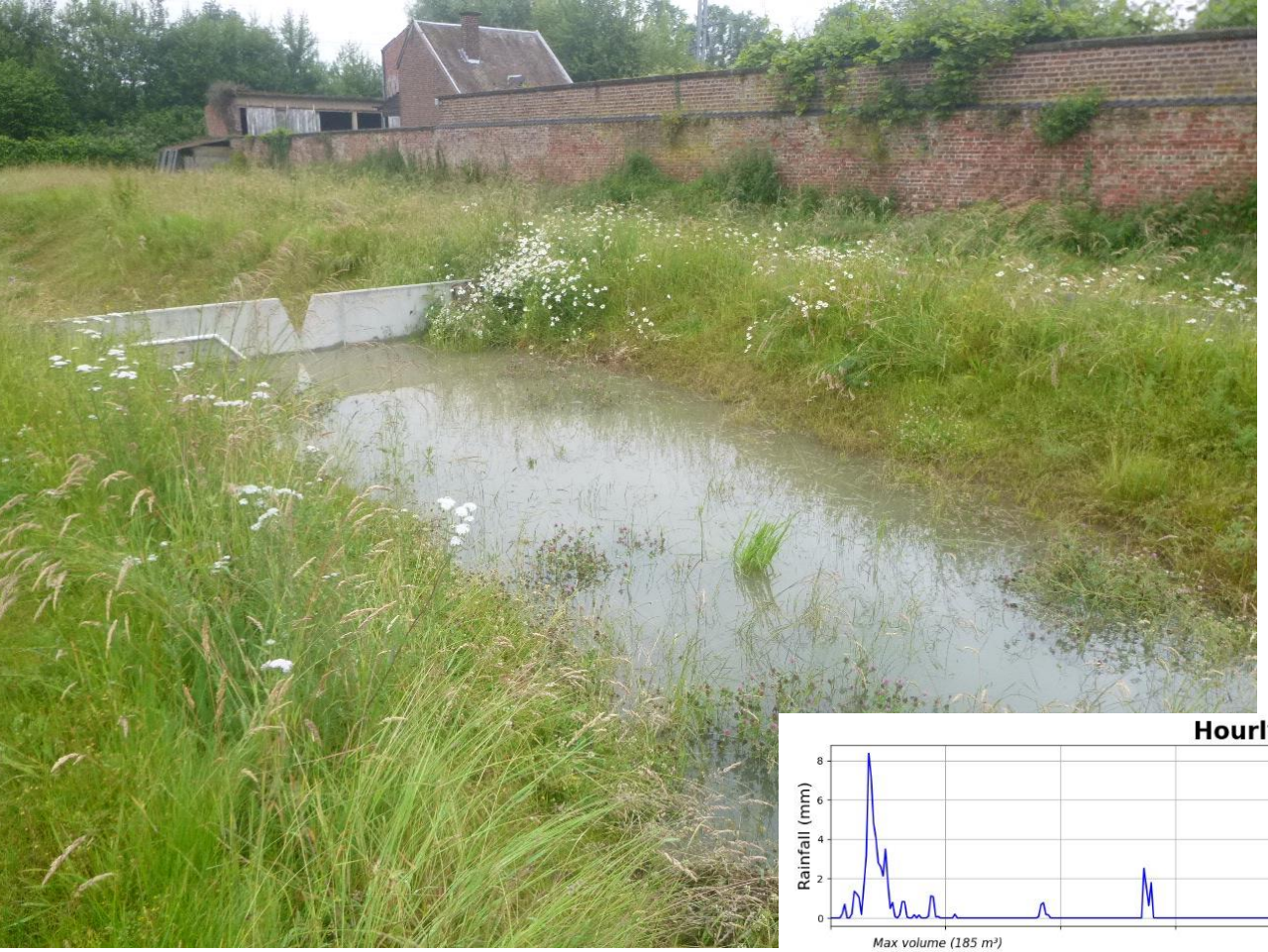
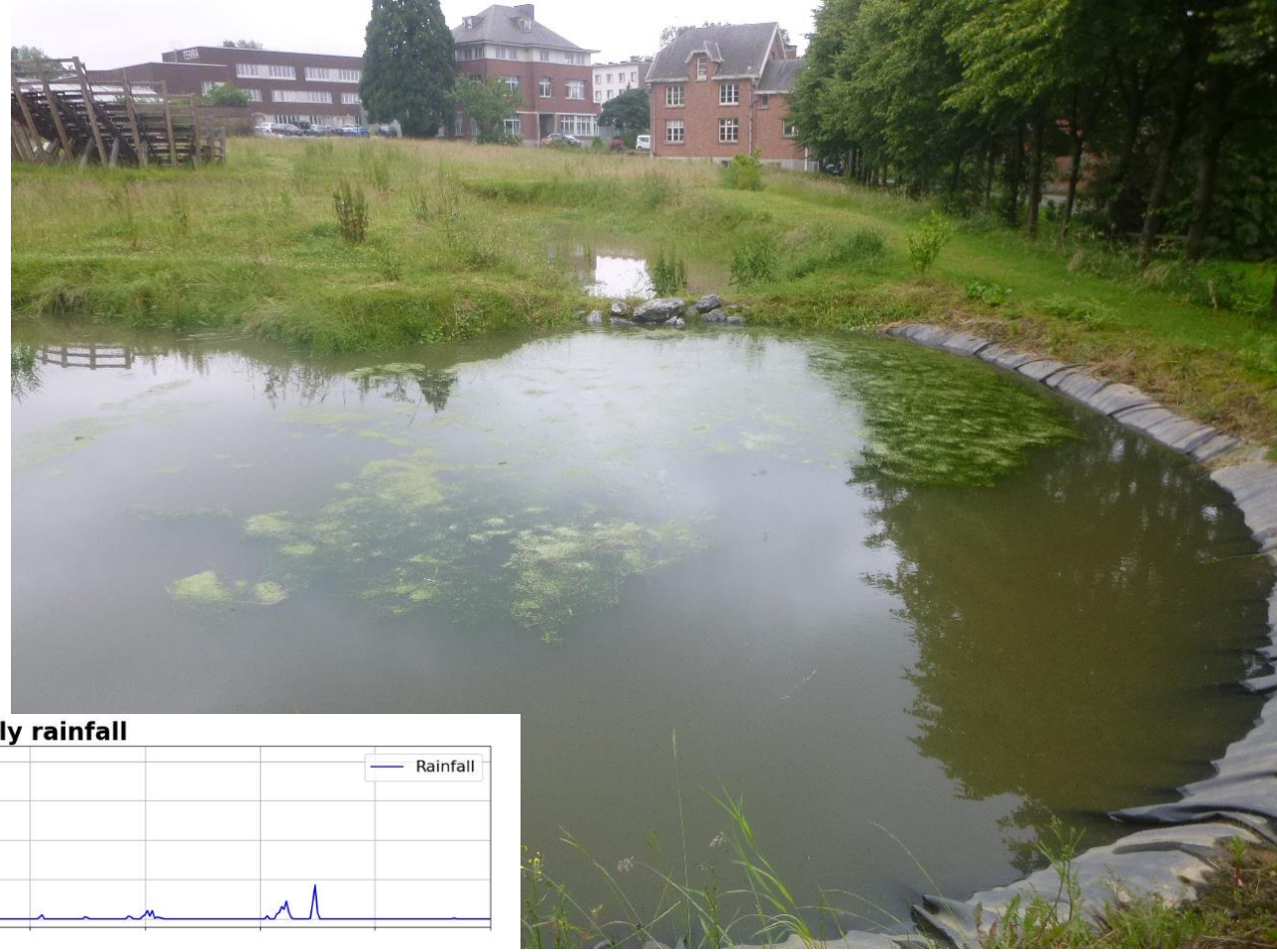
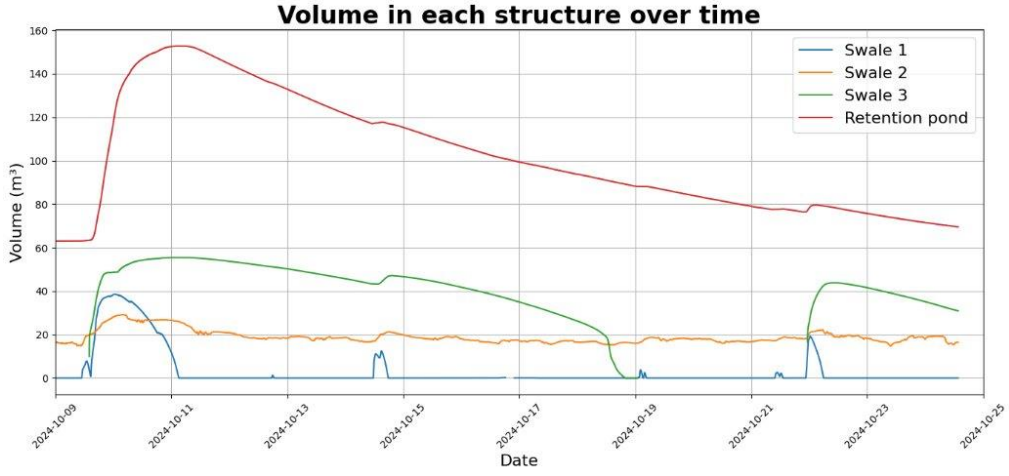
SPGE
Société Publique de Gestion de l'Eau






Hourly rainfall
Rainfall
Rainfall (mm)
0
2
4
6
8
Max volume (185 m³)

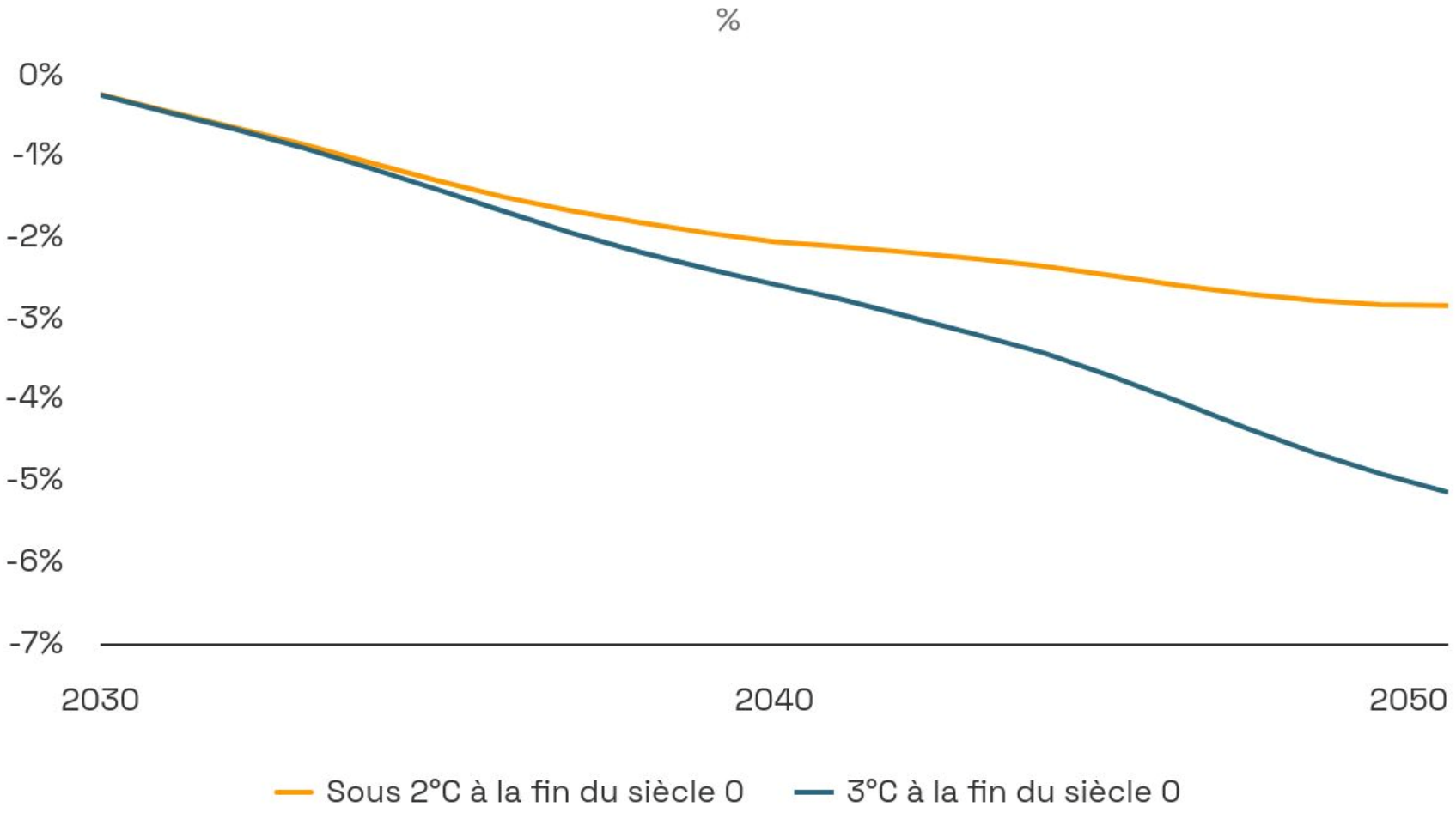



Volume in each structure over time
Swale 1
Swale 2
Swale 3
Retention pond
Volume (m³)
0
20
40
60
80
100
120
140
160
2024-10-09
2024-10-11
2024-10-13
2024-10-15
2024-10-17
2024-10-19
2024-10-21
2024-10-23
2024-10-25
Date

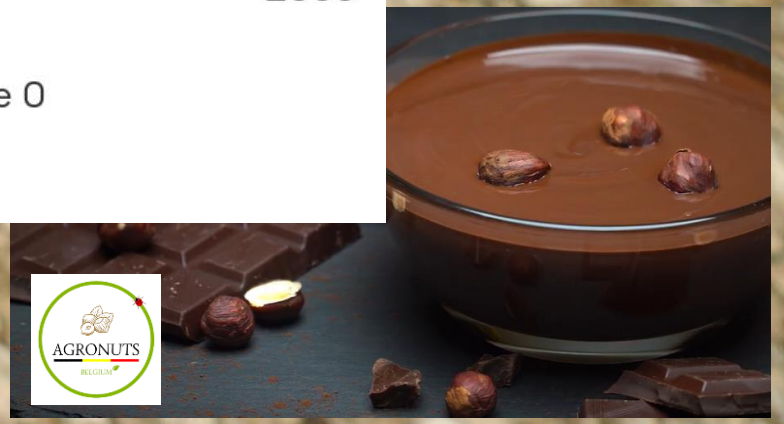

GRAINES CURIEUX
Avoine
GRAINES CURIEUX
Quinoa
GRAINES CURIEUX
Huile de Colza
so wood
KOMBUCHA
AGRONUTS
BELGIUM



## Impact sur le niveau du PIB




Source: Modélisation BFP basée sur les estimations du NGFS et de Kotz et al. 2024



HYDROLOGIE RÉGÉNÉRATIVE - BELGIQUE -

AGRO GEMBLOUX

L’Equipe du moment!

# Merci!

LIÈGE université
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# Façonner des territoires d'avenir : l'eau, les sols et le temps

Aurore Degré

EESP - 30 septembre 2025