

Les rivières intermittentes et cours d'eau éphémères: un challenge pour l'écologie et la gestion

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INRAE

**SMI
RES**

Science and Management
of Intermittent Rivers
and Ephemeral Streams

COST
EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

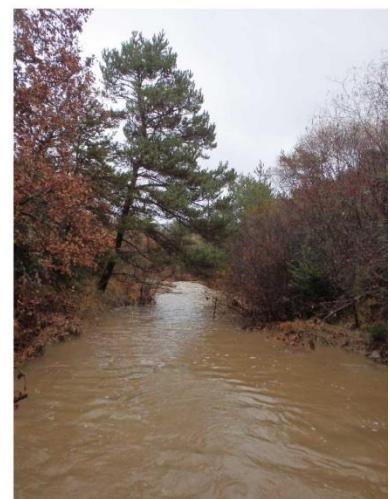
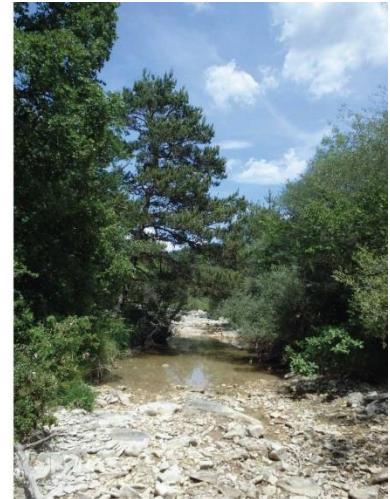
Quelques définitions

Rivières = plus large/profonde que les ruisseaux, même si la distinction est floue

Ephémère = durée plus courte et prévisibilité plus faible de l'écoulement que pour les intermittents, mais là aussi, distinction floue

IRES = pour refléter la forte variabilité des systems non-périennes

Assèchement: arrêt de l'écoulement avec des mouilles déconnectées ne surface et/ou assèchement complet du lit



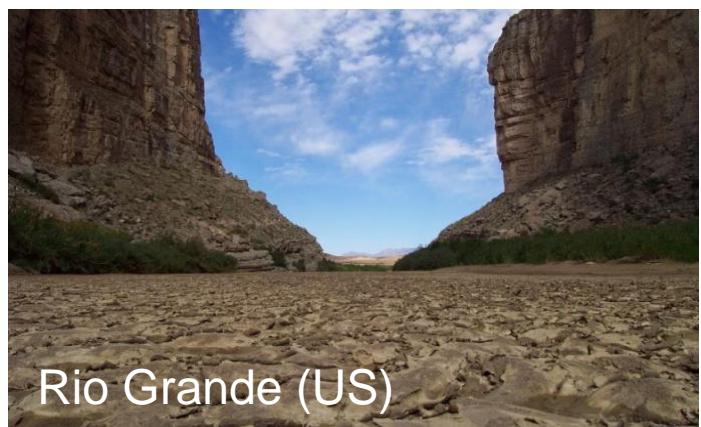
Calavon River, Southern France, B Launay

Naturellement prévalentes

McMurdo Valley (Antarctica)



Rio Grande (US)



Wind In the Willow (UK)



Manganui (NZ)



Danube (Germany)

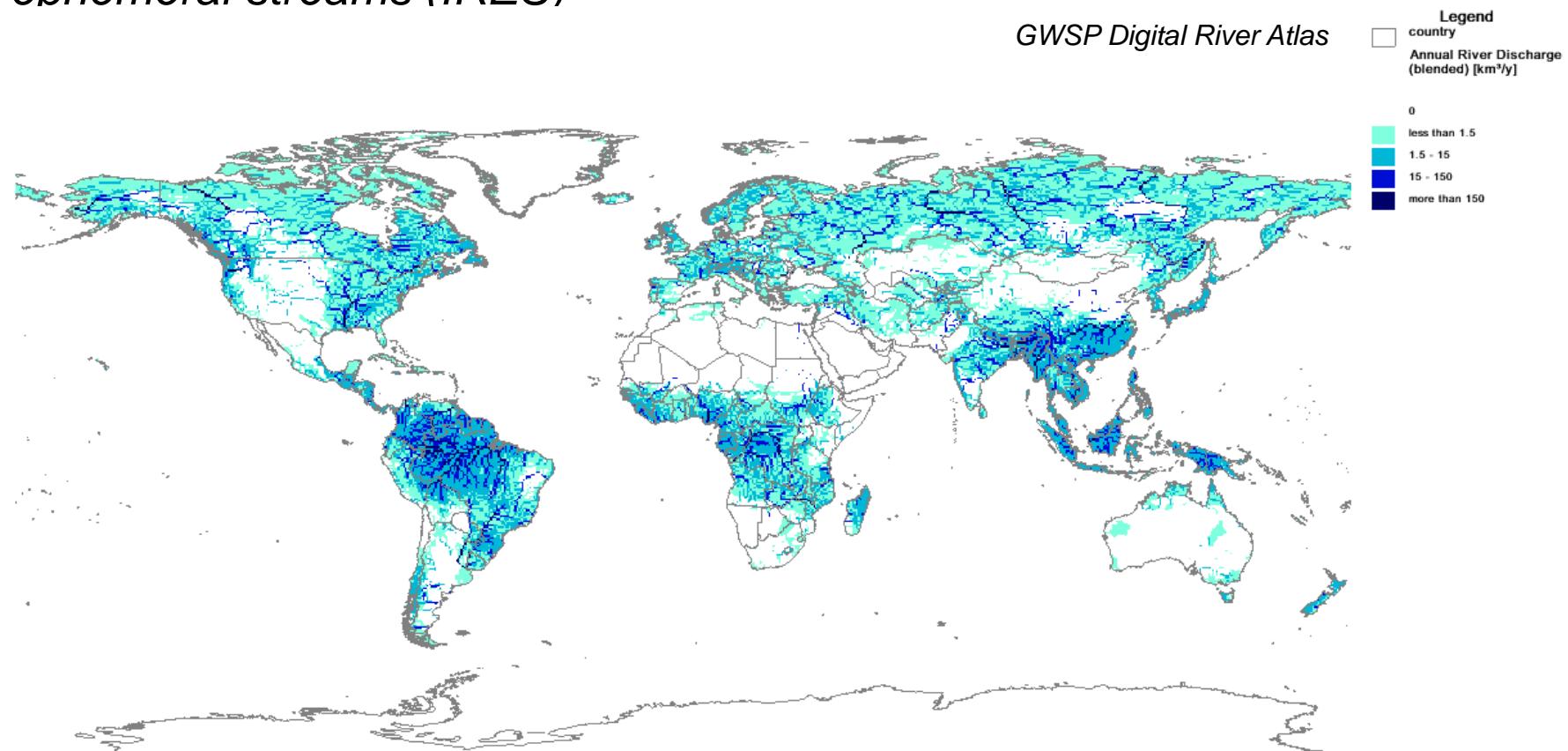


Tete (Mozambique)



Naturellement prévalentes

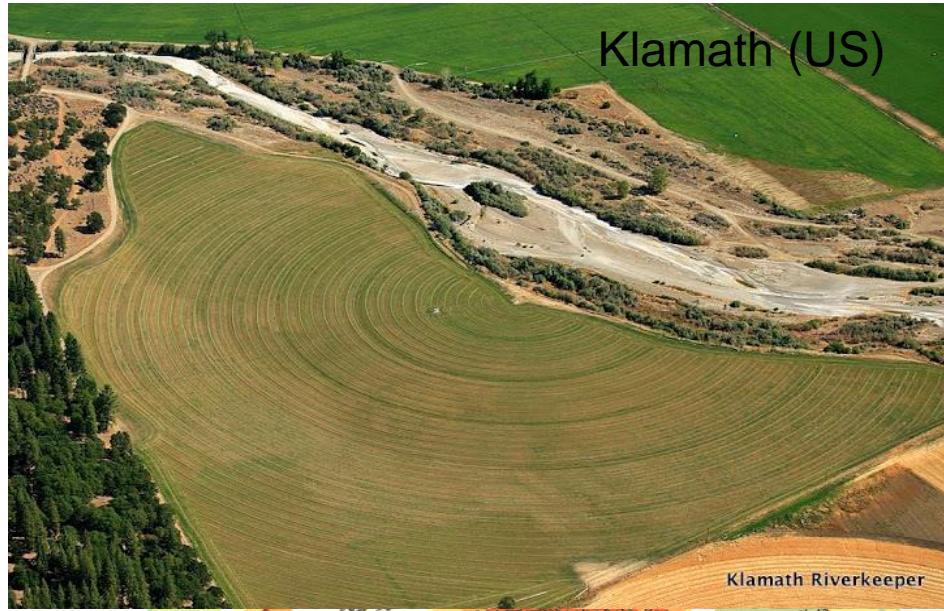
Half of the global river network is composed of intermittent rivers and ephemeral streams (IRES)



Datry, T., Larned, S. T., & Tockner, K. (2014). Intermittent rivers: a challenge for freshwater ecology. *Bioscience*, 64 (3): 229-235.

Et de plus en plus abondantes

In all regions facing drying trends due to climate change



In all regions where water needs are increasing



Et de plus en plus abondantes

Indus (Pakistan)



Mekong (Thailand)



Colorado (US)



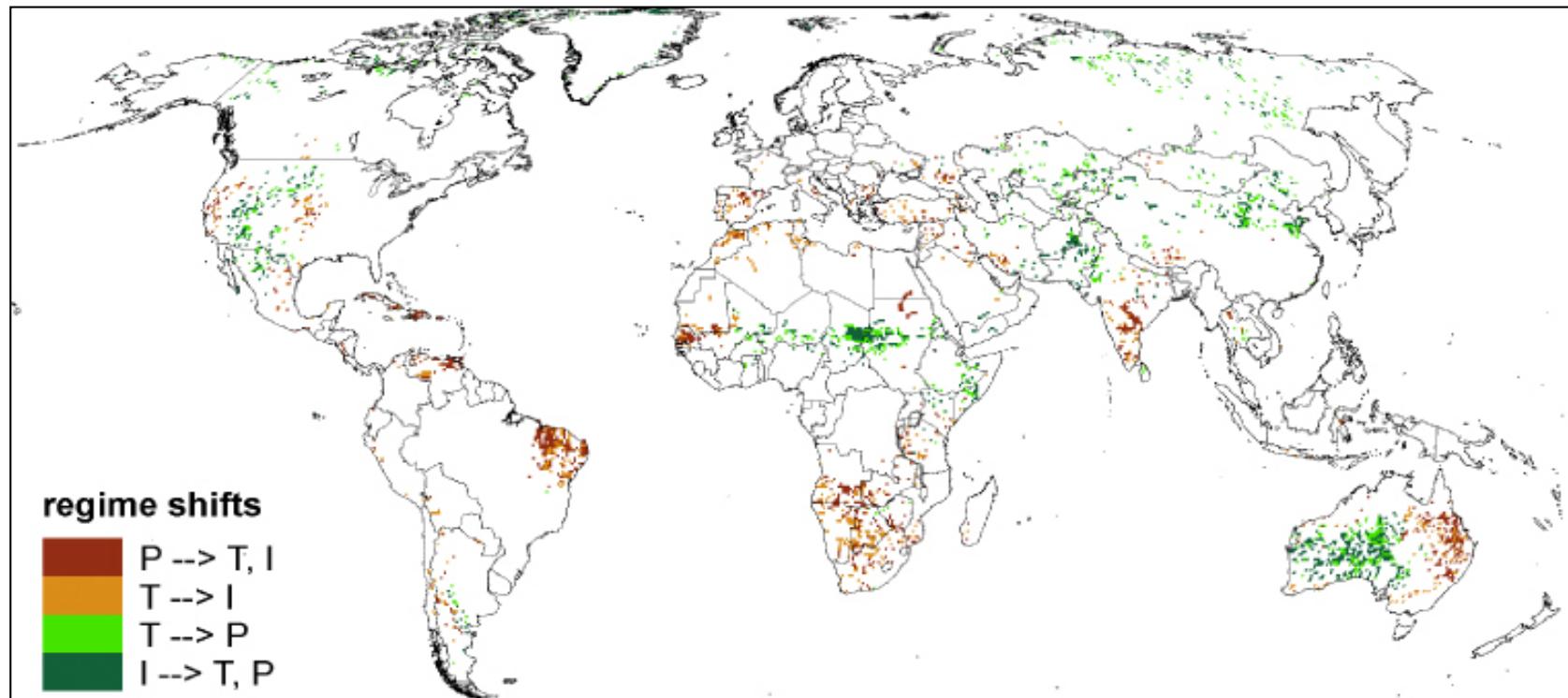
Amu Darya (Uzbekistan)



In the recent history, more than 7 of the world largest rivers have become intermittent

Et de plus en plus abondantes

IRES are expanding in some areas due to climate change and over-abstraction and decreasing in others due to artificial flow perenialisation



Regime shifts among perennial (P), transitional (T) and intermittent (I) river flow regimes occurring between 1961–90 and 2041–70 due to climate change (as computed with WaterGAP, climate scenario HadCM3 A2). Döll & Schmied 2012.

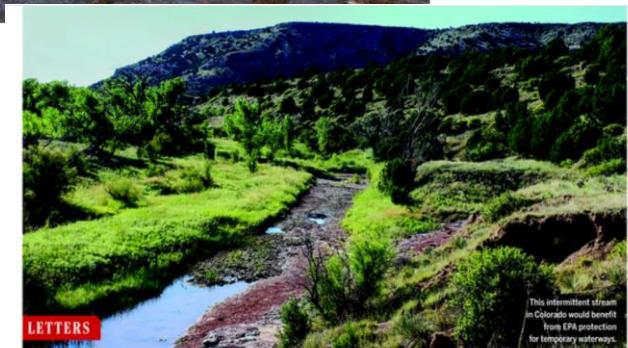
Et des conséquences de plus en plus dramatique



NEWS

River dispute raises Bolivia-Chile tensions

Bolivia has accused Chile of establishing a military base near their common frontier and a disputed river. Chile denies the charge as tensions ratchet up between the South American countries.



Edited by Jennifer Sills

Protecting U.S. temporary waterways

Protecting the ecological health of rivers relies on maintaining intact flows from the headwaters to downstream navigable waters (1). Yet, the U.S. Environmental Protection Agency (EPA) intends to rescind legal protection of tributary rivers, streams, and wetlands that do not have year-round flows (temporary waterways) and whose surface waters contribute flow

to modify the definition of “waters of the United States” to include temporary water hydrologically connected to navigable waters. This provided protection to many temporary waterways under the U.S. Clean Water Act and was hailed as a wise, well-informed decision (4). However, the recodification has not yet been implemented because the legal process is incomplete, and now reversal of the decision is expected (2).

We urge the EPA to uphold its 2015 decision and to ratify the legal status and protection of temporary waterways. This would provide 11% more waterways

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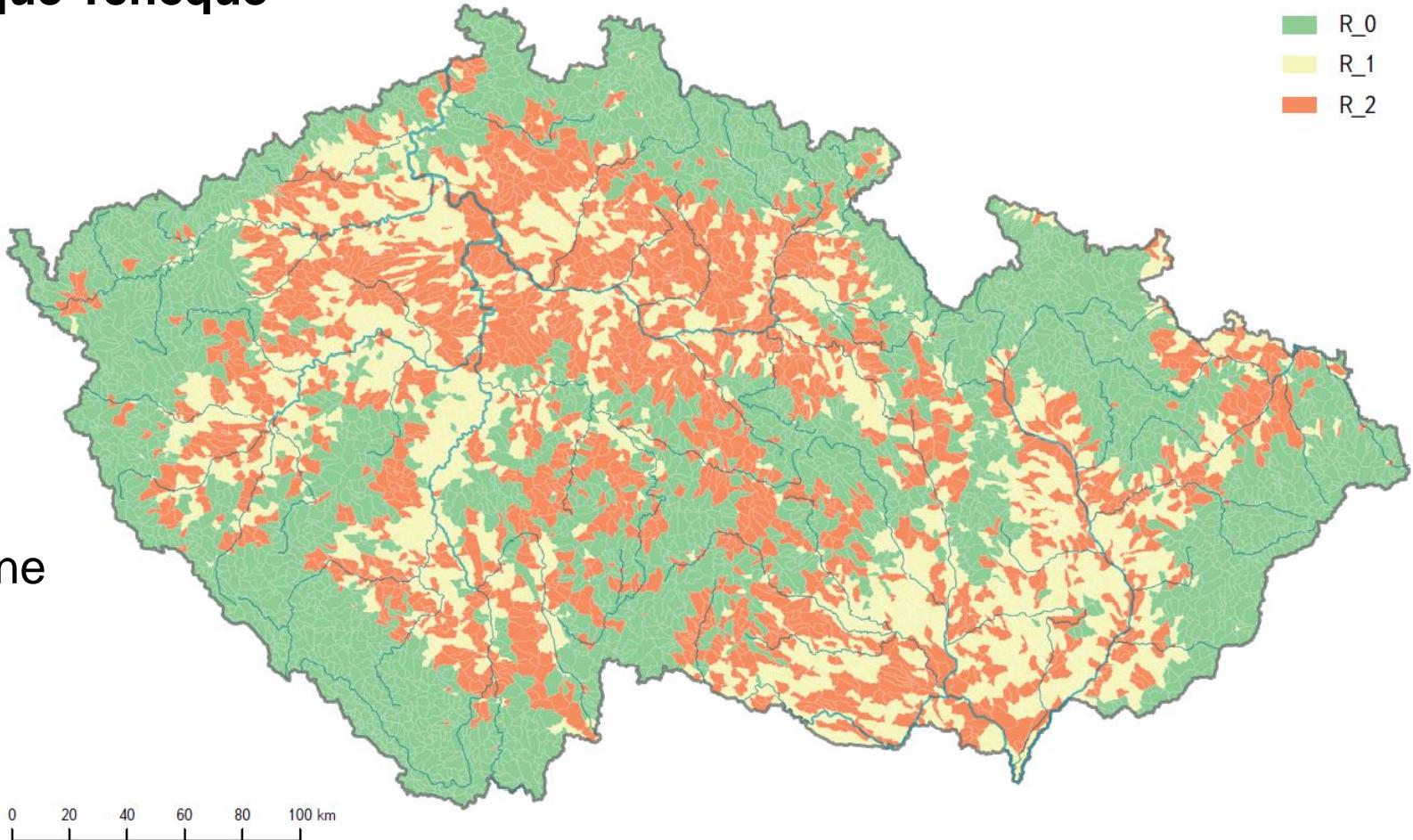
IRES sont souvent perçues comme anecdotiques en Europe



Photo: N. Bonada

Pourtant....

République Tchèque



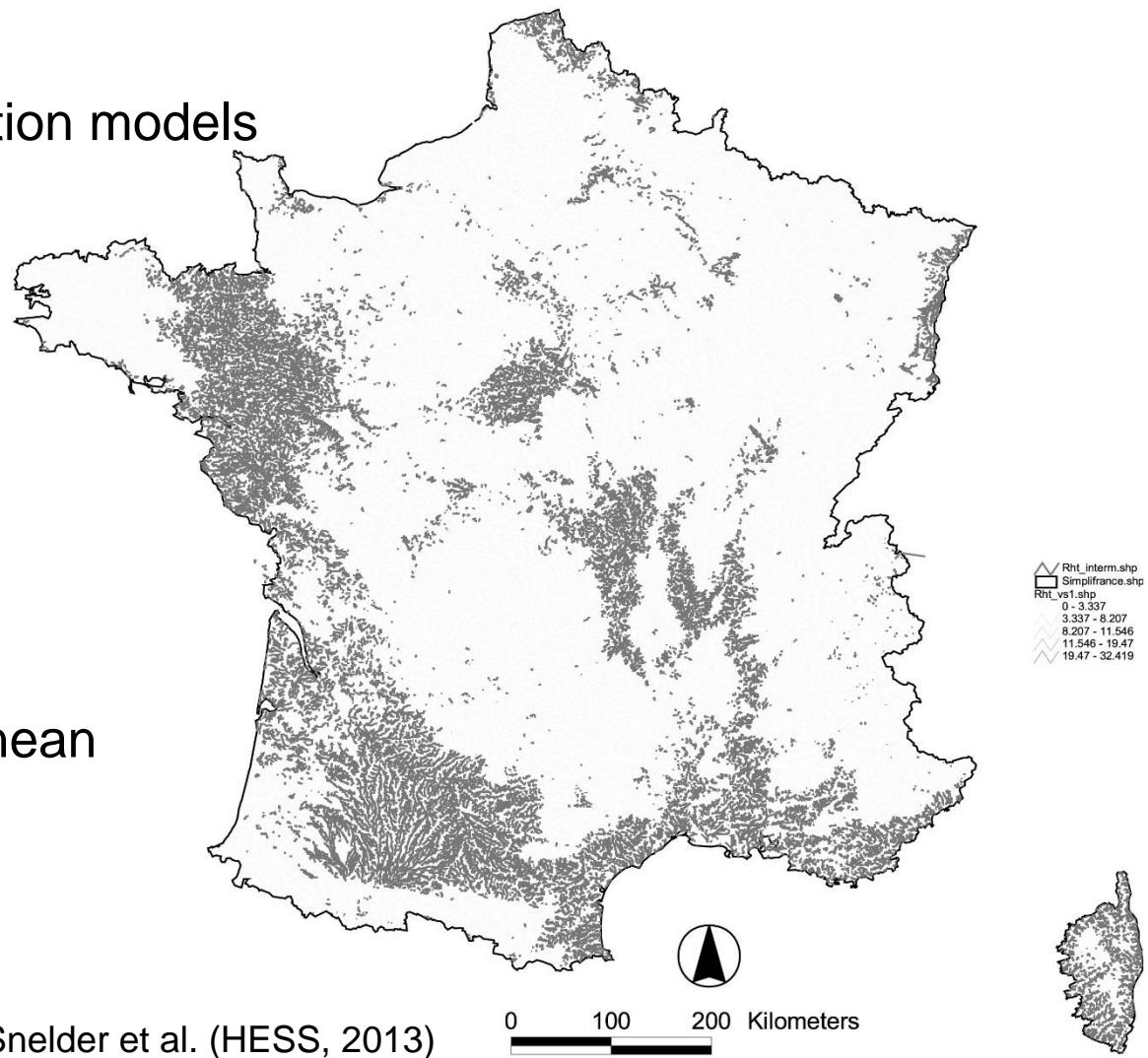
After Zahradkova et al. (VTEI, 2015)

Pourtant....

-predictions from regionalisation models

-28-43% of the network is
intermittent

-widespread distribution &
not only in the dry Mediterranean
region

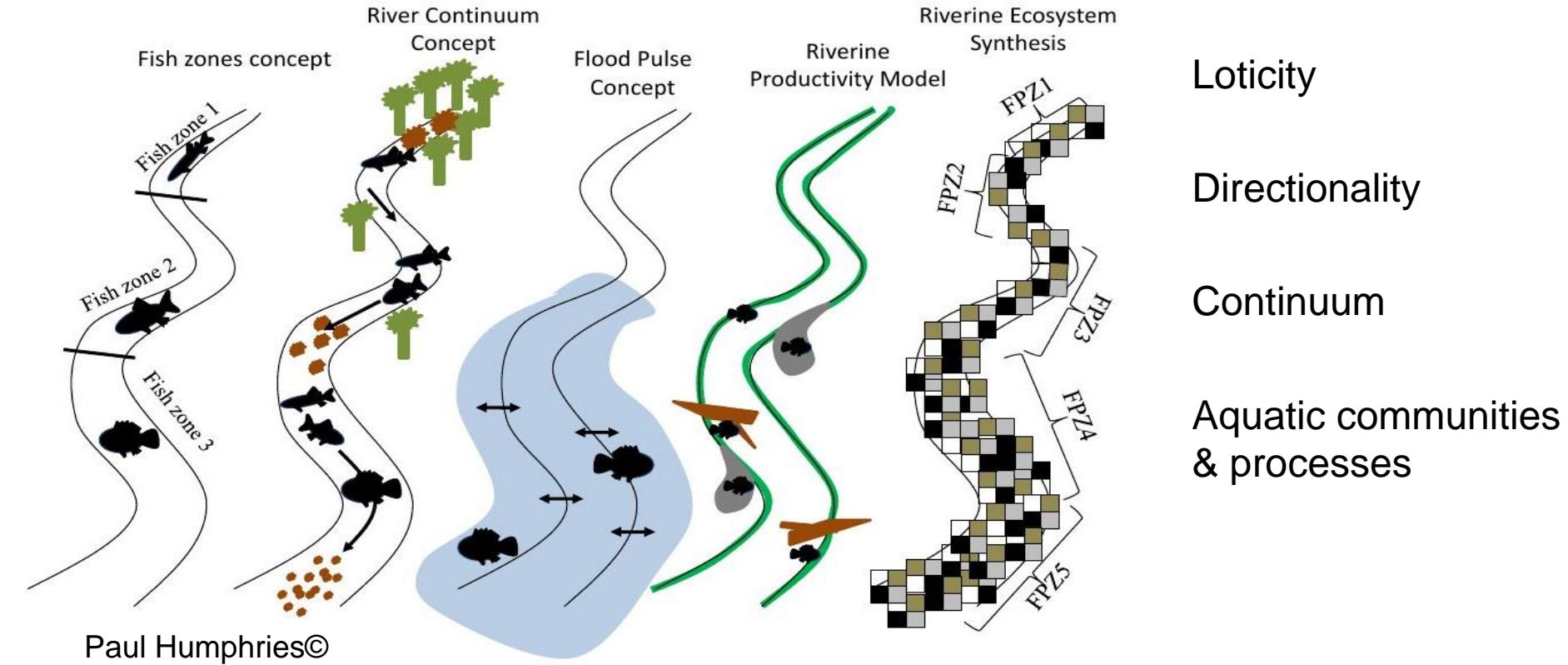


After Snelder et al. (HESS, 2013)

IRES: une addition récente à l'écologie aquatique

Historically overlooked by ecologists & water managers

River ecosystem concepts

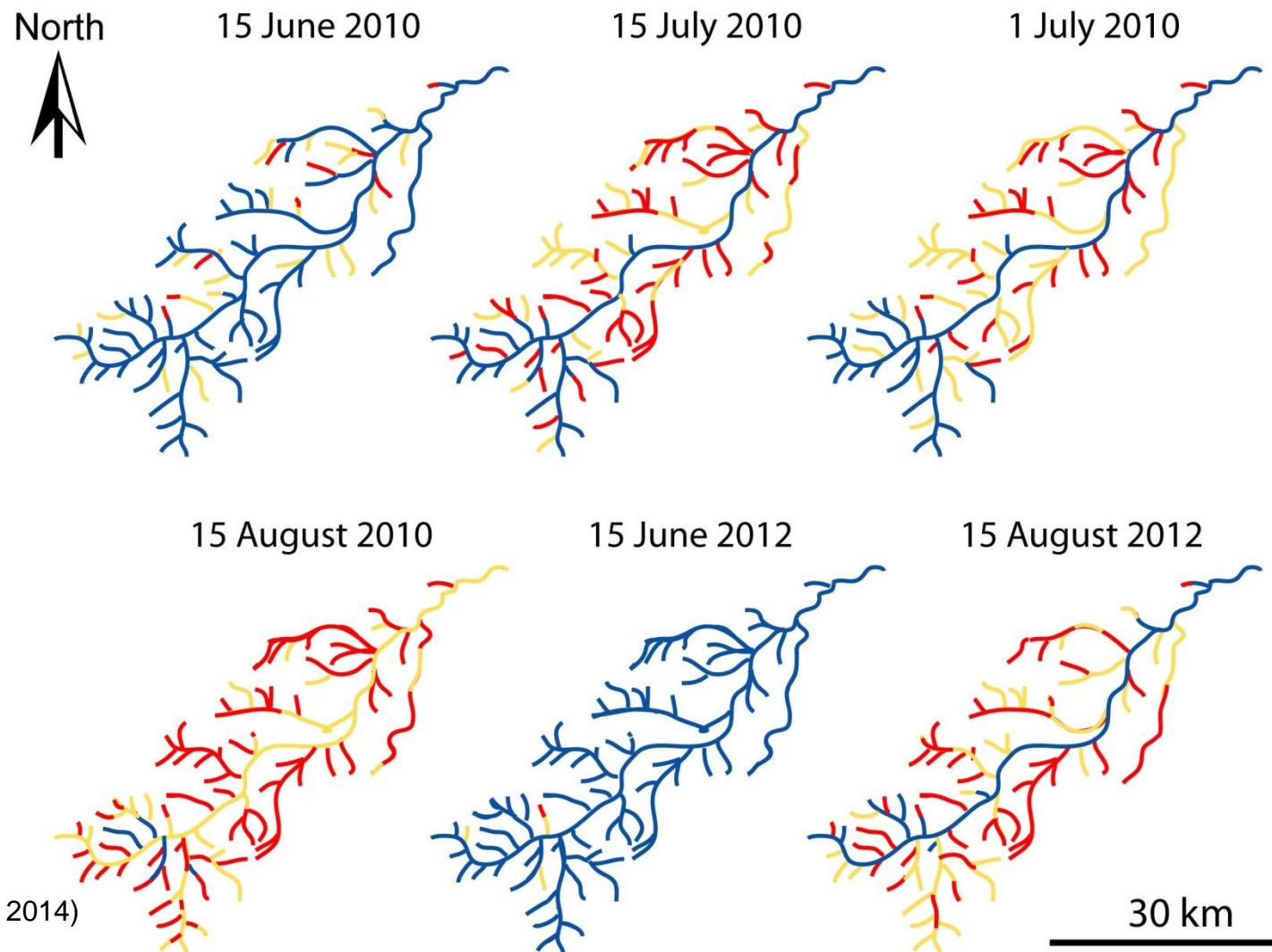
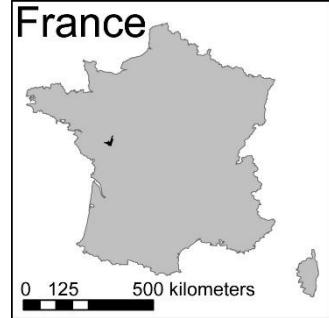


es spat restres

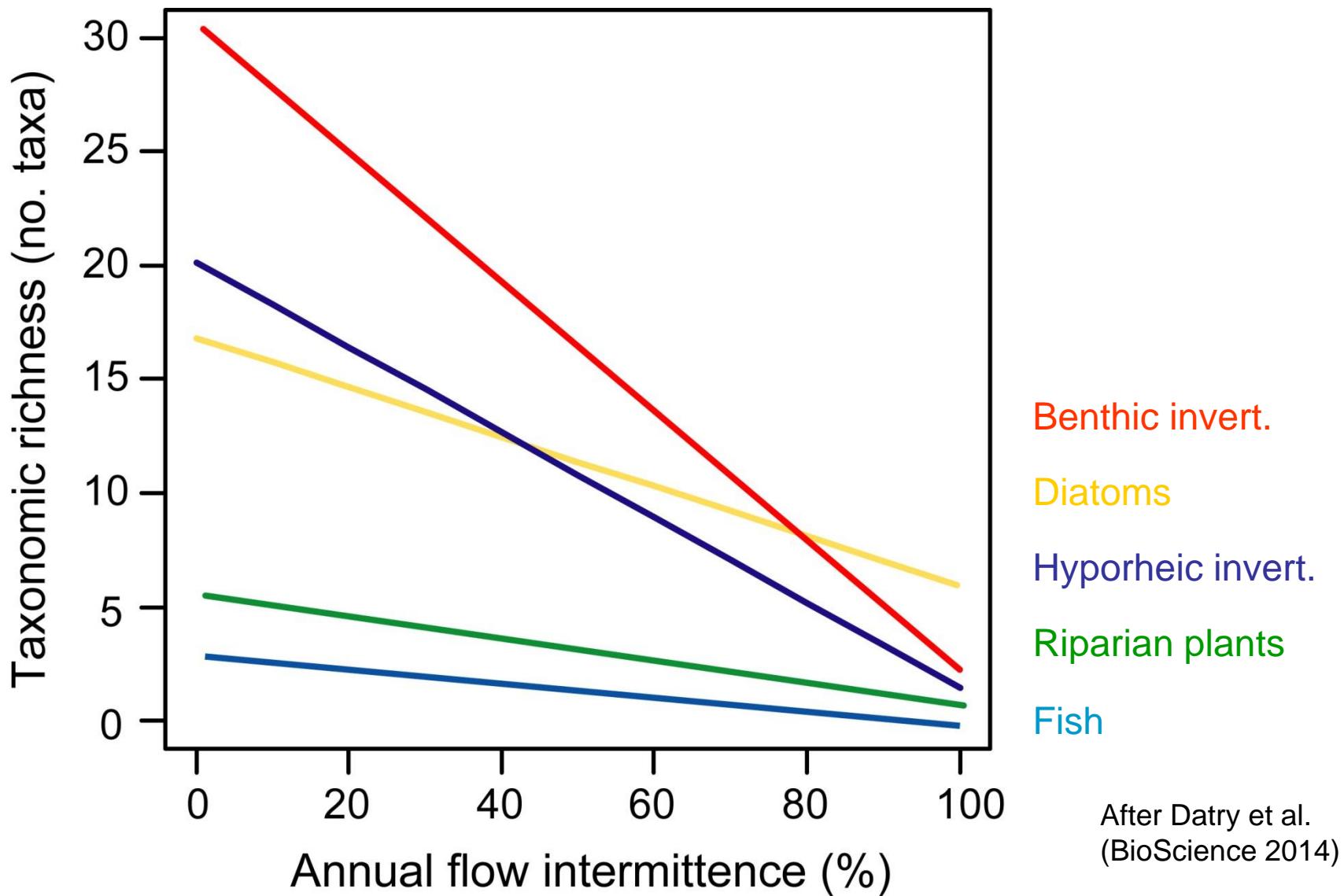


Des mosaïques spatio-temporelles d'habitats terrestres et aquatiques

Le Thouaret catchment:

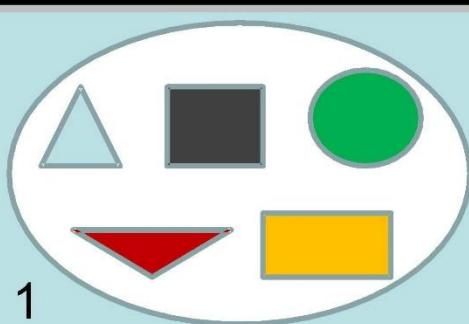


Une faible biodiversité?

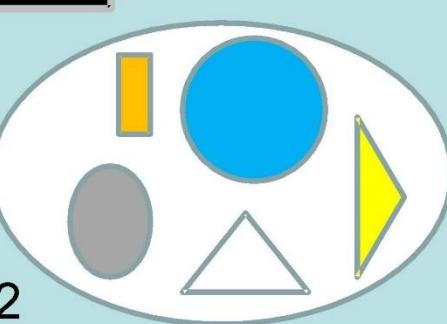


Une faible biodiversité?

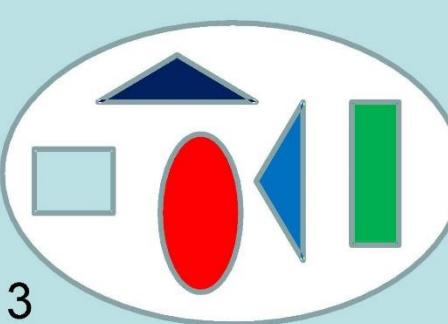
Maximum differentiation



1



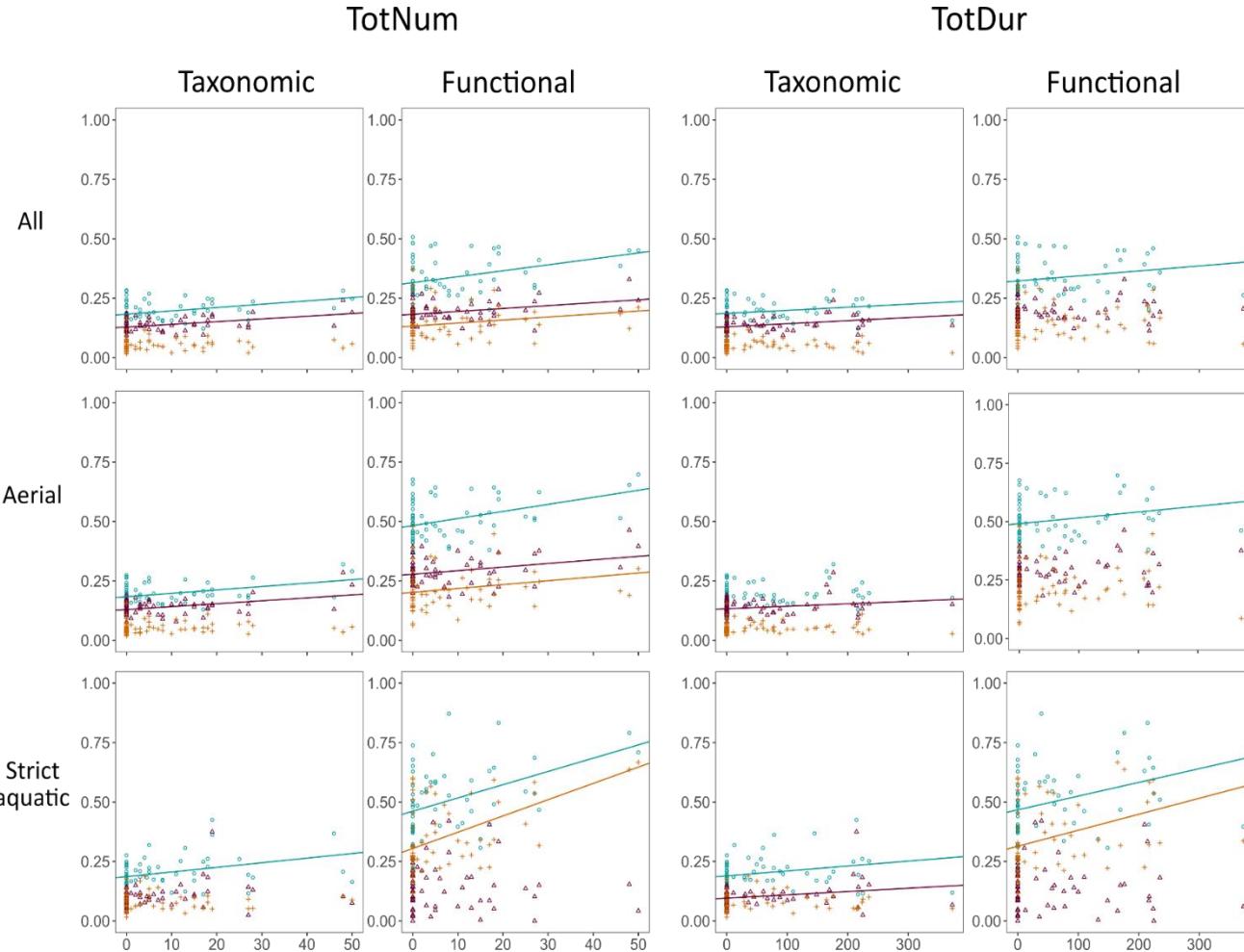
2



3

$$\begin{aligned}\alpha &= 5 \\ \gamma &= 15 \\ \beta &= N = 3\end{aligned}$$

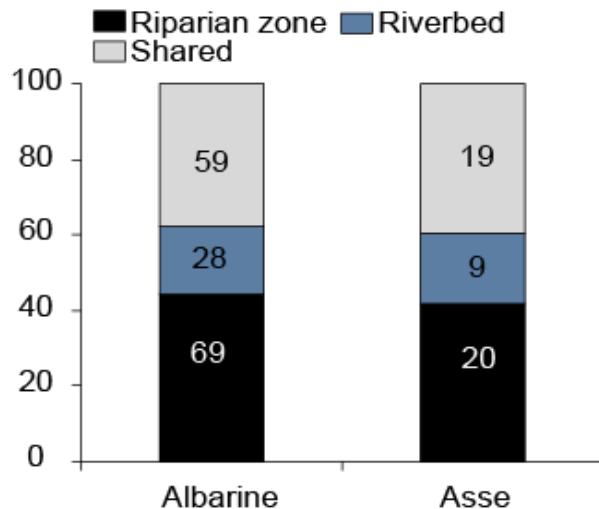
Une faible biodiversité?



After Crabot et al.
(Ecography 2019)

Les habitats lenticques et terrestres: *terra incognita*

=> 35 lotic taxa for 109 terrestrial taxa during dry events (Corti et al., FWB 2013)



10-30 % of unique taxa



After Corti & Datry (FWB, 2016)

=> More than 300 terrestrial taxa collected from dry riverbeds in Italy, Australia and South Africa (Wishart et al. 2000, Steward et al. 2011)

=> Lentic communities poorly described, some pivotal species for conservation perspectives (eg Odonata, Coleoptera)

Une certitude: les rivières s'asséchant à cause de l'homme ne sont pas comparables aux rivières intermittentes naturelles!

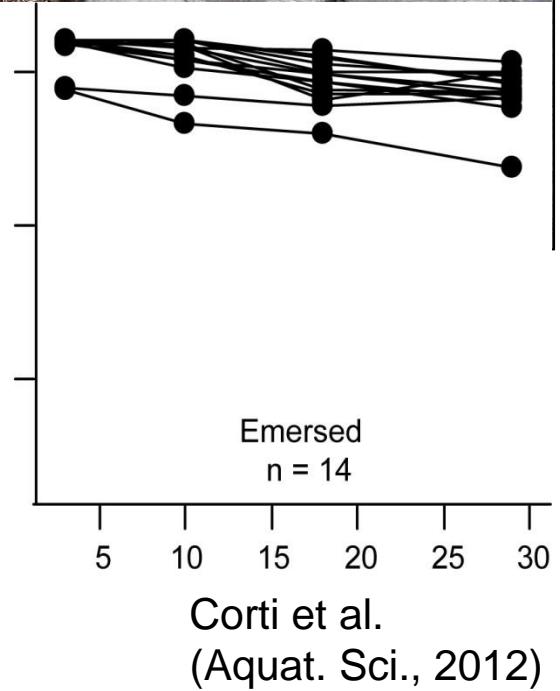
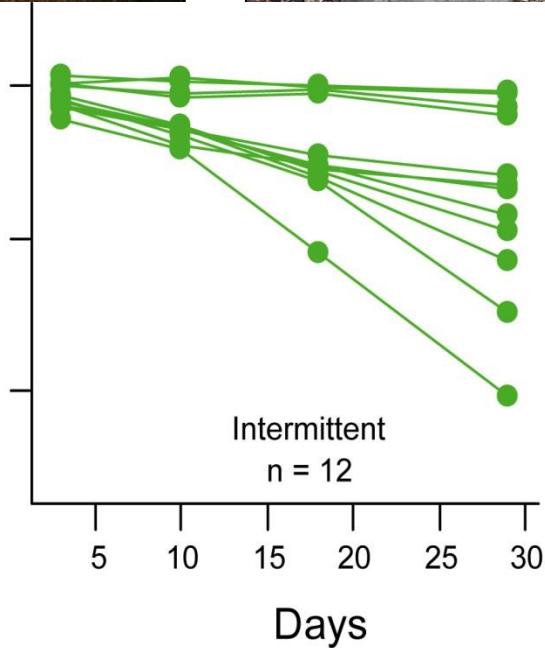
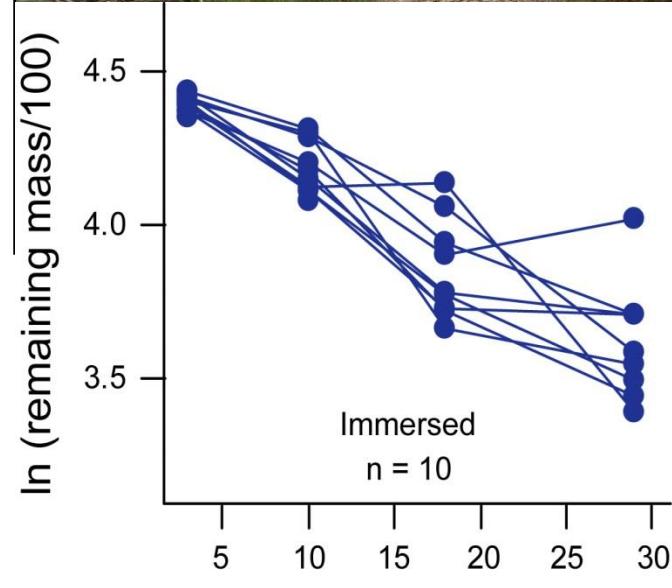


≠



Sans parler du fait que **les assèchements anthropiques sont très souvent associés à des pressions autres** (pesticides, nutriments, dégradation physiques)

Un fonctionnement biogéochimique en « pulse »



=> Accumulation of poorly-decomposed POM in lentic & terrestrial phases

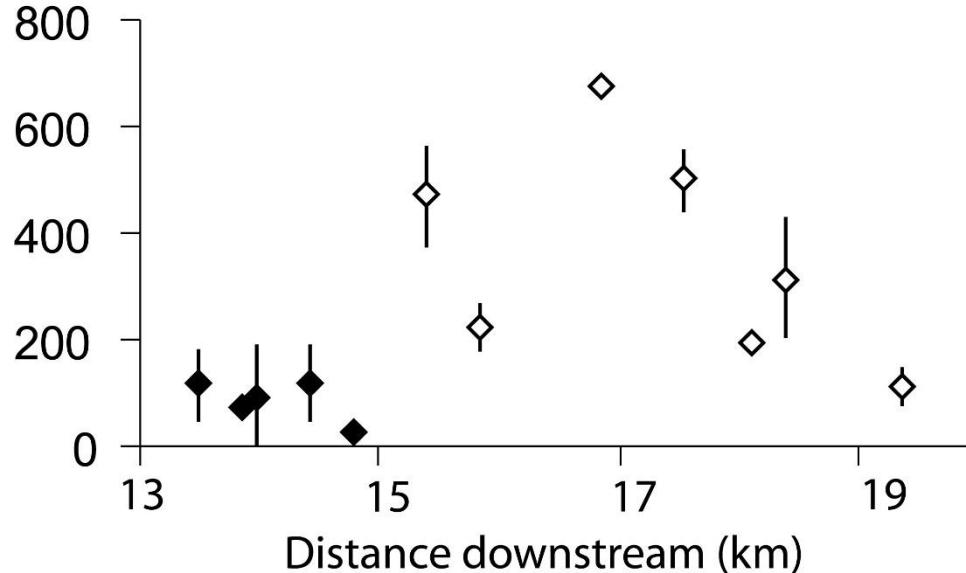
Un fonctionnement biogéochimique en « pulse »



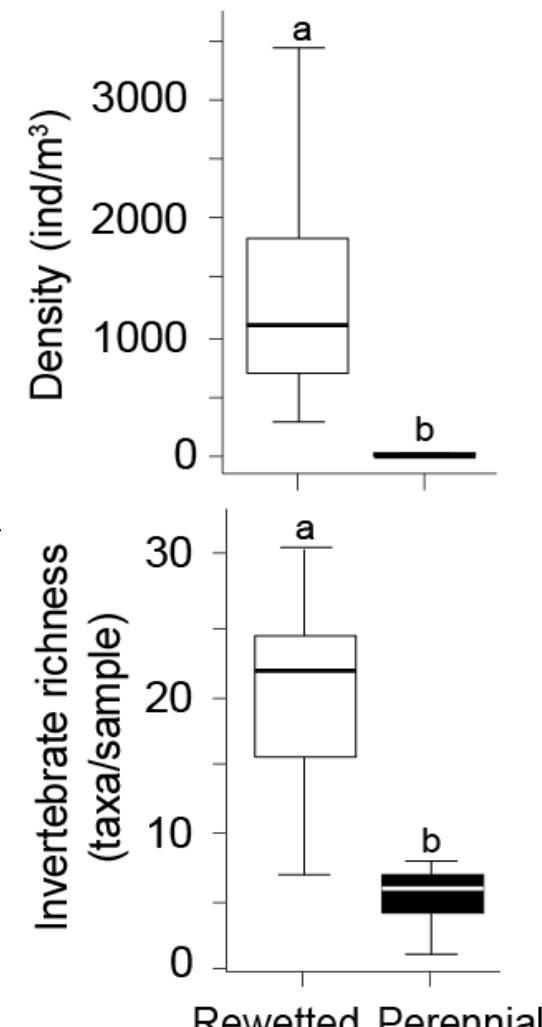
D'importantes quantités de matière organique transportées



POM (g m^{-3})



Terrestrial invertebrates

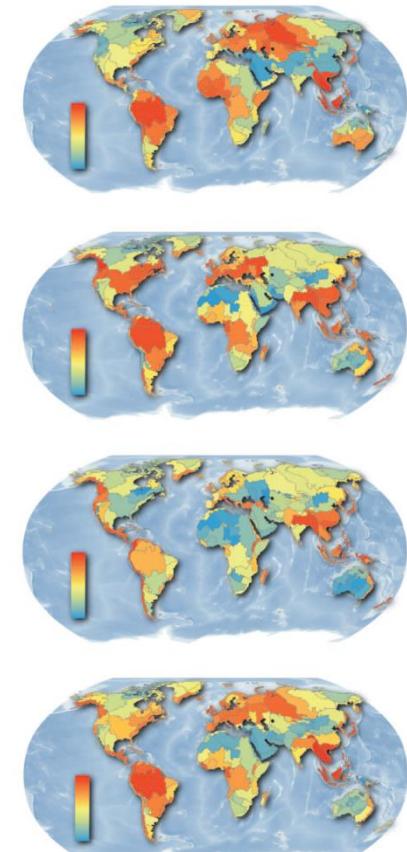
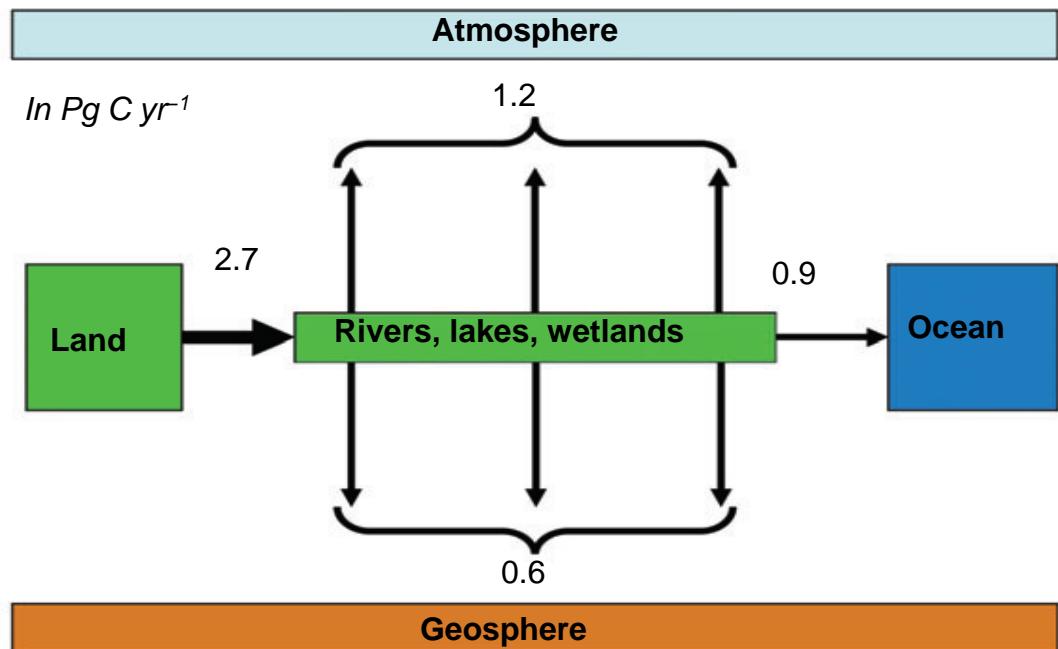


=> Ecological consequences (eg. foodwebs, anoxic pulses, etc) ?

=> Current biogeochemical models and estimates accurate?



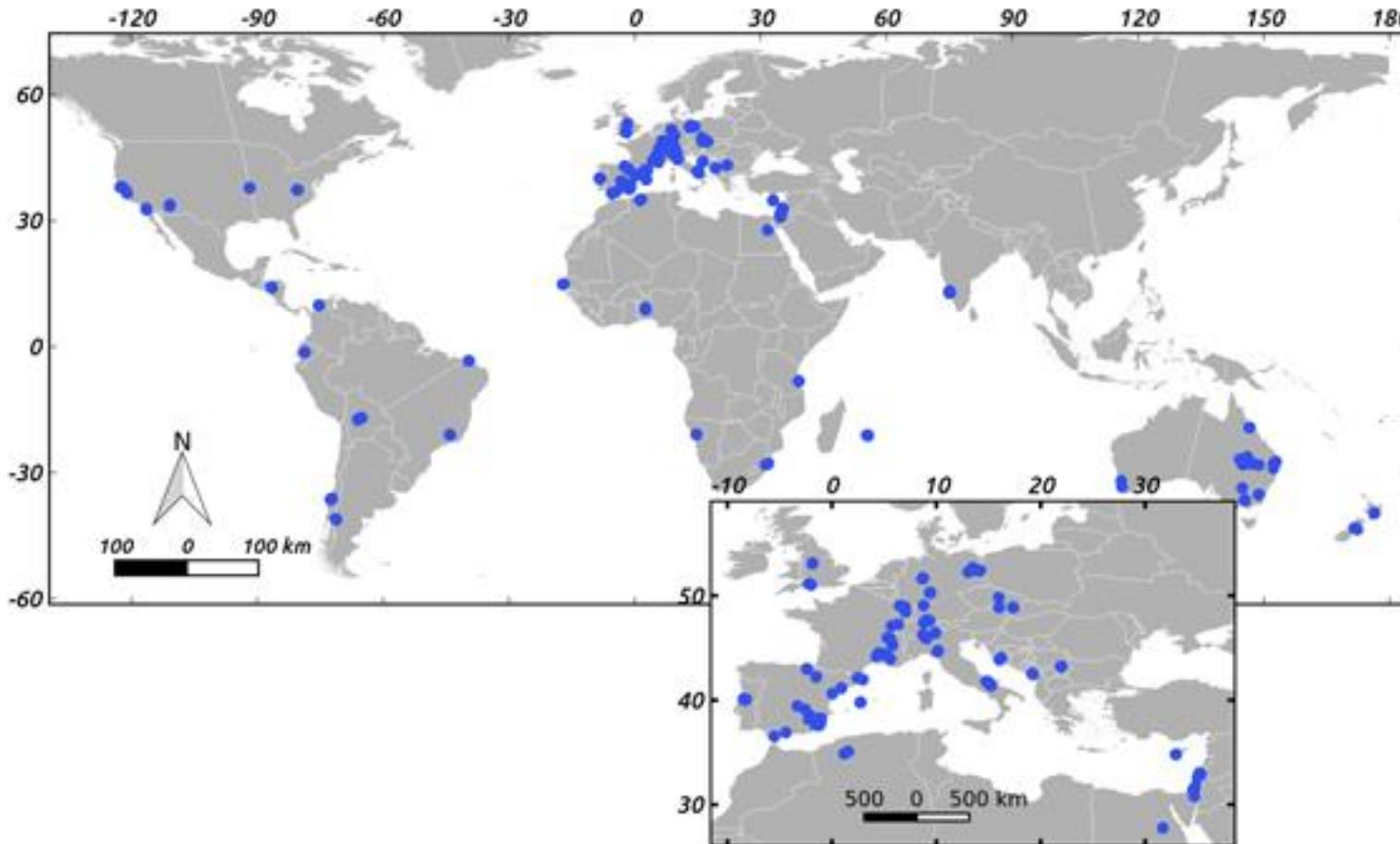
Un rôle substantiel dans le cycle global du C?



Aufdenkampe, A. K., Mayorga, E., Raymond, P. A., Melack, J. M., Doney, S. C., Alin, S. R., ... & Yoo, K. (2011). Riverine coupling of biogeochemical cycles between land, oceans, and atmosphere. *Frontiers in Ecology and the Environment*, 9(1), 53-60.

Raymond, P. A., Hartmann, J., Lauerwald, R., Sobek, S., McDonald, C., Hoover, M., ... & Kortelainen, P. (2013). Global carbon dioxide emissions from inland waters. *Nature*, 503(7476), 355-359.

Un projet collaboratif: “les 1000 rivières intermittentes”



>170 participants from 22 countries have sampled CPOM and sediments across 210 dry river reaches

Echantillonnage

CPOM fractions (wood, leaf litter, fruits, biofilms) and dry sediments collected from dry riverbeds using a standardized protocol

46 environmental variables measured or estimated

Each fraction dried and weighted

Shipped to us for further analyses in the lab



Czech Republic, P. Paril

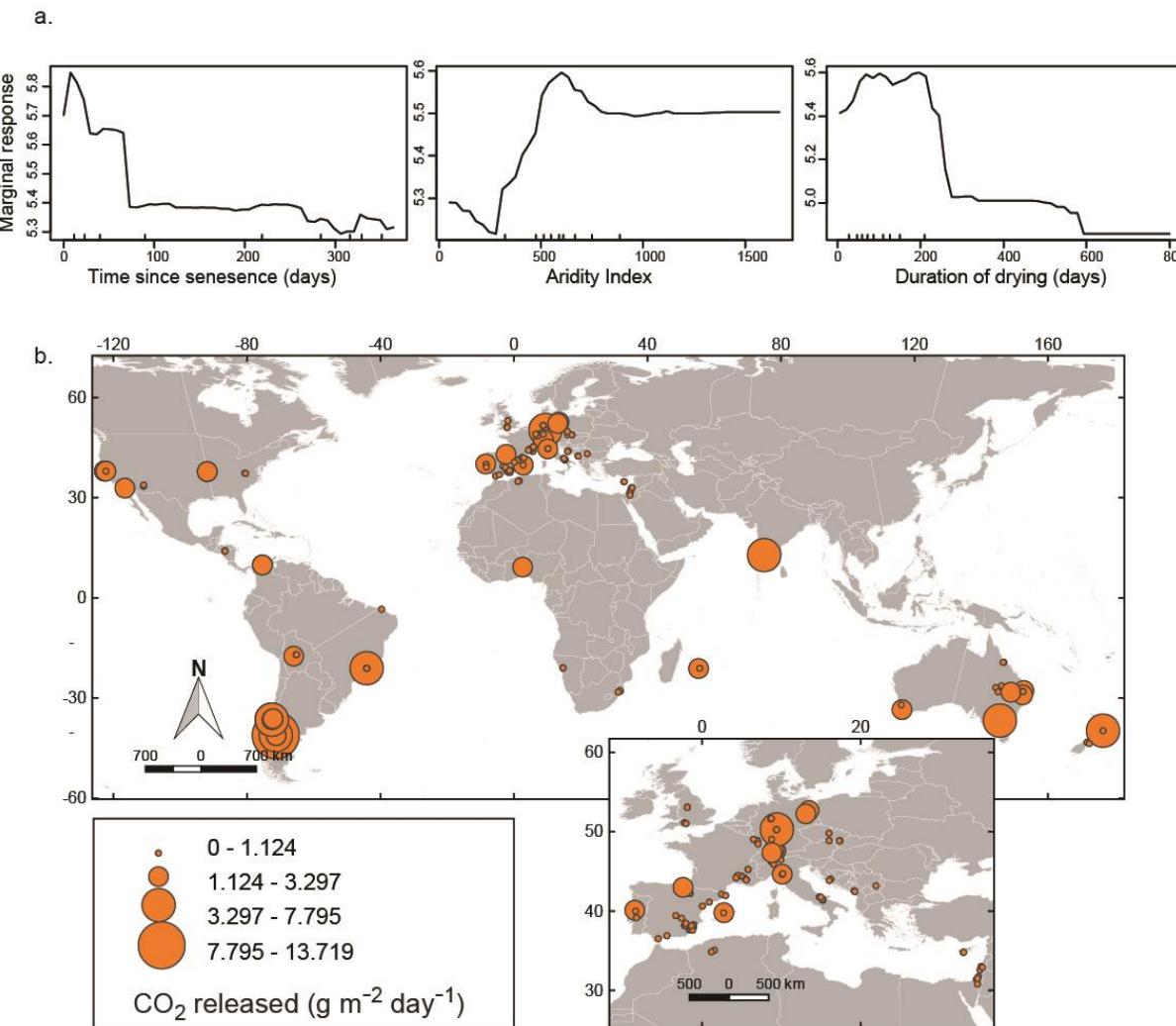
Mesure de respiration au labo



Respiration rates measured during the first 24h of rewetting using standard drinking water (Volvic®) without inoculum

Respiration $\text{CO}_2 / \text{m}^2 / \text{jour}$

RF explained 37% of the variance in the CO_2 potentially released / m^2 / day



IRES et les flux de CO₂ vers l'atmosphère

Perennial rivers and streams:

*Raymond et al. 2013, Nature:

1.8 Pg CO₂ released annually over 624 000 Km², which is ~29.0 g CO₂ m⁻² day⁻¹

* Aufdenkampe et al. 2011, FREE:

0.56 Pg CO₂ released annually over 624 000 Km², which is ~9.03 g CO₂ m⁻² day⁻¹

IRES:

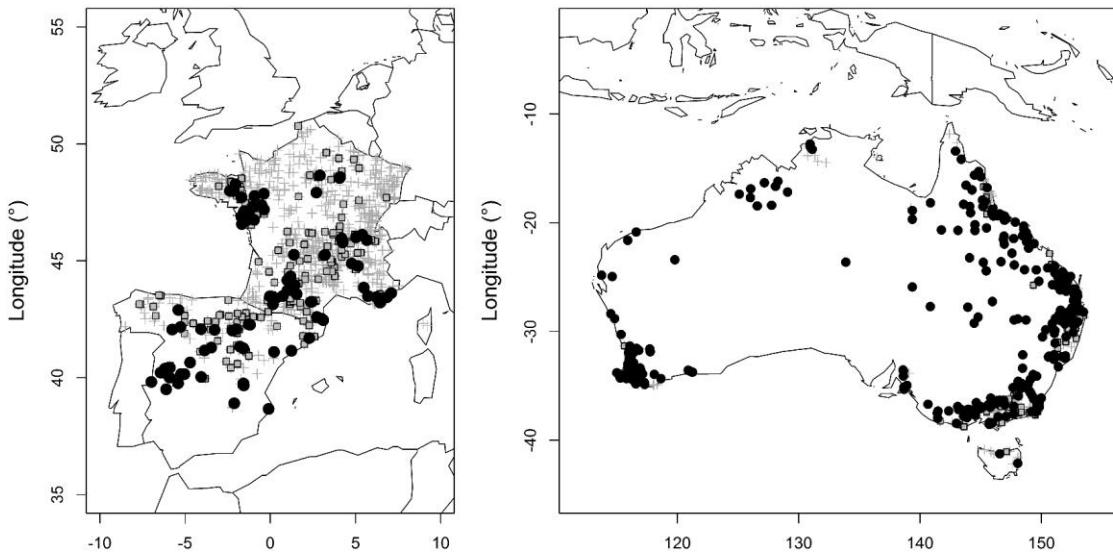
* Datry et al. 2018, Nature Geoscience:

The rewetting of accumulated CPOM leads to 0 to 13.7 g CO₂ m⁻² day⁻¹ (mean=0.9), which is between 3 and 10% of the contribution of perennial running waters, with one rewetting event of 24h per year and no inoculum.

And sediment rewetting?

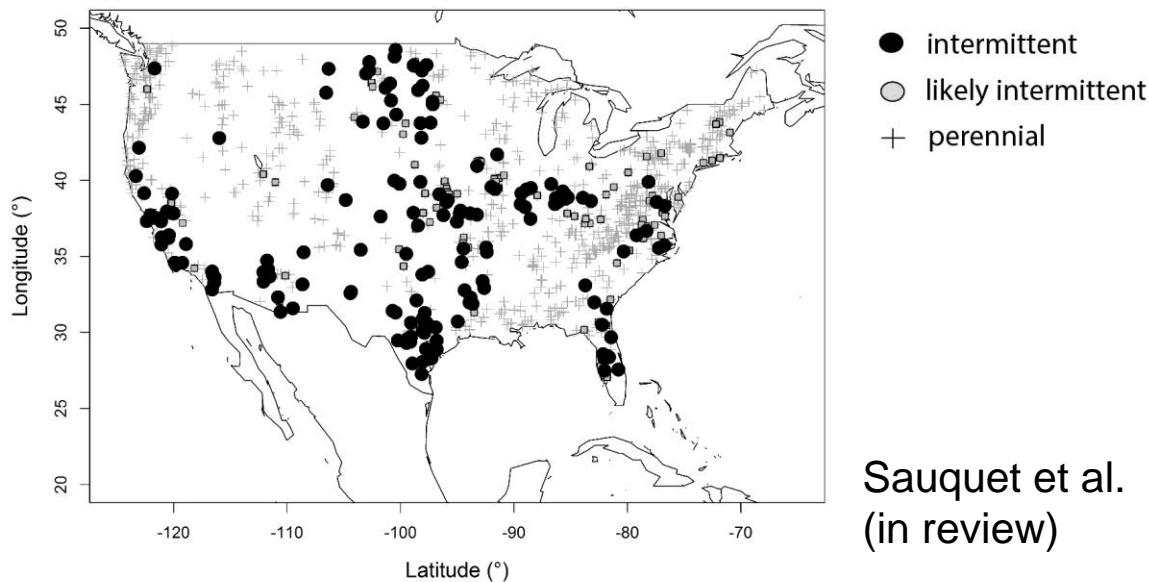


Les problèmes de gestion: peu de données hydro



Lack of hydrological data in most countries

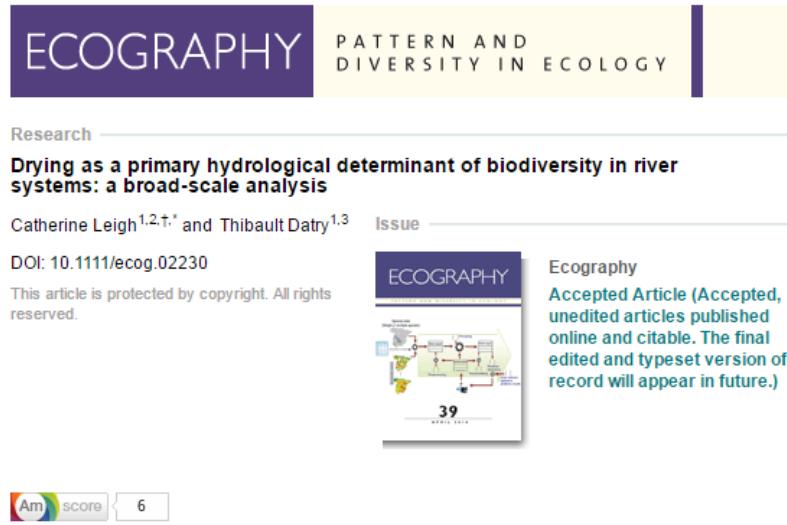
In France, <5% of flow gauging stations in IRES although they comprise 28-43% of the network



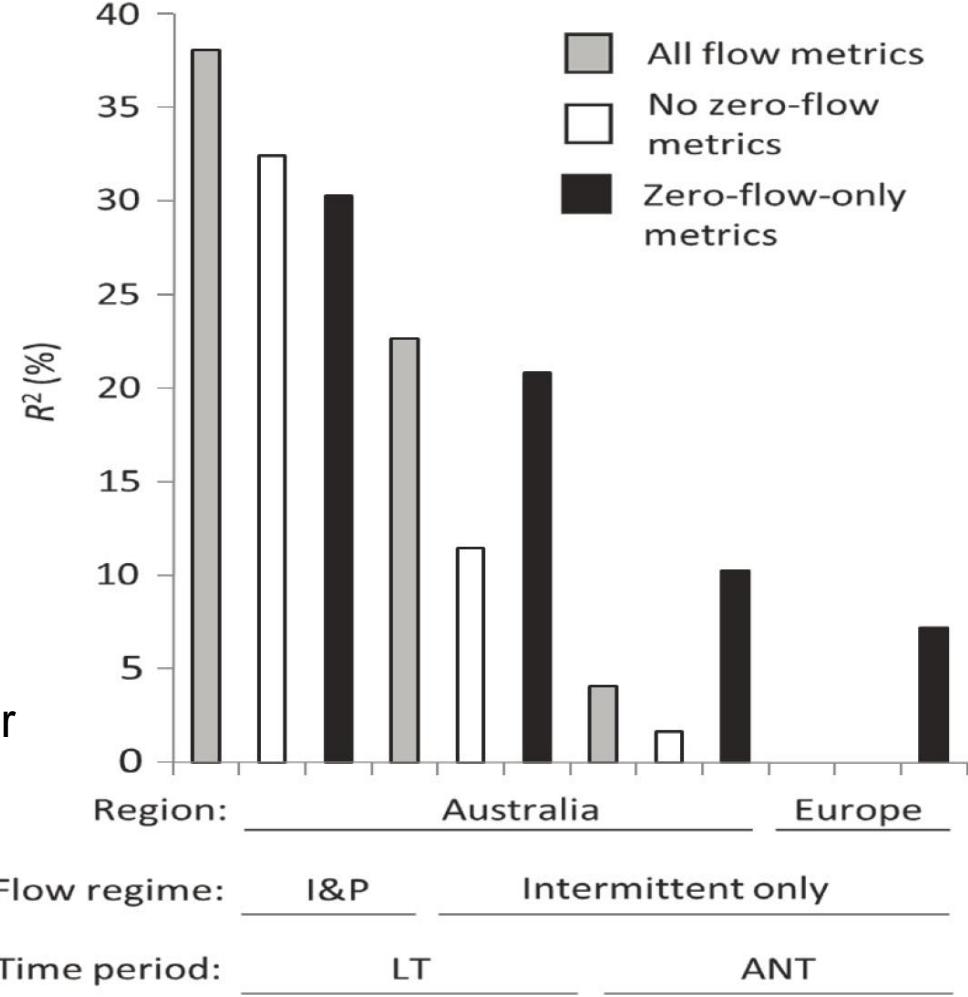
Most flow regime classifications overlook IRES (1 class)

Sauquet et al.
(in review)

Alors que l'assec explique autant que toutes les autres composantes du régime dont les crues



More variation in alpha diversity is explained by flow intermittence than other flow regime components



Les outils classiques de bioindication sont inappropriés

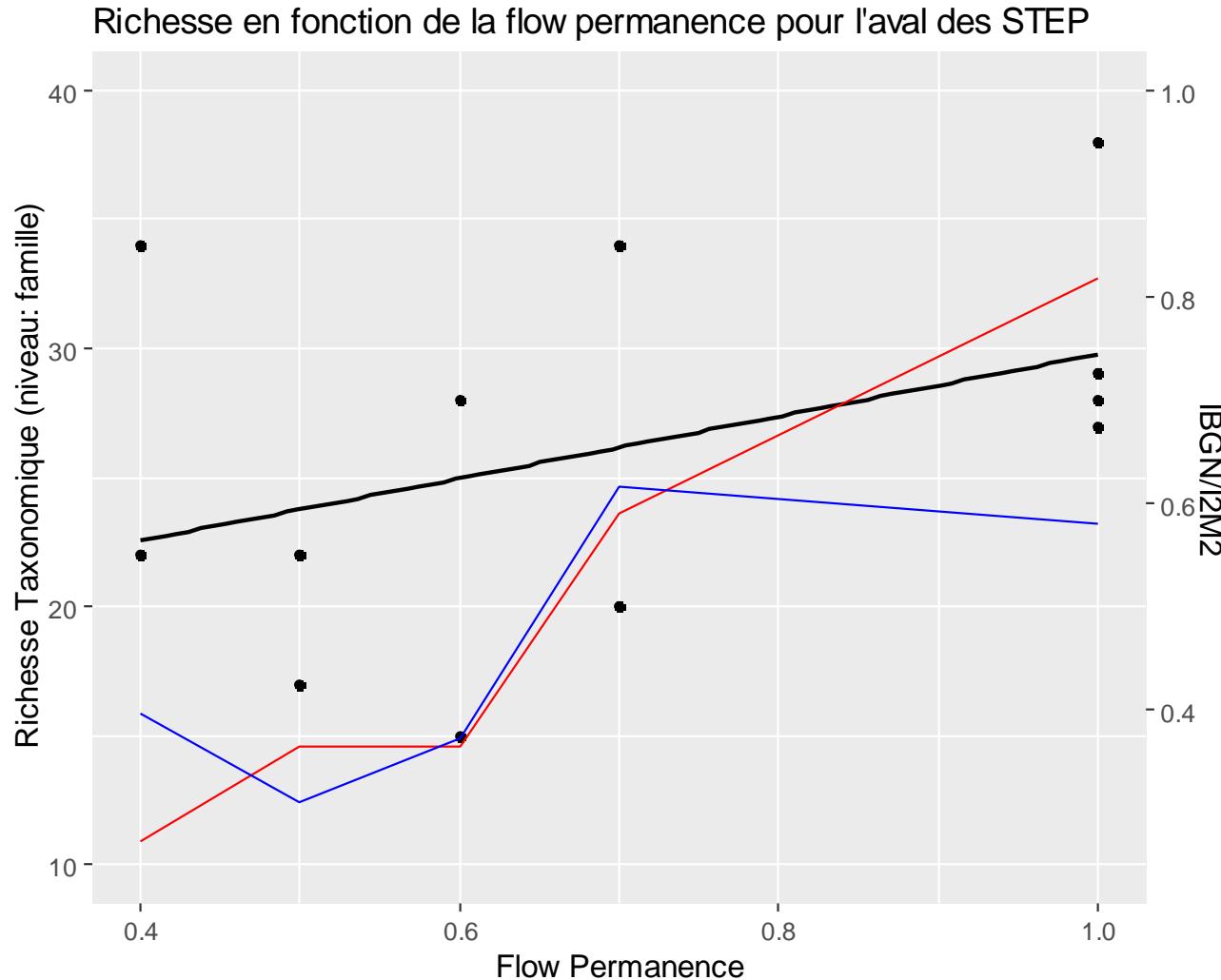
Sur l'Albarine (Ain, France)
6 stations (au niveau des STEP)
Différentes valeurs
d'intermittence
En amont et aval des rejets
2 saisons (Printemps-Hiver)



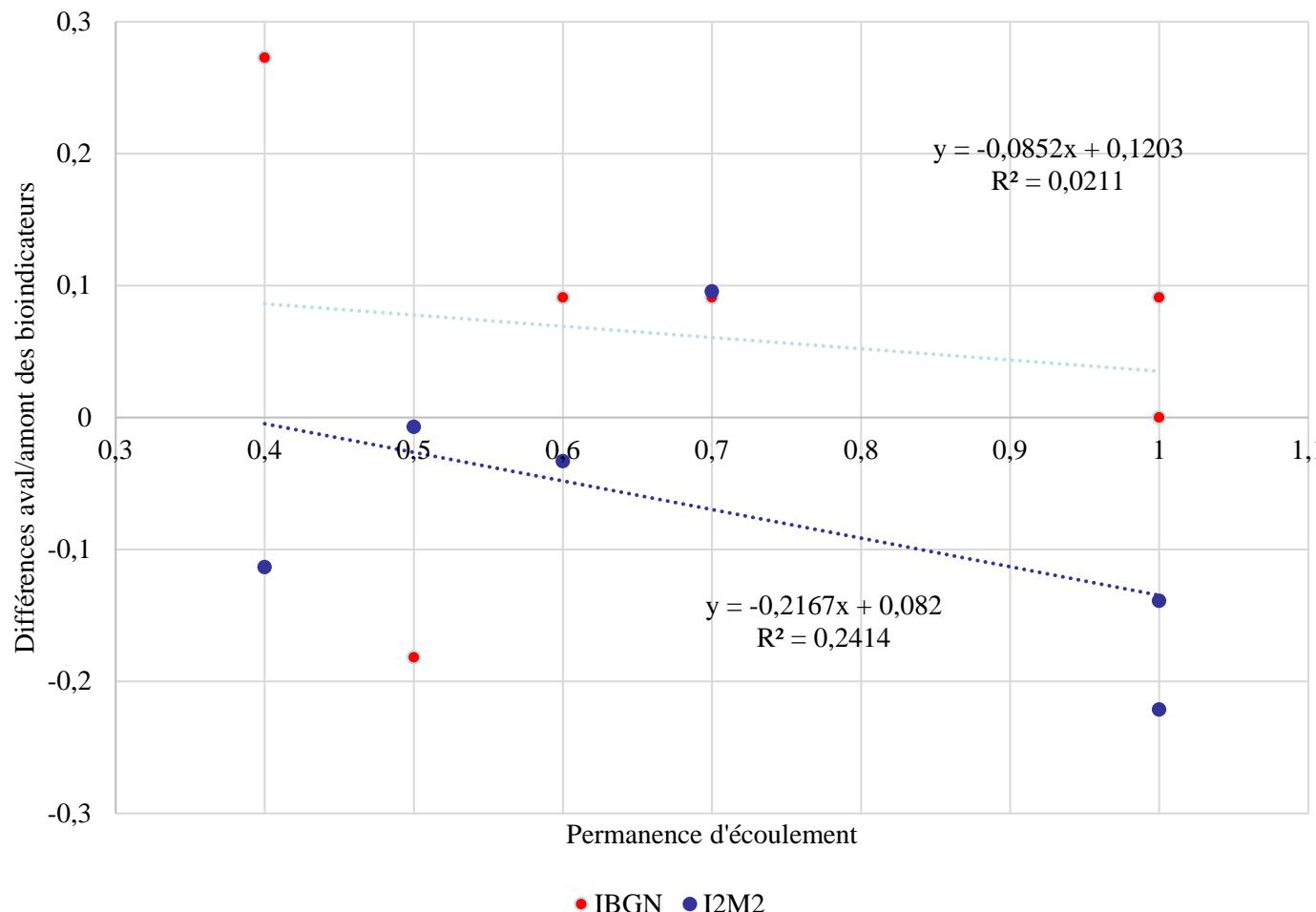
- Amont
- Aval
- Stations d'épuration
- NA
- - - intermittent
- pérenne
- - - rupture écoulements



Les outils classiques de bioindication sont inappropriés

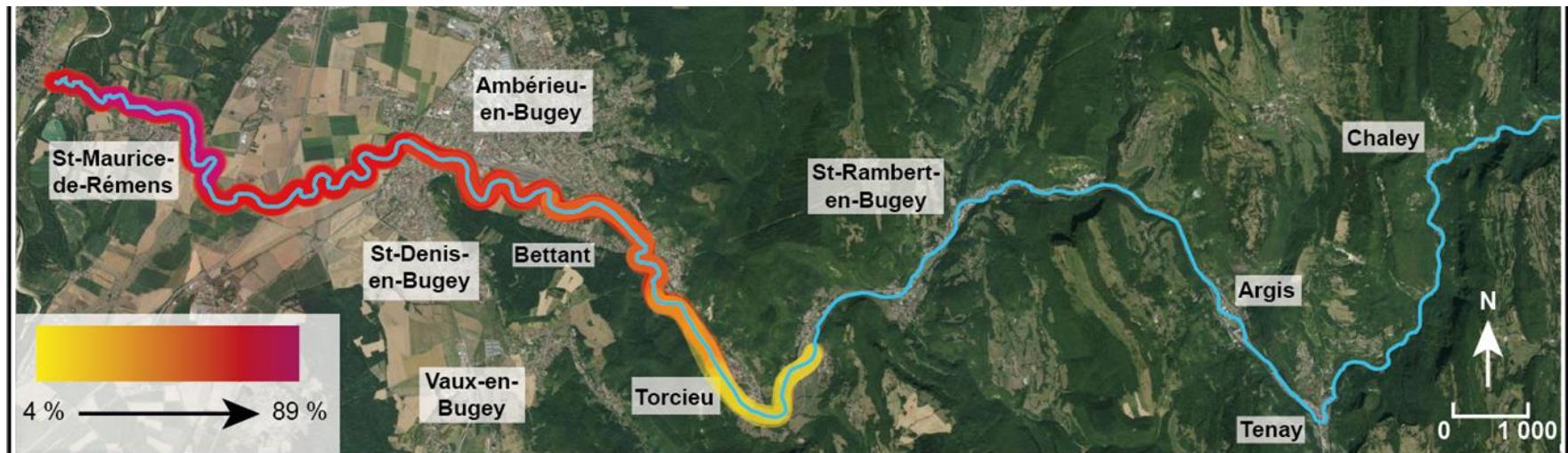


Les outils classiques de bioindication sont inappropriés



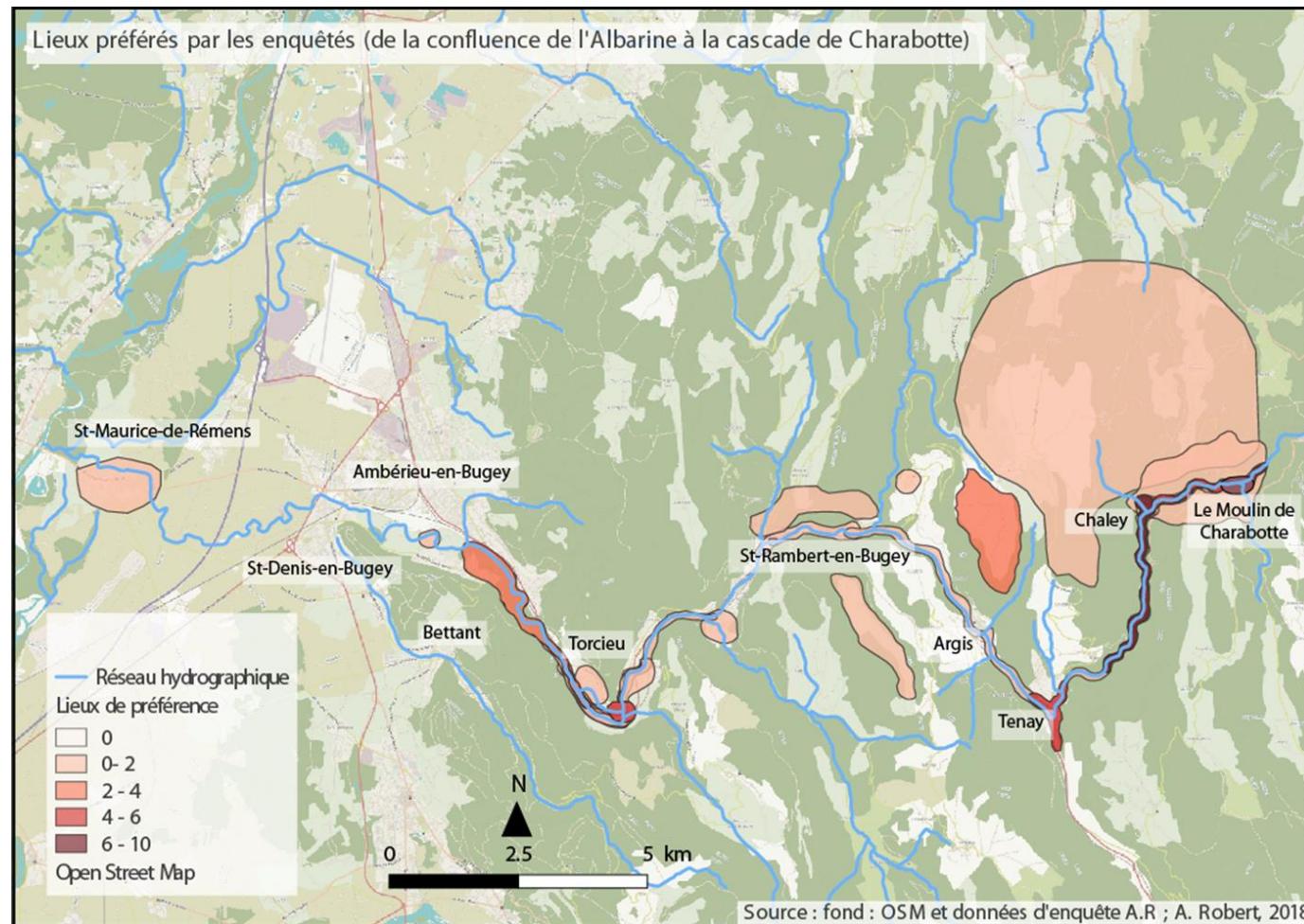
Au plus on a des sites **pérennes**, au plus une différence des notes est détectée et au plus on est en sites **intermittents**, au moins la pollution est visible

Des perceptions sociales complexes et négatives



Robert, Datry & Cottet 2020

Des perceptions sociales complexes et négatives



Robert, Datry & Cottet 2020

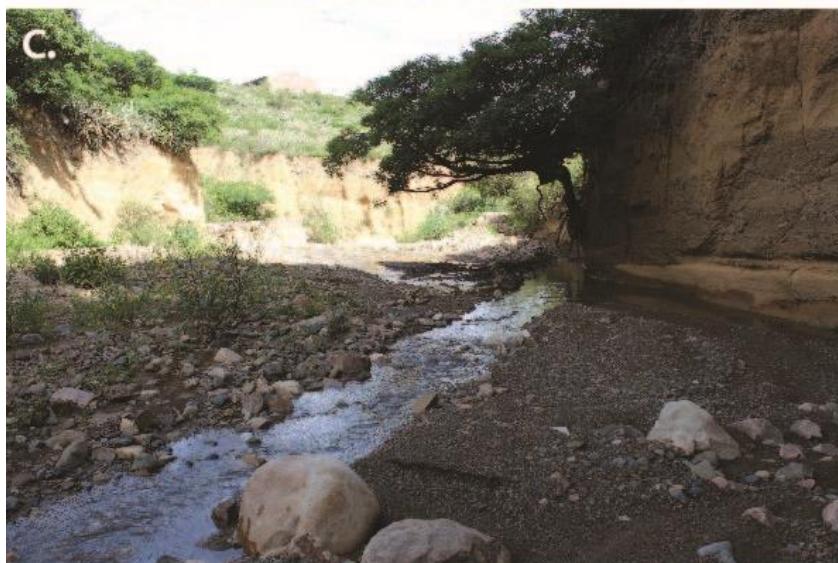
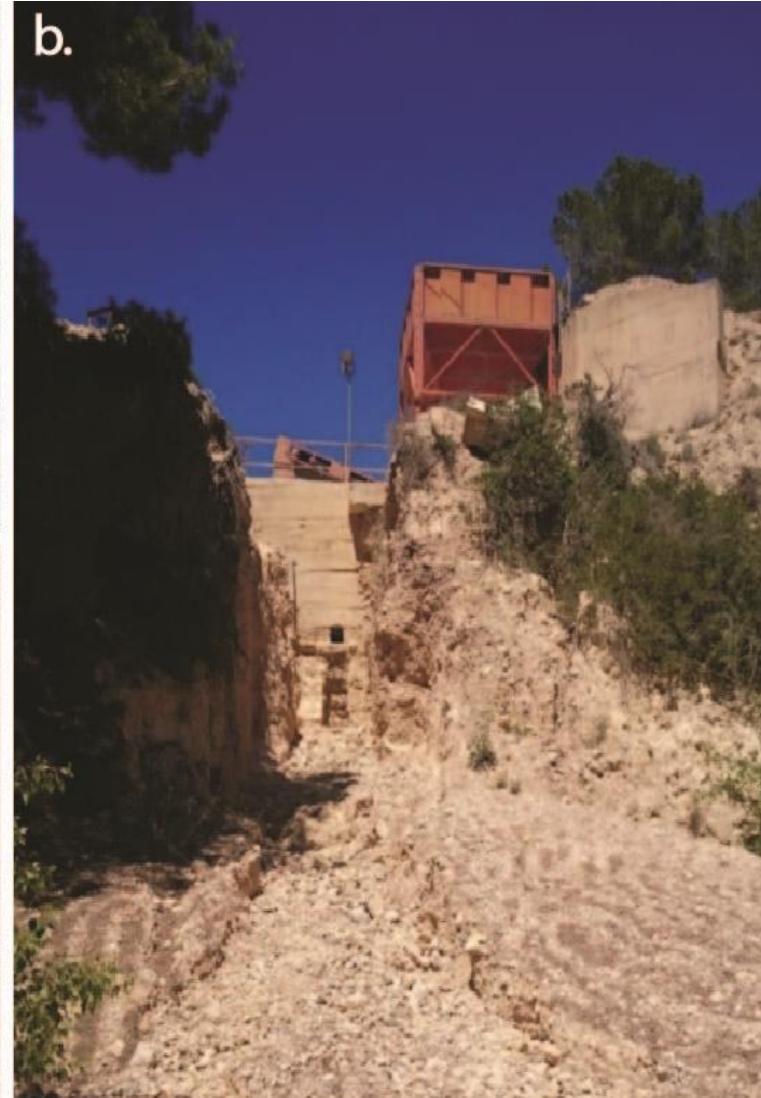
Des perceptions sociales complexes et négatives



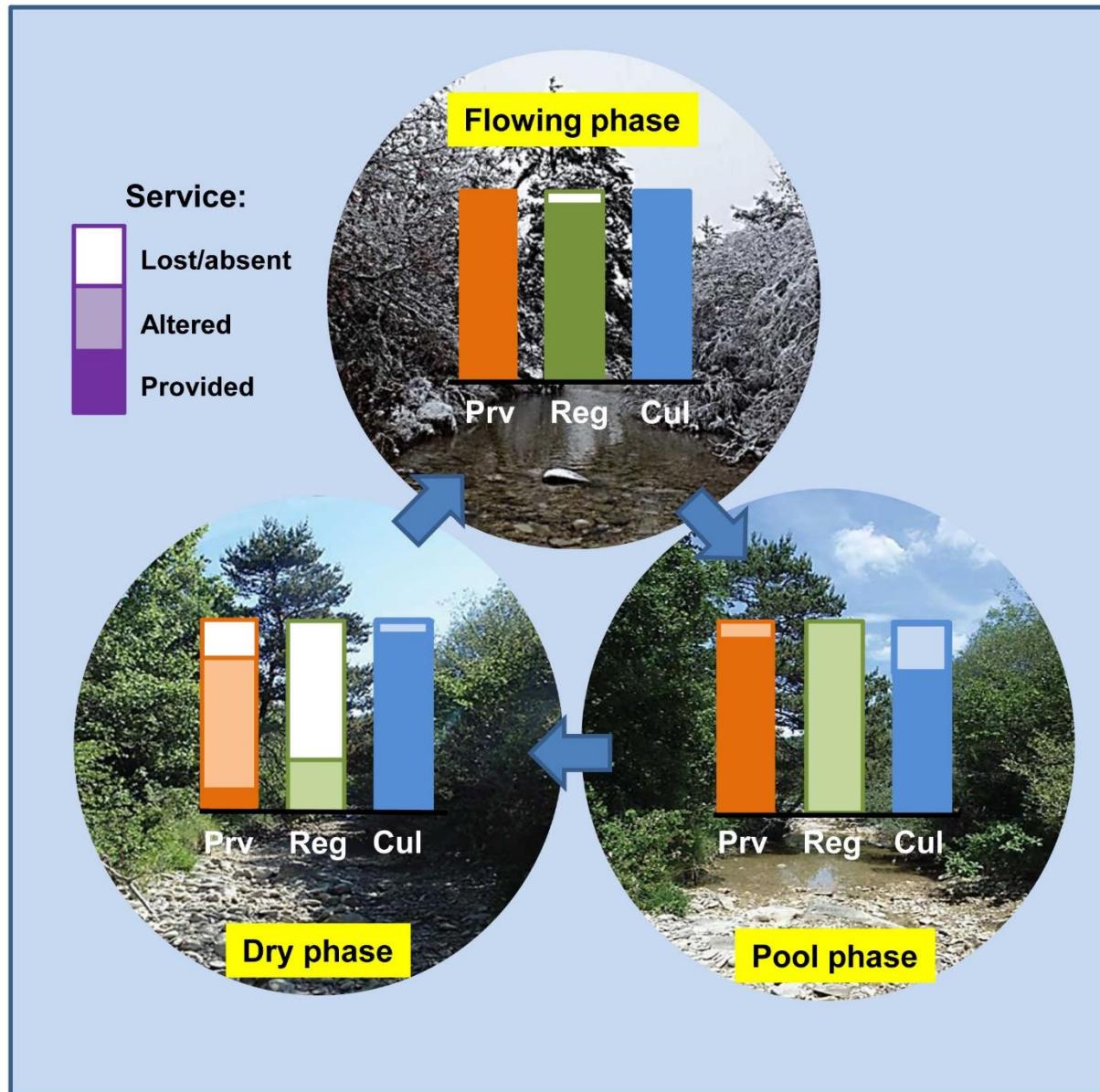
Robert, Datry & Cottet 2020

Implémentation de débits écologiques en IRES?

Artificial perennial flows, artificial intermittent flows, eflows in IRES?

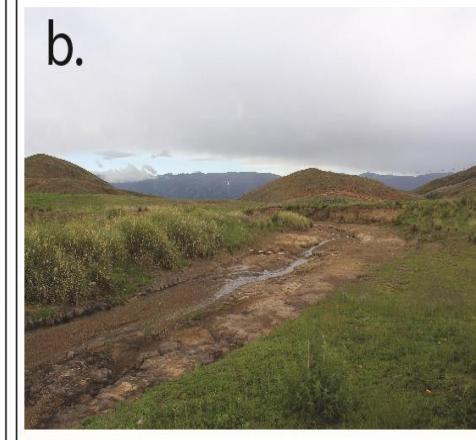


Implémentation de débits écologiques en IRES?



Datry et al. (2018)

**Beaucoup de questions
et de problèmes...**



**...mais les solutions
se développent!**

Les recherches augmentent de manière exponentielle...

Freshwater Biology
[Explore this journal >](#)

Special Issue
Ecological research and management of intermittent rivers: an historical review and future directions
Catherine Leigh , Andrew J. Boulton, Jennifer L. Courtwright, Ken Fritz, Christine L. May, Richard H. Walker, Thibault Datry

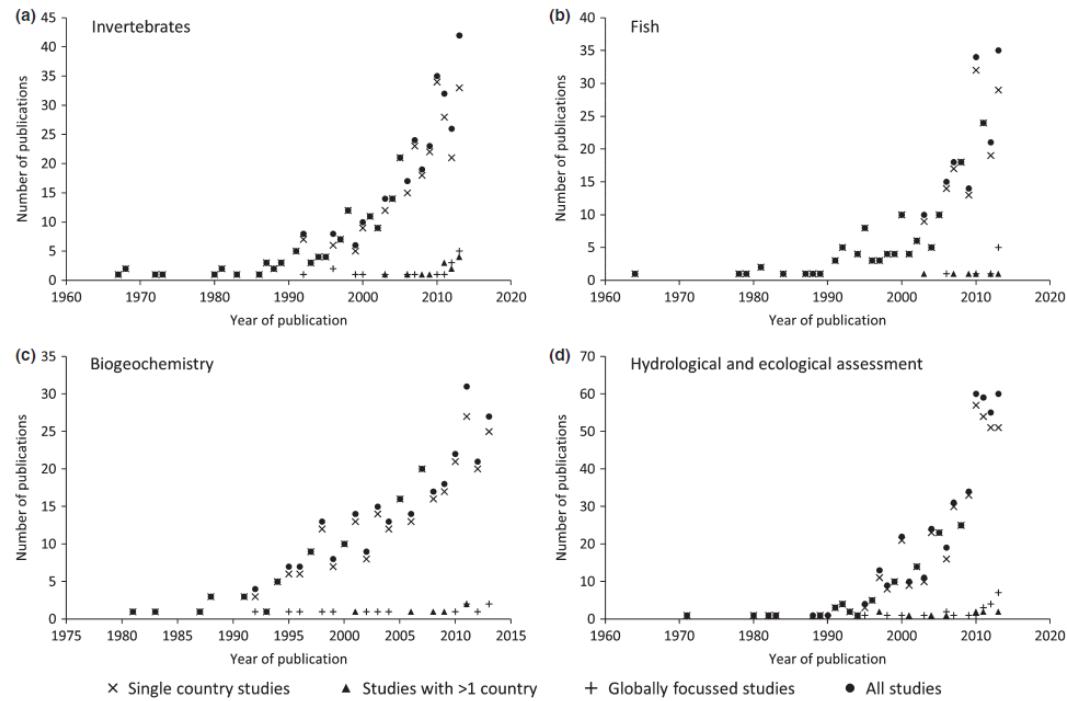


Fig. 2 The number of publications has increased over time for each of the four topics of intermittent river research on which we conducted literature searches: (a) invertebrates, (b) fish, (c) biogeochemistry and (d) hydrological and ecological assessment. See Tables S1 & S2 for detailed information on the searches. Data exclude the year 2014 because it was not complete at the time of the searches (21 August 2014).

... de même que les appels aux gestionnaires pour une meilleure reconnaissance et gestion...

POLICYFORUM

CONSERVATION

Why Should We Care About Temporary Waterways?

V. Aculia,¹ T. Datry,² J. Marshall,^{3,4} D. Barceló,^{5,6} C. N. Dahm,⁶ A. Ginebreda,⁵ G. McGregor,⁷ S. Sabater,^{8,9} K. Tockner,^{9,3} M. A. Palmer^{10,11*}

A proposed ruling by the U.S. Environmental Protection Agency (EPA), aimed at clarifying which bodies of water that flow intermittently are protected under law (*1*), has provoked conflict between developers and environmental advocates. Some argue that temporary streams and rivers, defined as waterways that cease to flow at some points in space and time along their course (see the figure, left) (Fig. 1) (*2*), are

Failure to recognize, understand, and manage temporary waterways leads to serious degradation of aquatic ecosystems accompanied by negative impacts to the societies that depend upon them.

Current Conservation Status

Traditional flow-gauging systems have vastly underestimated the number of intermittently flowing streams and rivers in most regions,

Intermittently flowing streams and rivers should be recognized, afforded protection, and better managed.

and services. They are critical conduits for water, energy, material, and organisms even when surface water is not present (*10*). Shallow subsurface flows may connect dry parts of a stream or river to downstream sections that have permanent flows, are often critical for the supply of water in permanent downstream parts of a river basin, and support diverse hyporheic biota (*11*).

Temporary waterways are also important conduits for lateral exchanges, as they



Different seasonal flows. (Left) The Furores stream (northeast Iberian Peninsula) and (right) an intermittent tributary in Parker's Creek (mid-Atlantic U.S.) during the dry and wet seasons.

essential to the integrity of entire river networks. Others argue that full protection will be too costly. Similar concerns extend far beyond the United States. Debate over how to treat temporary waterways in water-policy frameworks is ongoing (*3*), particularly because some large permanent rivers are shifting to temporary because of climate change and extraction of water (*4*). Even without human-induced changes, flow intermittency is part of the natural hydrology for streams and rivers globally.

We stress here the importance of policies to protect intermittently flowing streams and rivers and outline information needs that are critical to implementation of those policies.

and digital hydrological data sets used widely by water resource managers are thus unrepresentative (*5*). With development of novel affordable sensors, advances in remote sensing, and new modeling approaches, researchers are now showing that flow intermittency is not only very common (*6*, *7*) but makes up the majority of river networks in many regions (*8*). Recent work indicates that 69% of first-order streams (the smallest) below 60° latitude flow only intermittently (see the figure, right), as do even a substantial fraction (~34%) of larger, fifth-order rivers (*9*).

Waterways that are naturally temporary support high biodiversity and important ecosystem processes and provide valuable goods

move nutrients and organisms back and forth between the channel and the floodplain or riparian vegetation region because of changes in flow. These exchanges are critical to maintenance of riparian and floodplain ecosystems and, in some arid regions, support the majority of riparian vegetation (*12*). Riparian vegetation, as well as vegetation that grows in dry sections of temporary river channels, provides essential wildlife habitat, forage for livestock, and wood and other ecosystem services for local people (*13*). Several fish species maintain healthy populations in temporary waterways; some species exhibit higher survival and reach larger sizes if they use temporary streams during early life stages (*14*).

Temporary streams are being buried or degraded at alarming rates owing to development, mining, hydrologic alteration, and

¹Catalan Institute for Water Research, 17003 Girona, Spain. ²National Research Institute of Science and Technology for Environment and Agriculture (IRSETA), Aquatic Environments, Ecology and Pollution (UR-MALY), 69626 Villeurbanne, France.

³Queensland Department of Science, Information Technology, Innovation and the Arts, Brisbane 4001, Australia. ⁴Australian Rivers Institute, Griffith University, Nathan 4111, Australia. ⁵Water and Soil Quality Research Group, Department of Environmental Chemistry, Institute of Environmental Assessment and Water Research-Spanish Council for Scientific Research (IDAEA-CSIC), 08034 Barcelona, Spain. ⁶Department of Biology, University of New Mexico Albuquerque, NM 87131, USA.

⁷Institute of Aquatic Ecology, University of Girona, 17071 Girona, Spain. ⁸Institute of Biology, Freie Universität Berlin, 14195 Berlin, Germany. ⁹Leibniz Institute for Freshwater Fisheries and Biogeochemistry, 12587 Berlin, Germany. ¹⁰Department of Entomology, University of Maryland, College Park, MD 20742, USA. ¹¹National Socio-Environmental Synthesis Center, Annapolis, MD 21401, USA. *Corresponding author: m.apalmer@umd.edu

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... de même que les appels aux gestionnaires pour une meilleure reconnaissance et gestion...



Implementing the Water Framework Directive to temporary rivers



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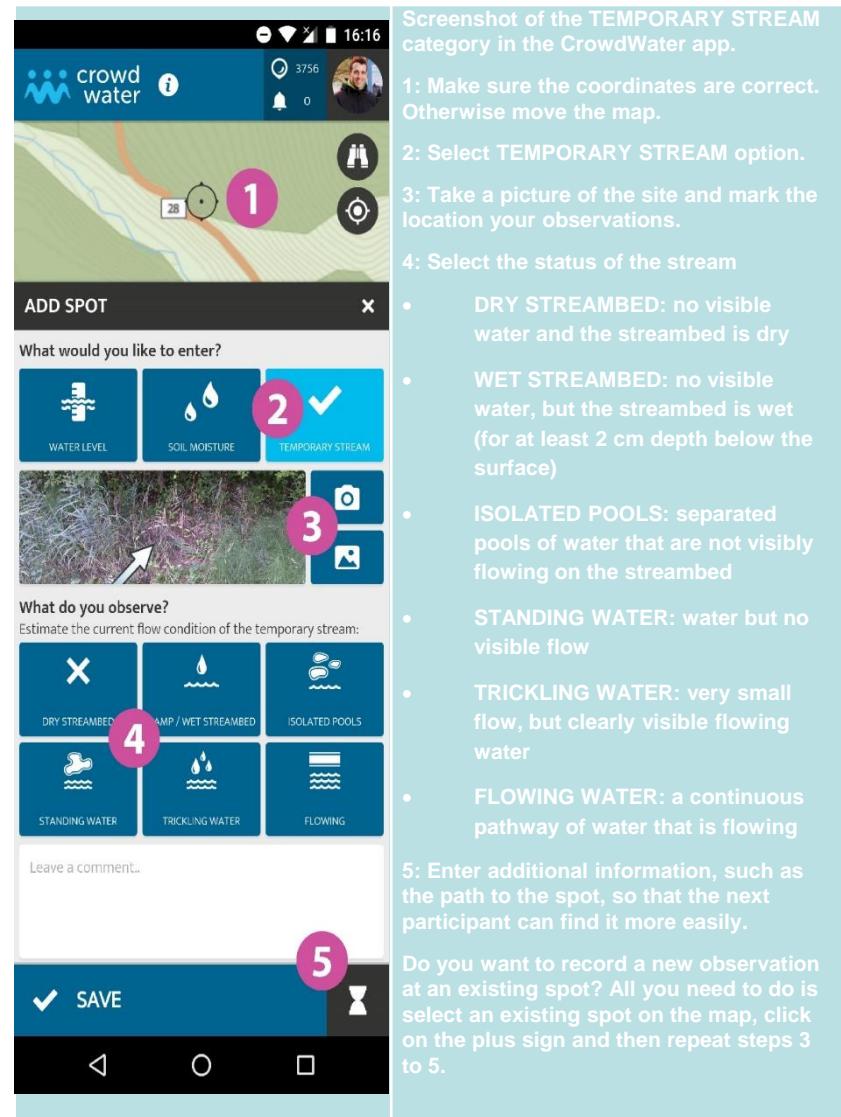
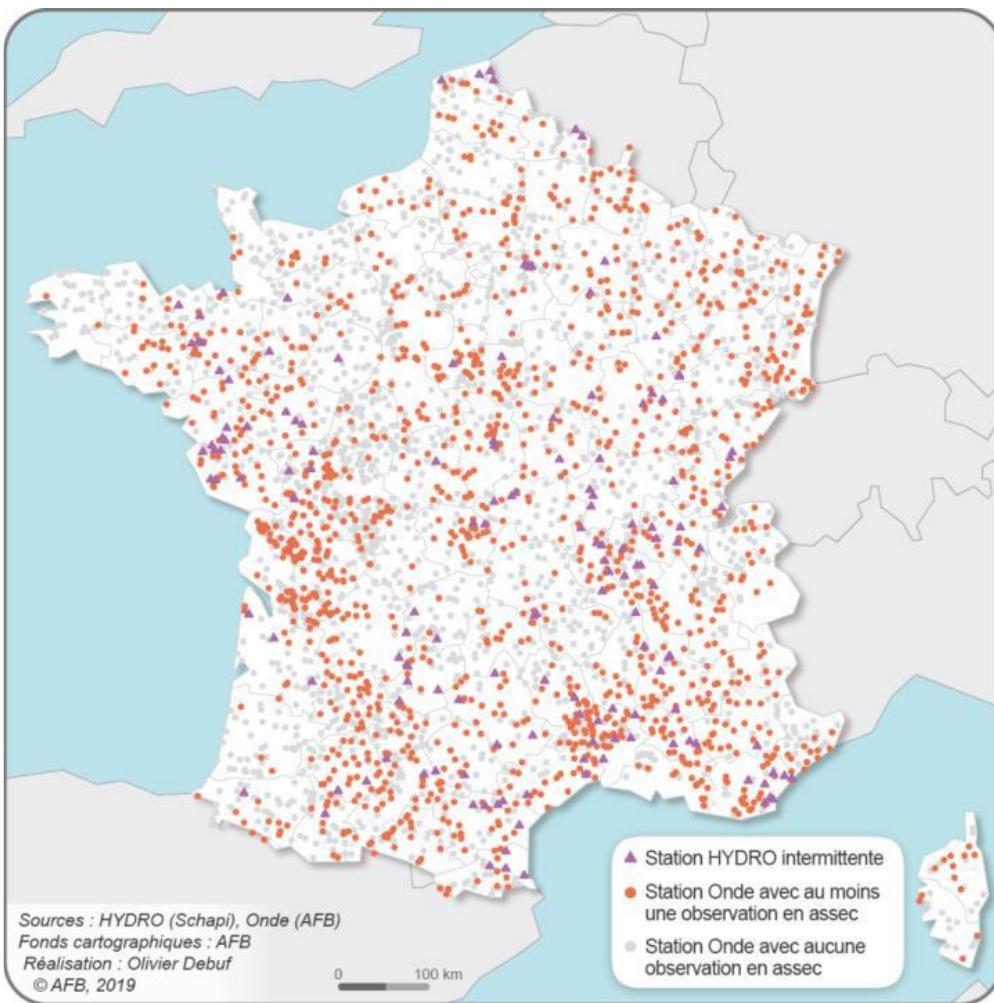


Water abstraction is one of the major impacts on temporary rivers in the Mediterranean region. Picture: N. Cid.

News & Events

- 12 June 2017
The 2017 Environment Prize of the Government of Catalonia to RiuNeT app
- 20 May 2017
A day at the 3rd Science Festival to celebrate LIFE's 25th anniversary
- 10 May 2017
TRivers celebrates LIFE's 25th Anniversary at the 3rd Science Festival of the UB
- 03 February 2017
LIFE Trivers will lead a participatory process that will gather priority measures for the conservation of temporary rivers

Des données hydrologiques nouvelles



Des données hydrologiques nouvelles



Un accroissement des efforts internationaux

The screenshot shows the homepage of the IRBAS (Intermittent River Biodiversity Analysis & Synthesis) website. The header includes the URL irbas.cesab.org, a search bar, and various navigation icons. Below the header is a large image of a forest floor with a central circular graphic containing the text "Advancing the Science and Management of Intermittent Rivers". The main menu at the bottom includes links for IRBAS, CONTRIBUTE AND ACCESS DATA, LATEST NEWS, PEOPLE, and CONTACT.

Latest news

Freshwater Biology

Special Issue INTERMITTENT RIVER ECOLOGY AS A MATURING, MULTIDISCIPLINARY SCIENCE: CHALLENGES, DEVELOPMENTS AND PERSPECTIVES

Volume 61, issue 8
Pages 1171–1364

August 2016

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Thibault Dafy, Kent Fidz and Catherine Leigh

Abstract | Article | PDF (480K) | References | Request Permissions

Intermittent river ecology: it's not a dry topic - check out the new Special Issue in Freshwater Biology

Challenges, developments and perspectives in intermittent river ecology: an introductory...

The new special issue of Freshwater Biology traces the challenges, developments and perspectives in this booming field of research and

Tweets by @IRBAS_project

IRBAS @IRBAS_project Global perspective of intermittent river ecohydrology: check out the last IRBAS study: onlinelibrary.wiley.com/doi/10.1111/ecog.0230, @CLeigh_rivers, @tdatry

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Science and Management
of Intermittent Rivers
and Ephemeral Streams

COST
Action
CA15113

What is SMIRES

WGs

STSMs

Events

News

Network Contact

SMIRES is a COST Action addressing the Science and Management of Intermittent Rivers & Ephemeral Streams. SMIRES brings together > 200 hydrologists, biogeochemists, ecologists, modellers, environmental economists, social researchers and stakeholders from 31 different countries to develop a research network for synthesising the fragmented, recent knowledge on IRES, improving our understanding of IRES and translating this into a science-based, sustainable management of river networks.

Latest news



A Training School on the biogeochemistry of IRES !

SMIRES organizes its first Training School (TS): "Biogeochemistry in intermittent streams: techniques and concepts".

Upcoming events

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SMIRES organizes its first Training School (TS): "Biogeochemistry in intermittent streams: techniques and concepts".

MC and WG meetings at Irstea, Lyon, France, 06 and 07 June 2017

MC and WG meetings at Irstea, Lyon, France, 06 and 07/06/2017

The third Management Committee and WG meetings will be held at Irstea, in Lyon, France.

A Special Session on IRES in 2017 at SEFS10, Czech Republic

A Special Session on IRES will be organised at SEFS10, in Czech Republic, in July 2017. More information: <http://www.sefs10.cz/ss12-intermittent-rivers-and-ephemeral-streams>

Short Term Scientific Mission (STSM)

Latest call for proposal, [here](#)

How to join?

If you would like to join SMIRES, please go to the [contact](#) page.



COST Action CA15113

The following links access information about this Action on the COST website.

- SMIRES
- Management Committee
- Memorandum of Understanding
- COST Vademeum

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Merci de votre attention!

