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

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SMIRES

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-pérennes

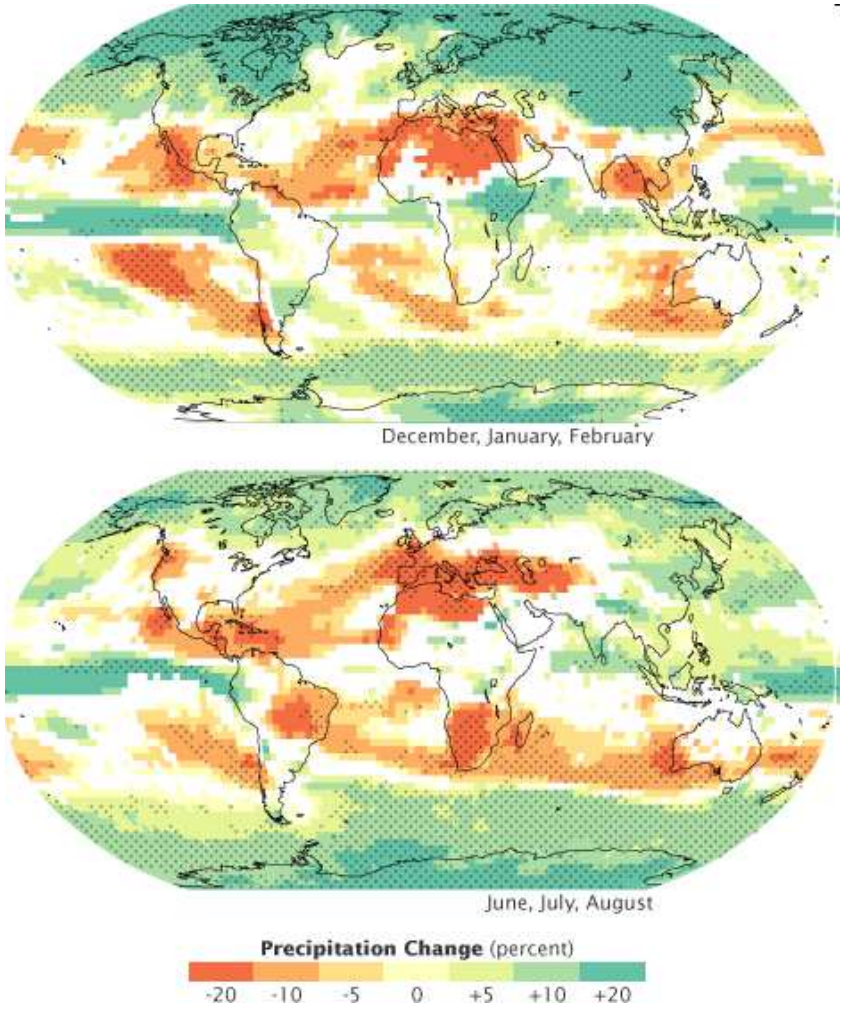
Assèchement: arrêt de l'écoulement avec des mouilles déconnectées ne surface et/ou assèchement complet du lit

Calavon River, Southern France, B Launay

IRES sont partout sur Terre

Et de plus en plus abondantes

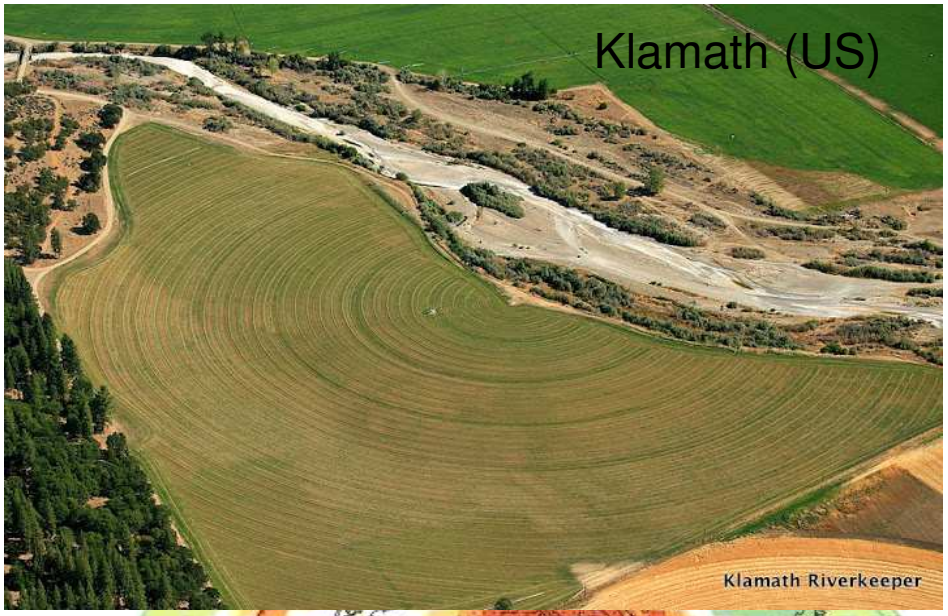
In all regions facing drying trends due to climate change



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

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

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.

LETTERS

This intermittent stream in Colorado would benefit from EPA protection for temporary waterways.

Edited by **Jennifer Sills**

Protecting U.S. temporary waterways

Protecting the ecological health of rivers relies on maintaining intact flows from source areas 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 recodify the definition of "waters of the United States" to include temporary waters 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 U.S. temporary waterways

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IRES sont souvent perçues comme anecdotiques en Europe

IRES sont souvent perçues comme anecdotiques en Europe

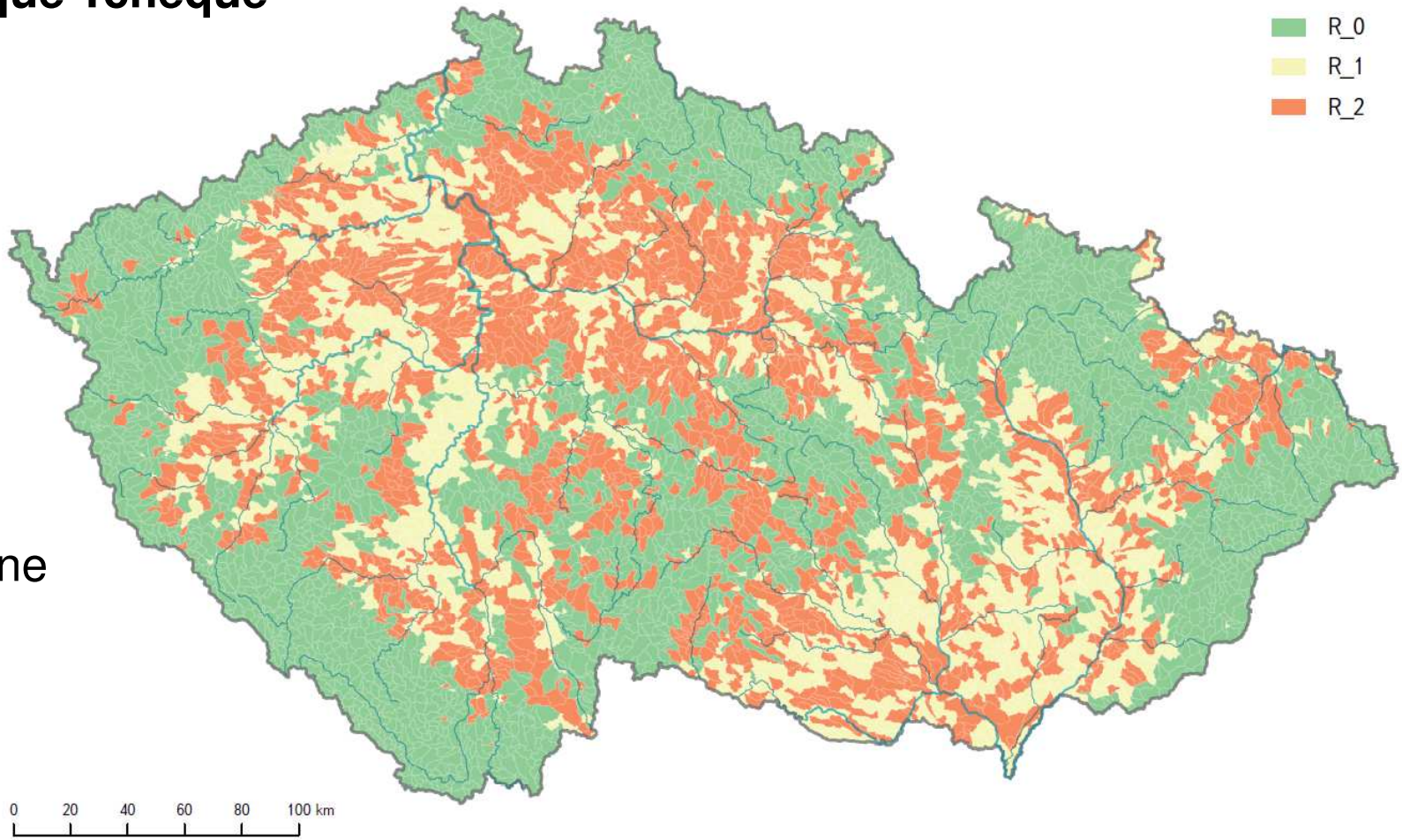
Photo: N. Bonada

Pourtant….

République Tchèque

Risk analysis

>50% prone to drying



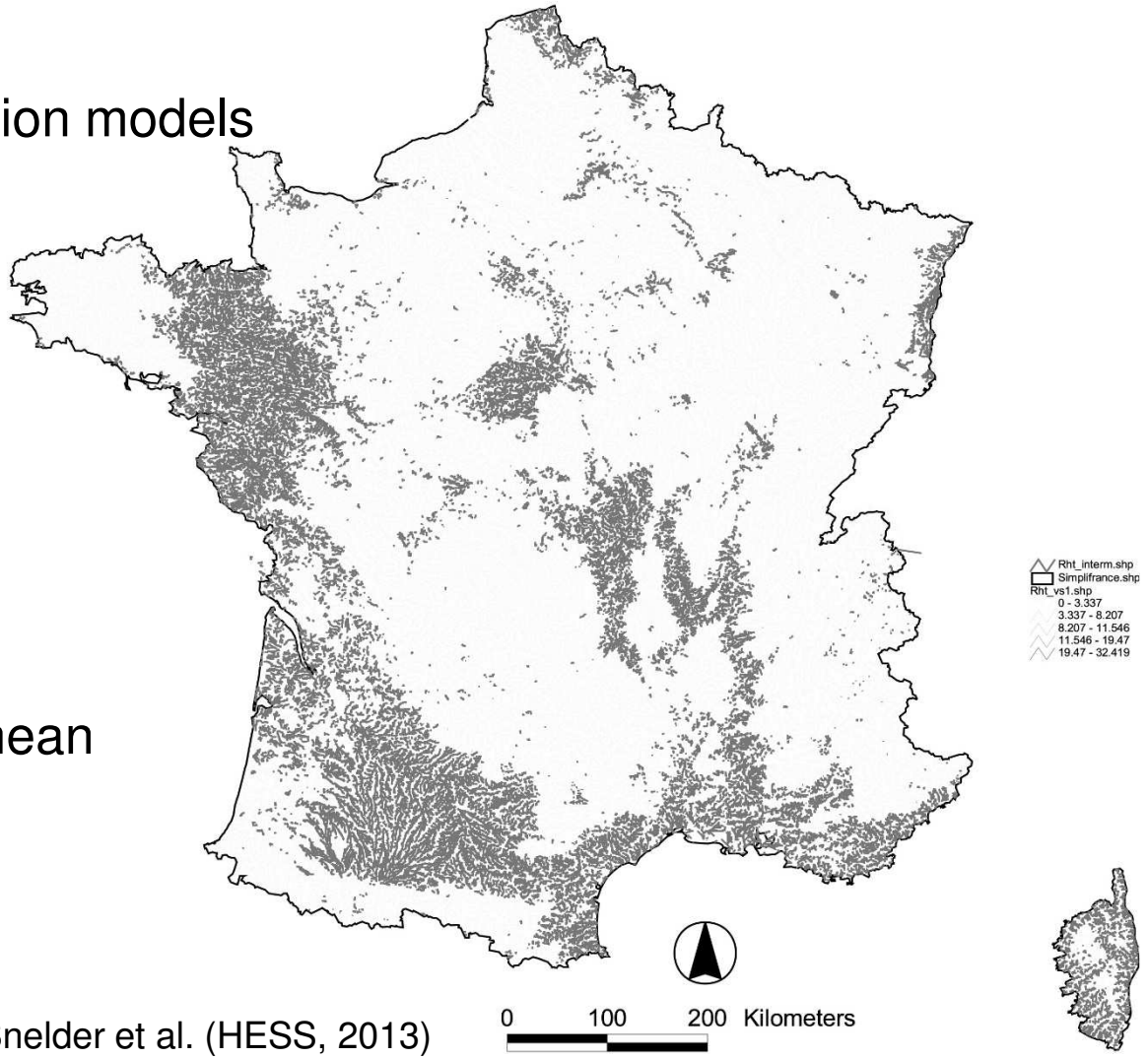
After Zahradkova et al. (VTEI, 2015)

Pourtant….

-predictions from regionalisation models

-28-43% of the network is intermittent

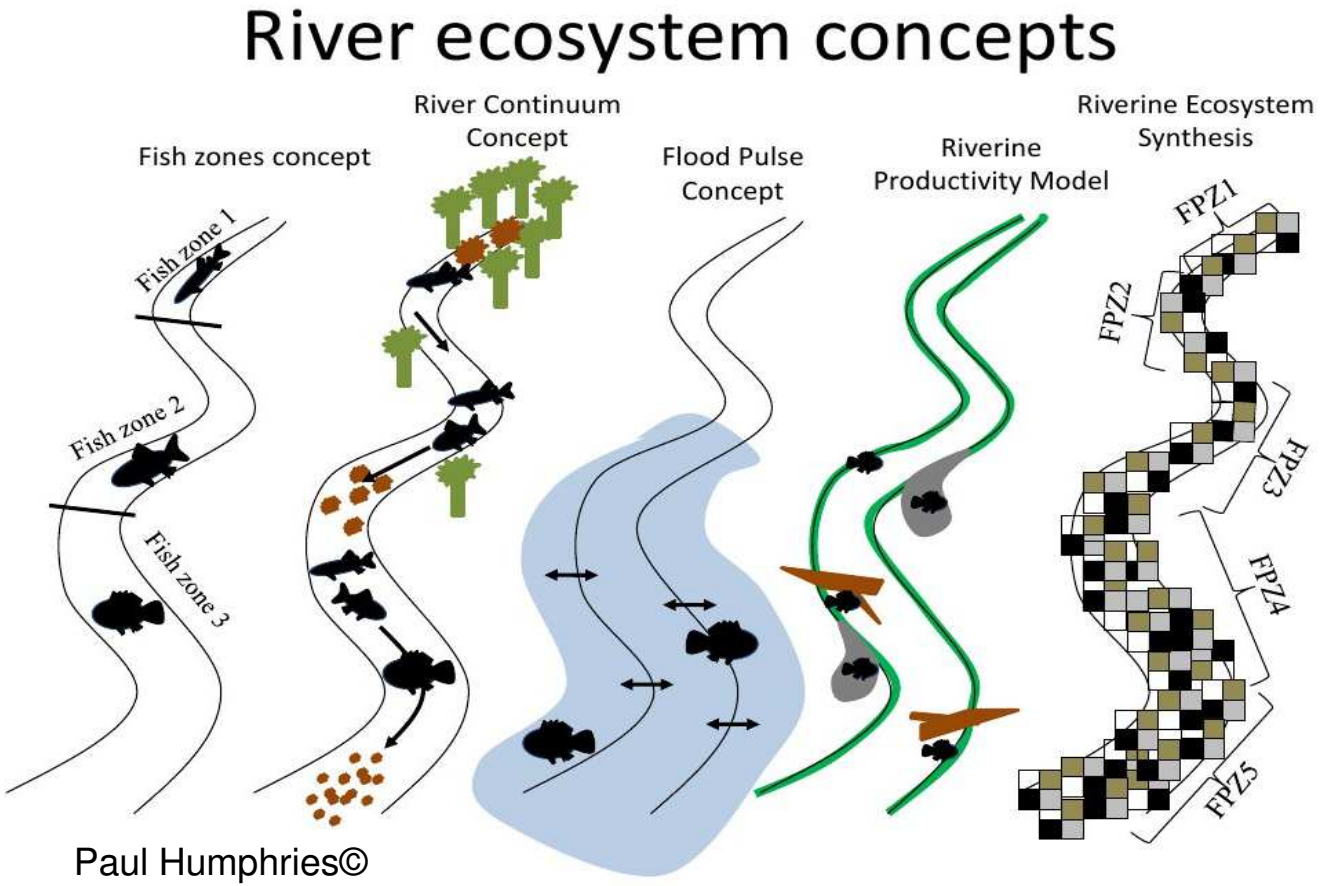
-widespread distribution &
not only in the dry Mediterranean region



After Snelder et al. (HESS, 2013)

IRES: une addition récente à l'écologie aquatique

Historically overlooked by ecologists & water managers



Loticity

Directionality

Continuum

Aquatic communities & processes

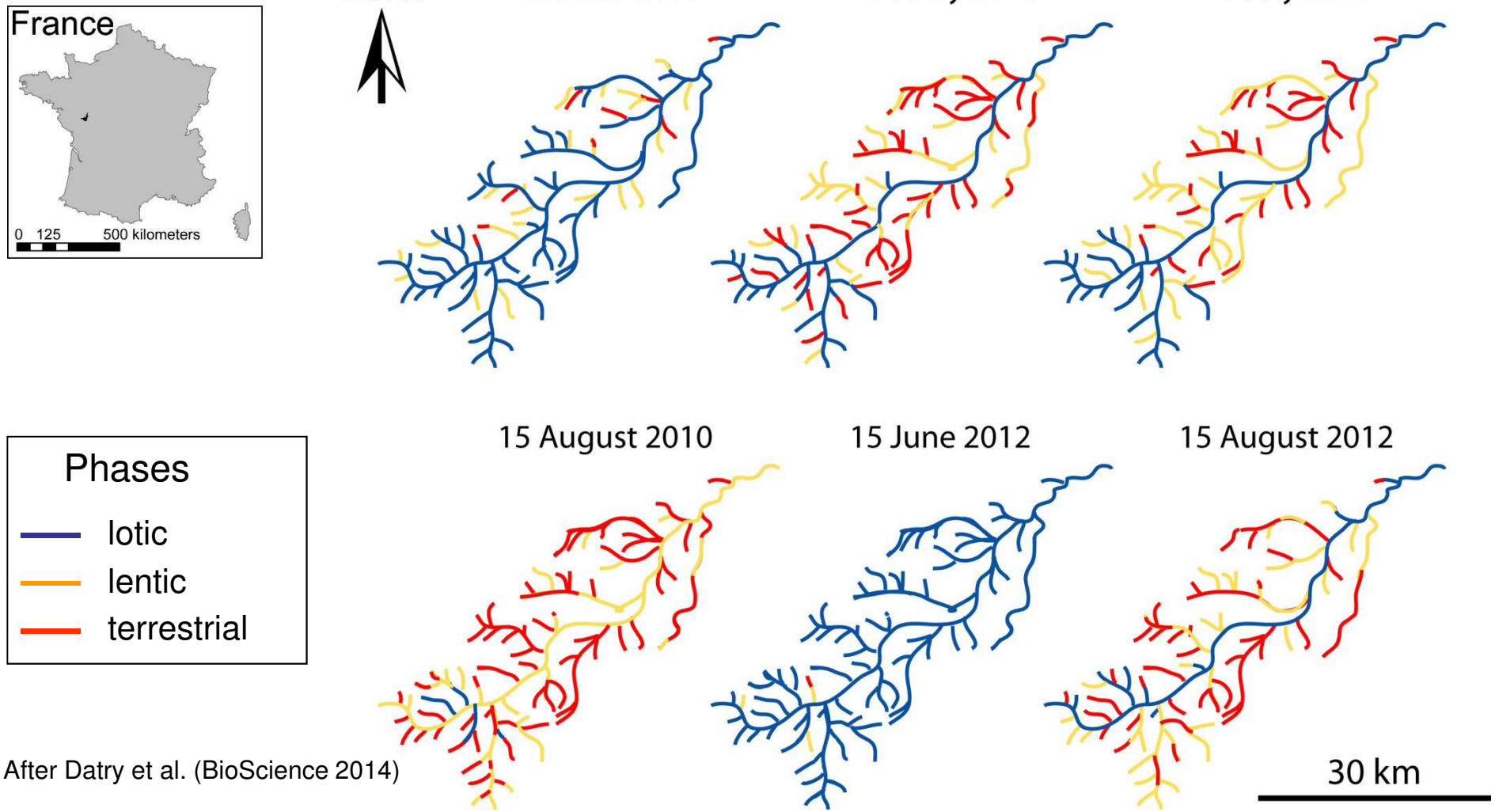
Les IRES challengent nos connaissances et modes de gestion des rivières

Des mosaïques spatio-temporelles d'habitats terrestres et aquatiques

es spat
rrestres

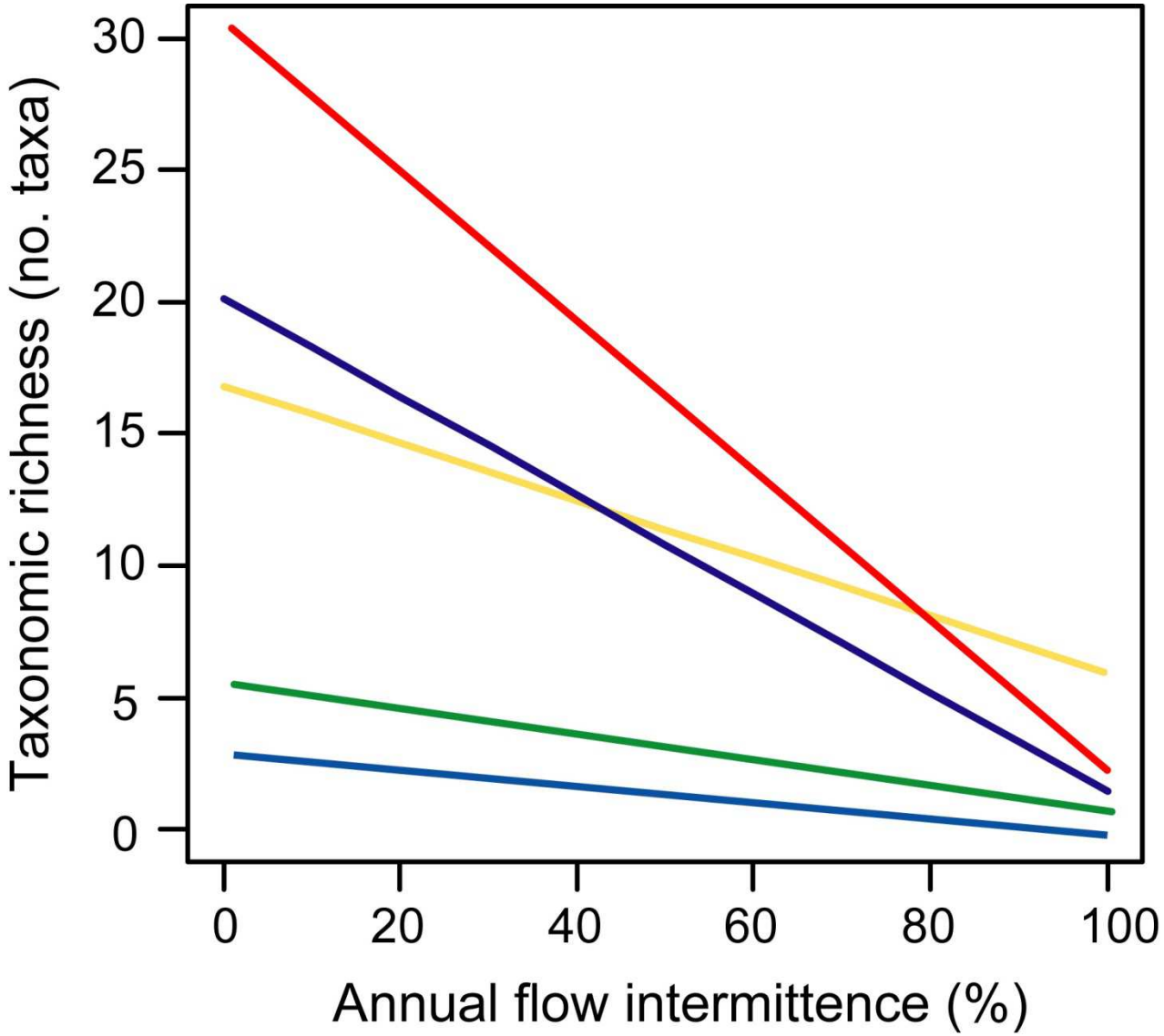
Des mosaïques spatio-temporelles d'habitats terrestres et aquatiques

Le Thouaret catchment:



After Datry et al. (BioScience 2014)

Une faible biodiversité?



Benthic invert.

Diatoms

Hyporheic invert.

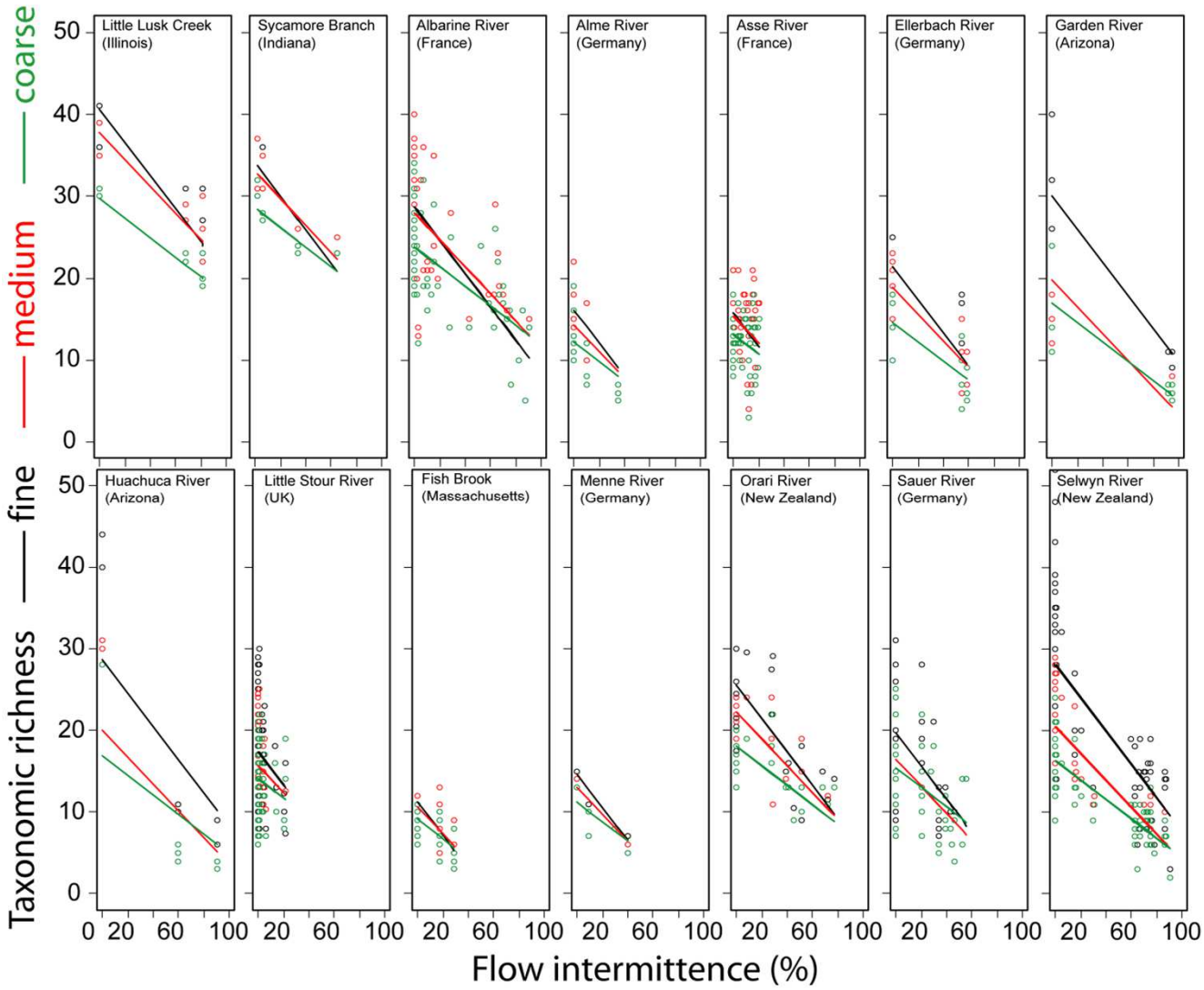
Riparian plants

Fish

After Datry et al.
(BioScience 2014)

Une faible biodiversité?

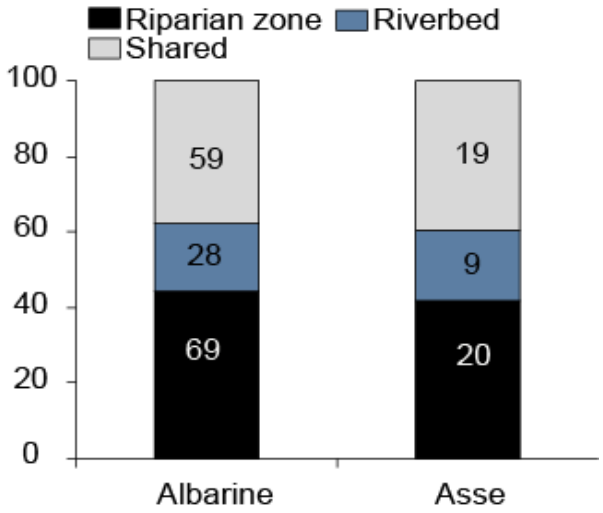
Taxonomic richness across lotic phases



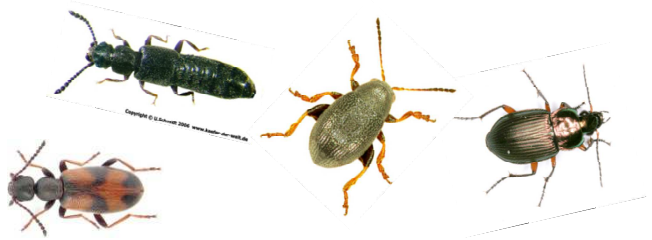
Datry et al. (Ecography, 2014)

Les habitats lentiques et terrestres: *terra incognita*

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



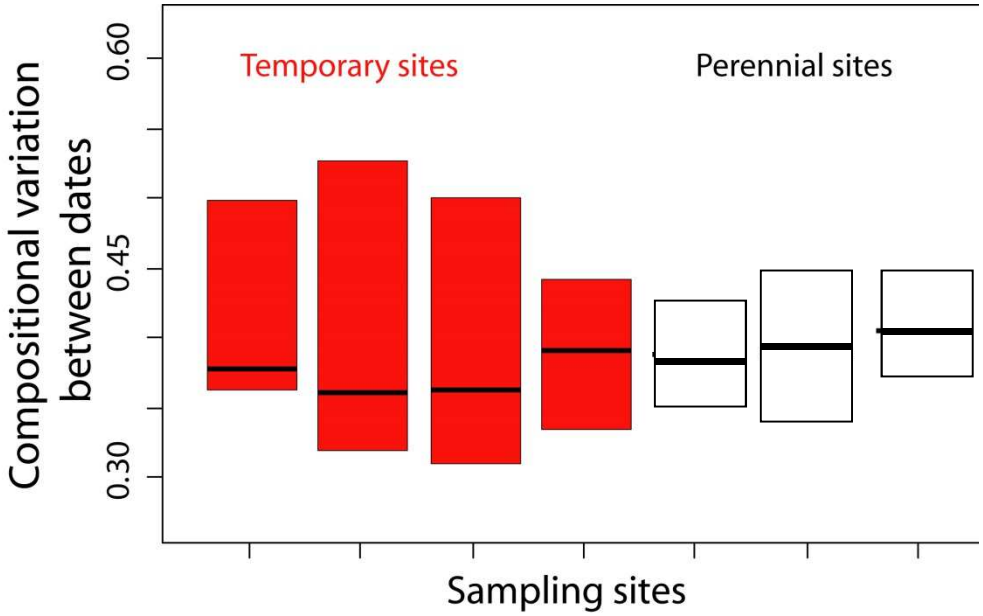
10-30 % of unique taxa

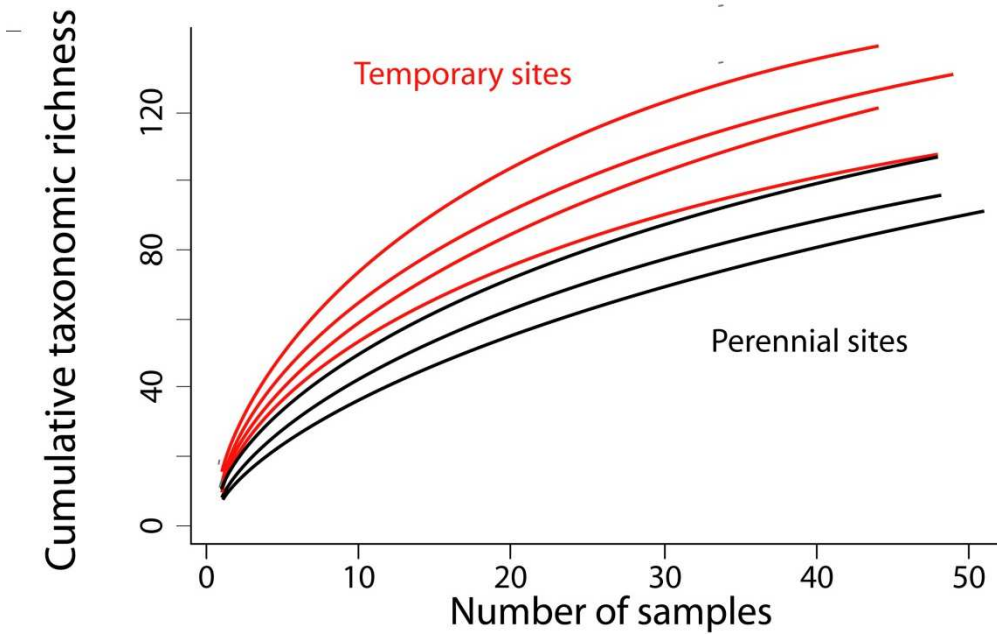


After Corti & Datry (FWB, 2016)

=> 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)





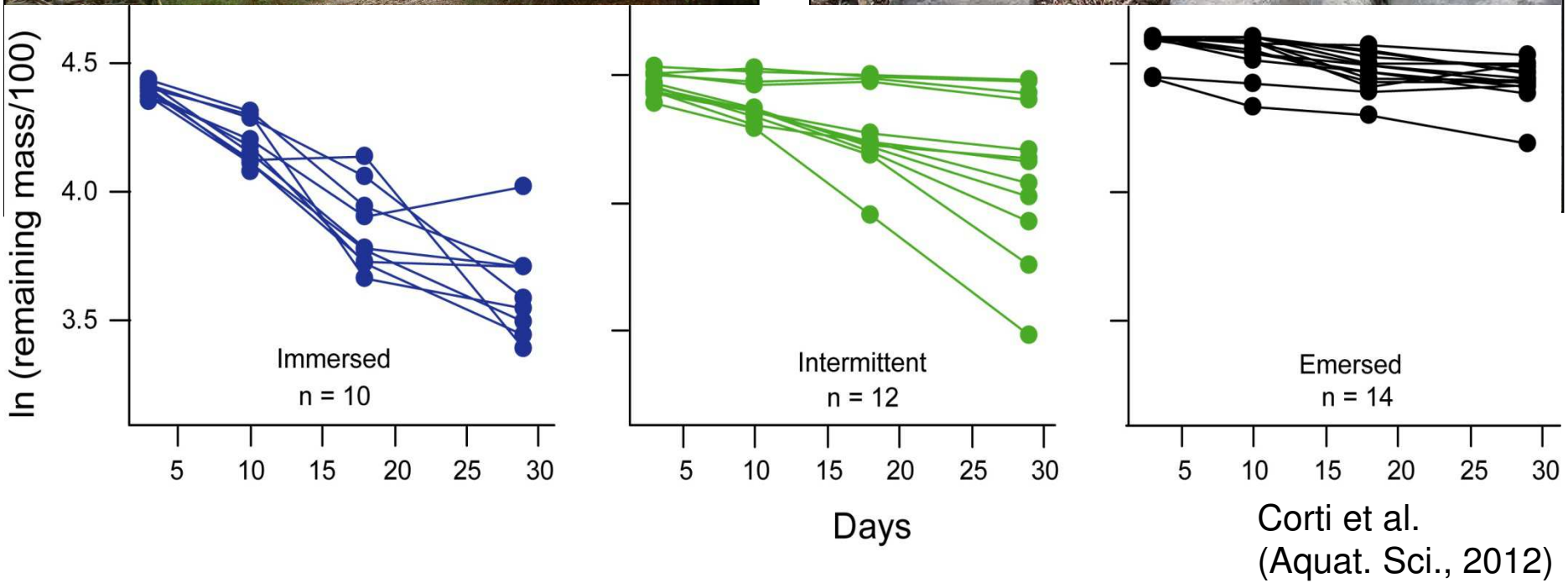
Corti et al. (2017)

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 »

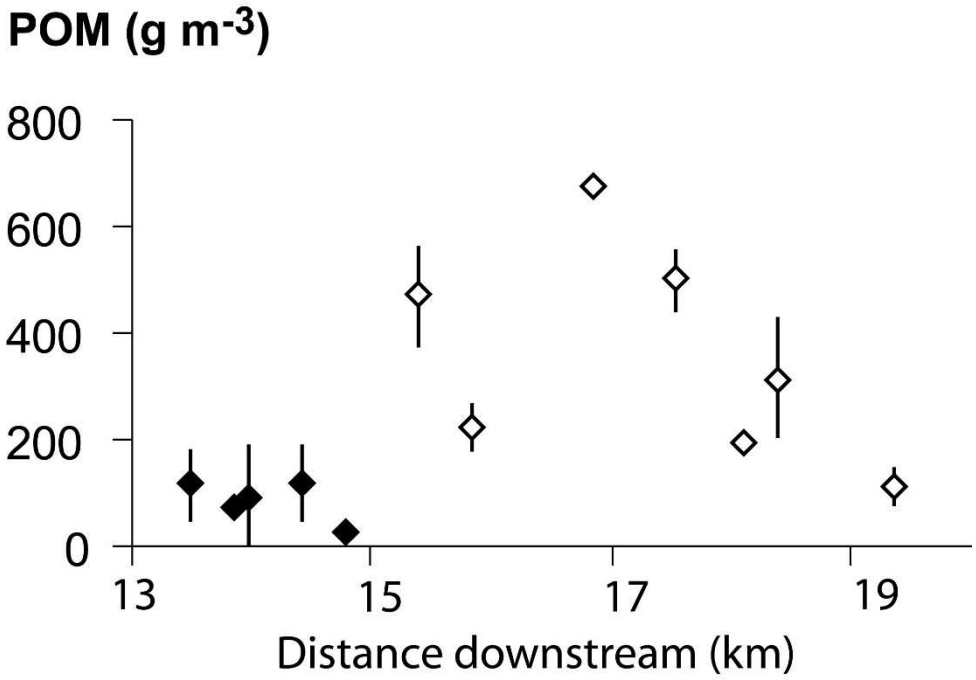


Corti et al.
(Aquat. Sci., 2012)

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

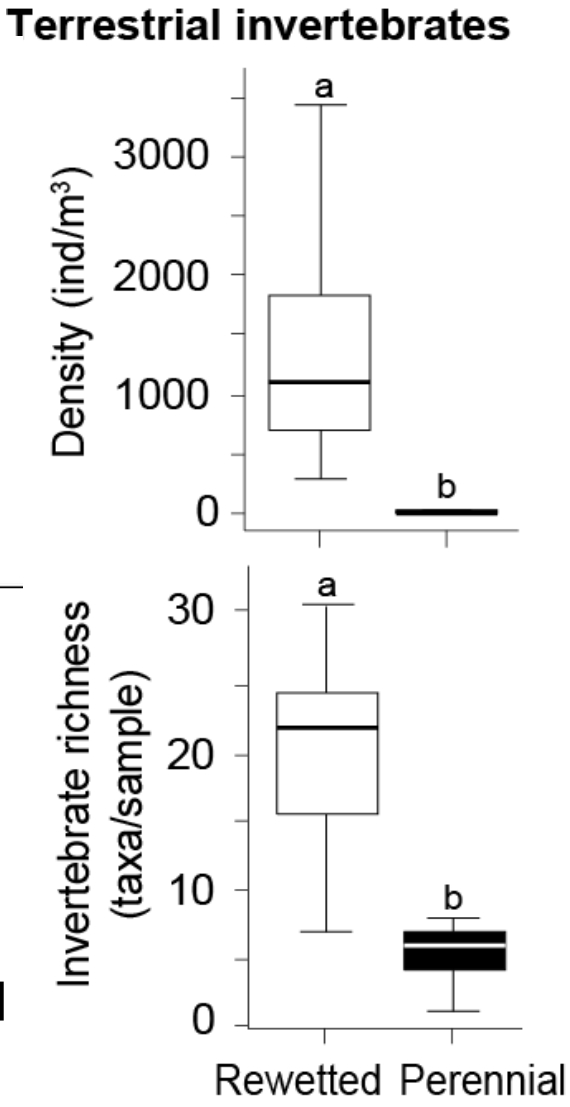
Un fonctionnement biogéochimique en « pulse »

D'importantes quantités de matière organique transportées



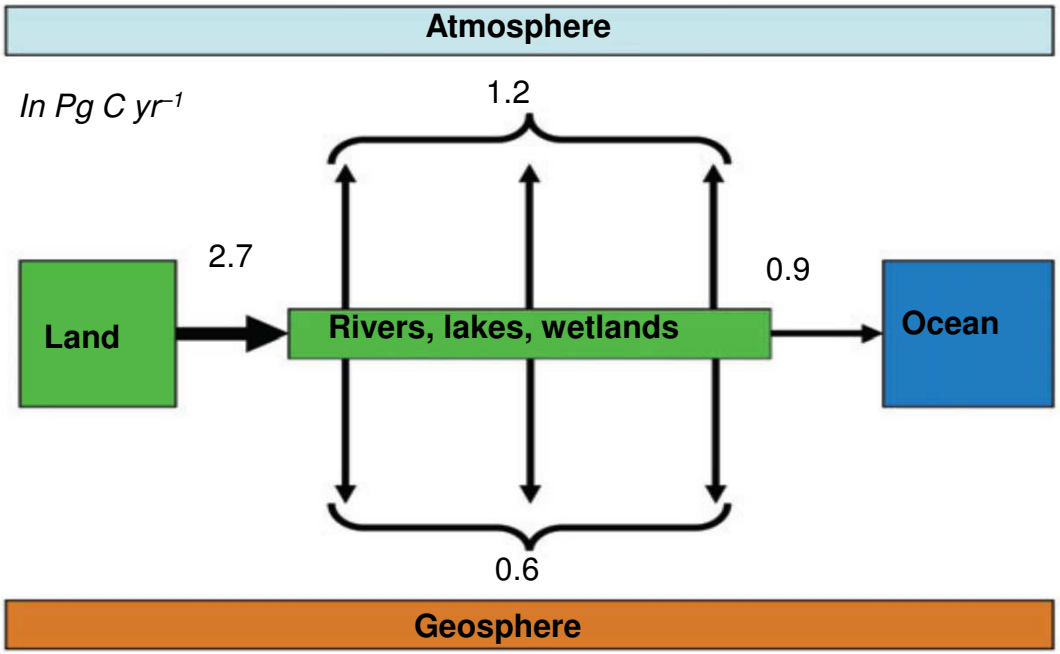
=> Ecological consequences (eg. foodwebs, anoxic pulses, etc) ?

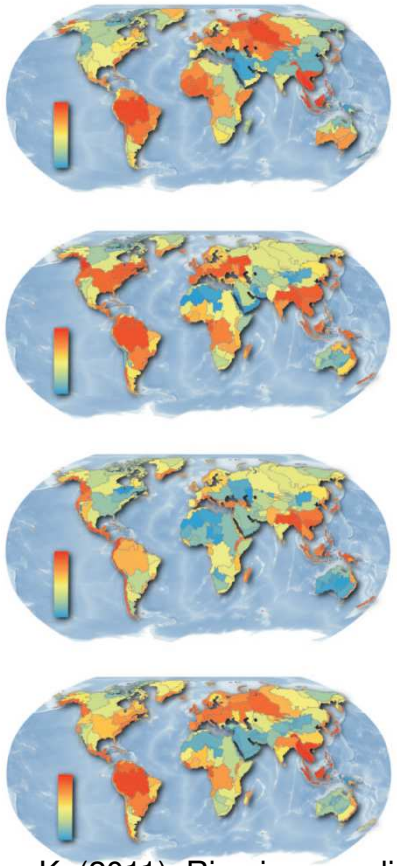
=> Current biogeochemical models and estimates accurate?



After Corti & Datry (FWS, 2012)

Un rôle substantiel dans le cycle global du C?

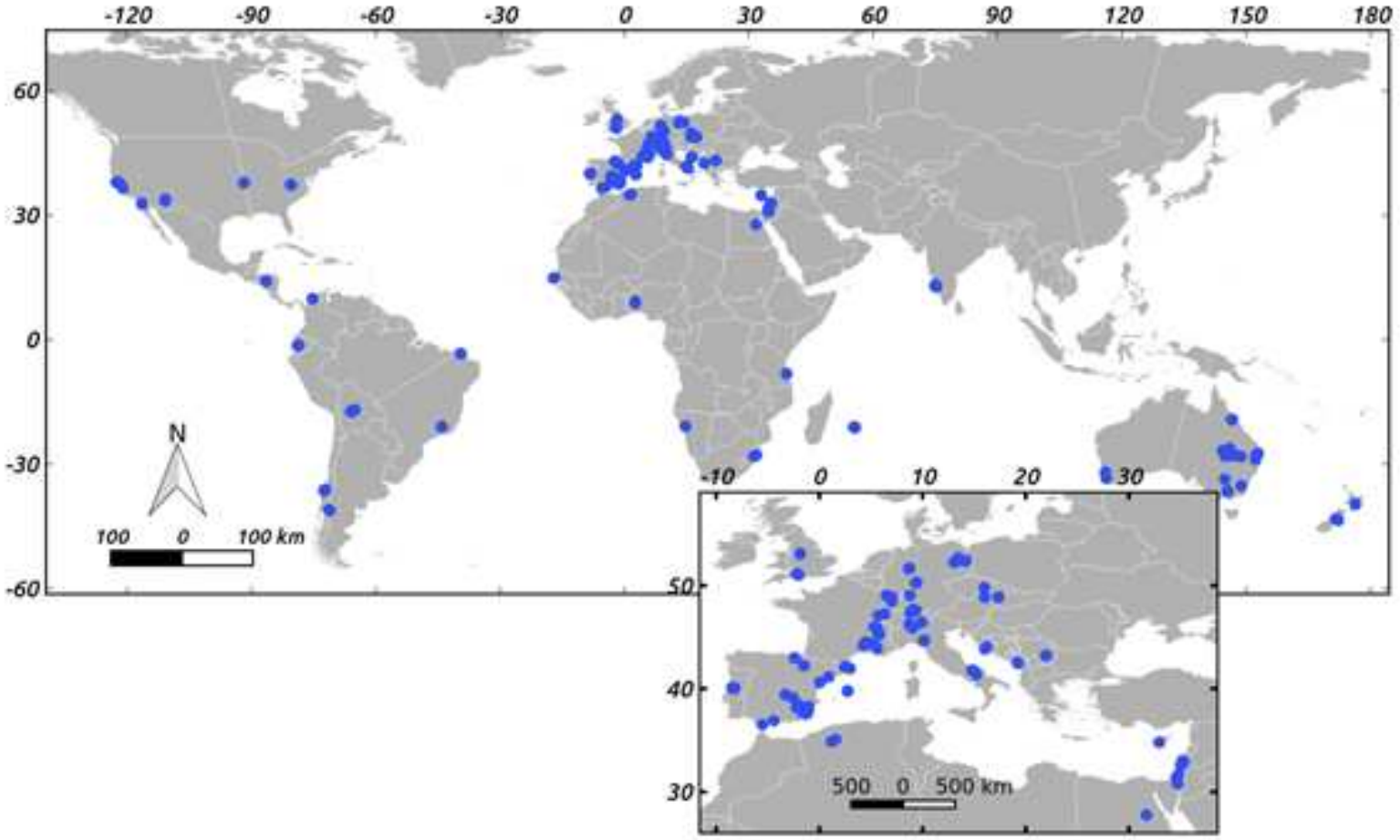




Aufdenkampe, A. K., Mayorga, E., Raymond, P. A., Melack, J. M., Doney, S. C., Alin, S. R., ... & Yoo, K. (2011). Riverine coupling of biogeochemical cycles between land, oceans, and atmosphere. *Frontiers in Ecology and the Environment*, *9*(1), 53-60.

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

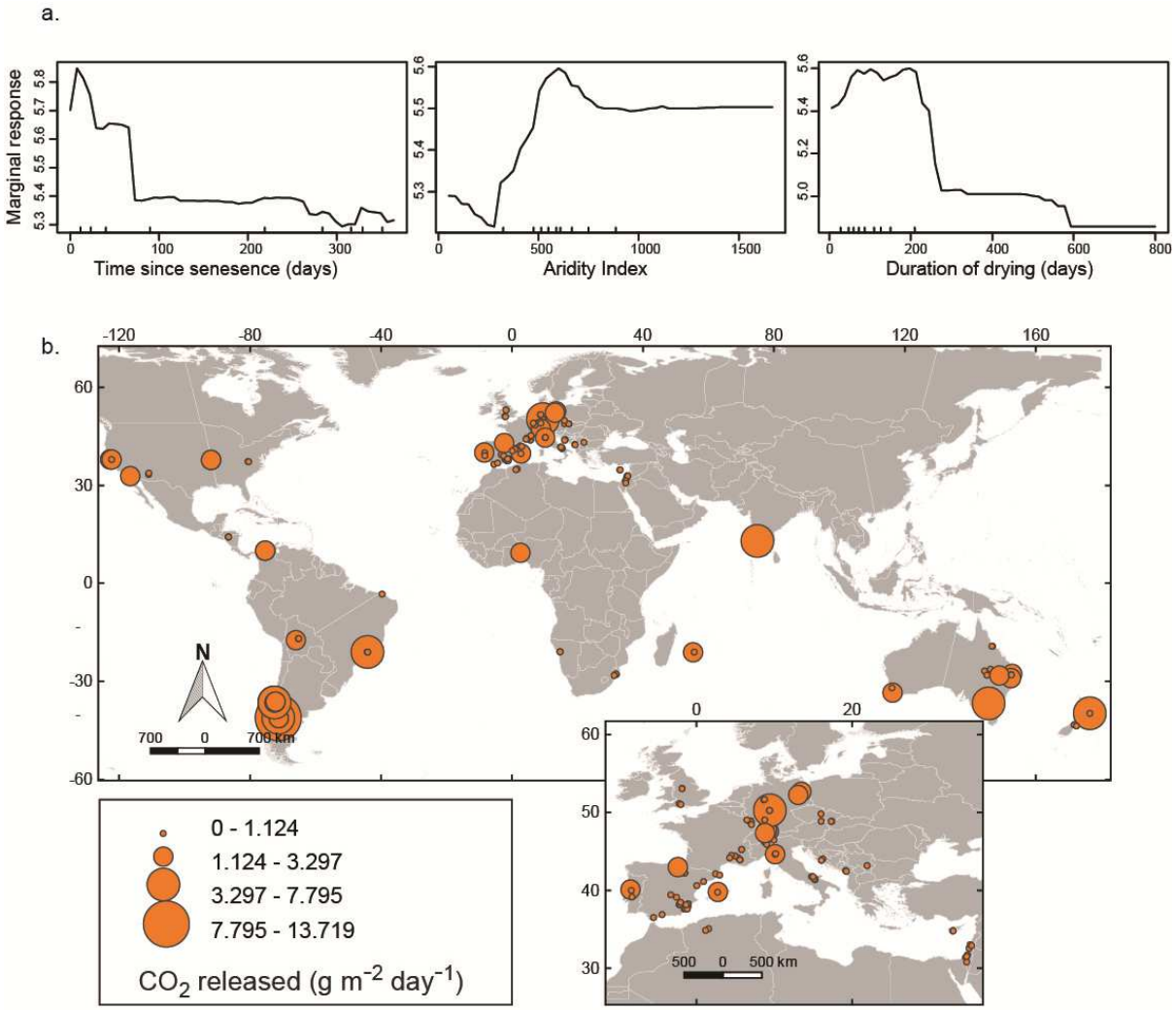
Respiration rates measured during the first 24h of rewetting using standard drinking water (Volvic®) without inoculum

Poids moyens en in $g.m^{-2}$

Type	Min	Max	Mean	±	S.D.	Fraction
Total	2.3	8 291	284	±	834	100
Leaf litter	0	720	128	±	84	42
Wood	0	7 820	162	±	724	39
Herb	0	500	7	±	39	6
Biofilm	0	327	6	±	35	5
Fruits	0	351	14	±	44	5
Catkins	0	41	1	±	4	2
Other	0	257	7	±	26	1

Respiration CO_2 / m^2 / jour

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



IRES et les flux de CO_2 vers l'atmosphère

Perennial rivers and streams:

*Raymond et al. 2013, Nature:

1.8 Pg CO_2 released annually over 624 000 Km^2 , which is ~29.0 g CO_2 m^{-2} day^{-1}

* Aufdenkampe et al. 2011, FREE:

0.56 Pg CO_2 released annually over 624 000 Km^2 , which is ~9.03 g CO_2 m^{-2} day^{-1}

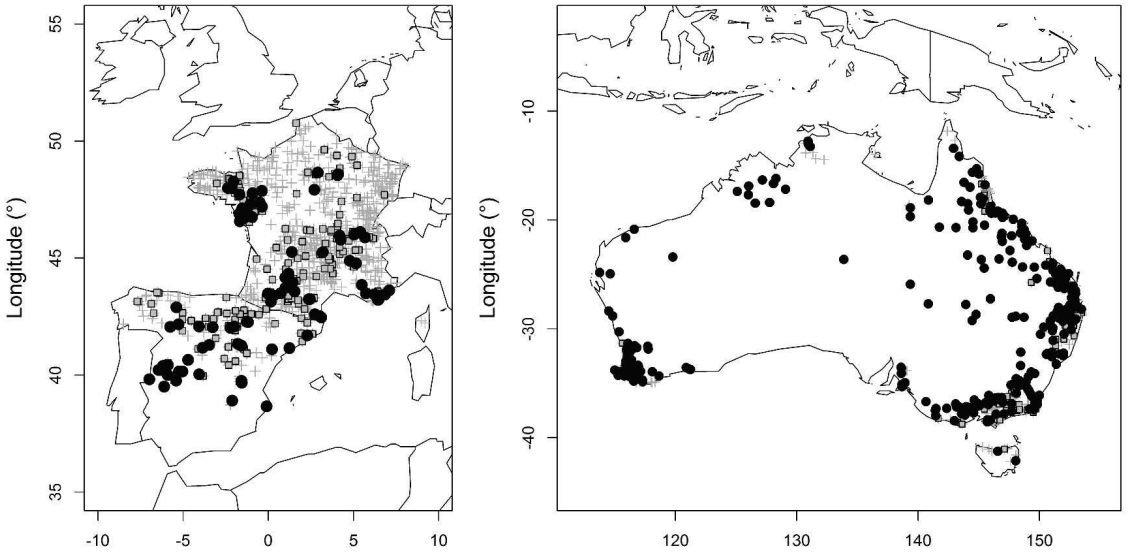
IRES:

* Datry et al. 2018, Nature Geoscience:

The rewetting of accumulated CPOM leads to 0 to 13.7 g CO_2 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.

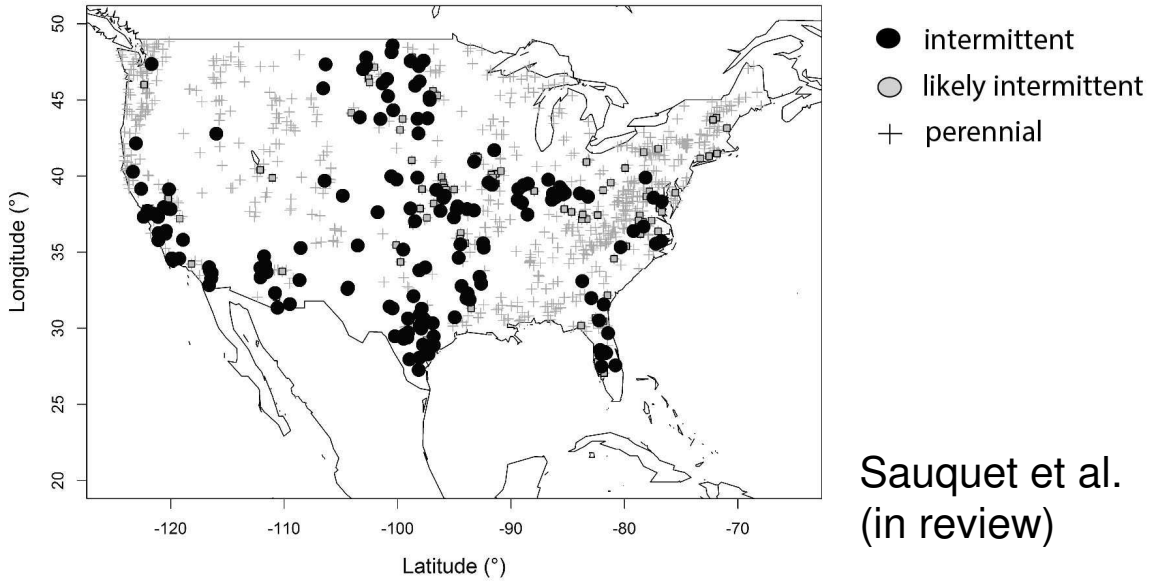
And sediment rewetting?

Les problèmes de gestion: peu de données hydro



Lack of hydrological data in most countries

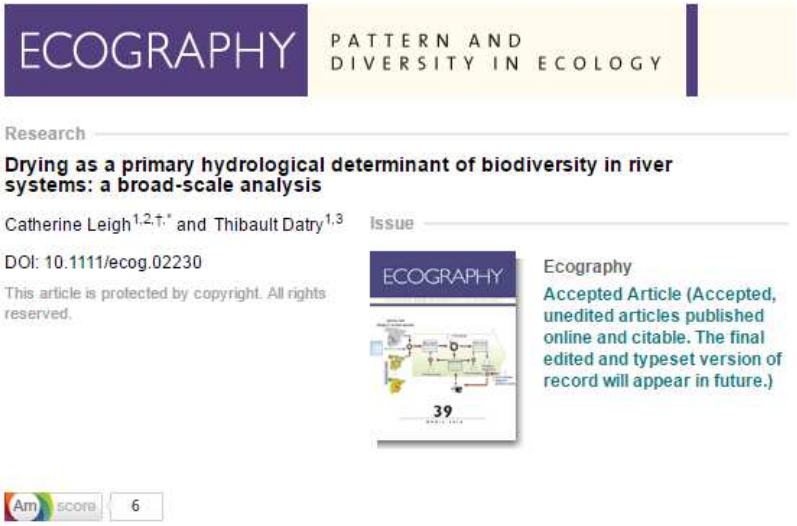
In France, <5% of flow gauging stations in IRES although they comprise 28-43% of the network



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



ECOGRAPHY PATTERN AND DIVERSITY IN ECOLOGY

Research

Drying as a primary hydrological determinant of biodiversity in river systems: a broad-scale analysis

Catherine Leigh[1,2,†,*] and Thibault Datry[1,3]

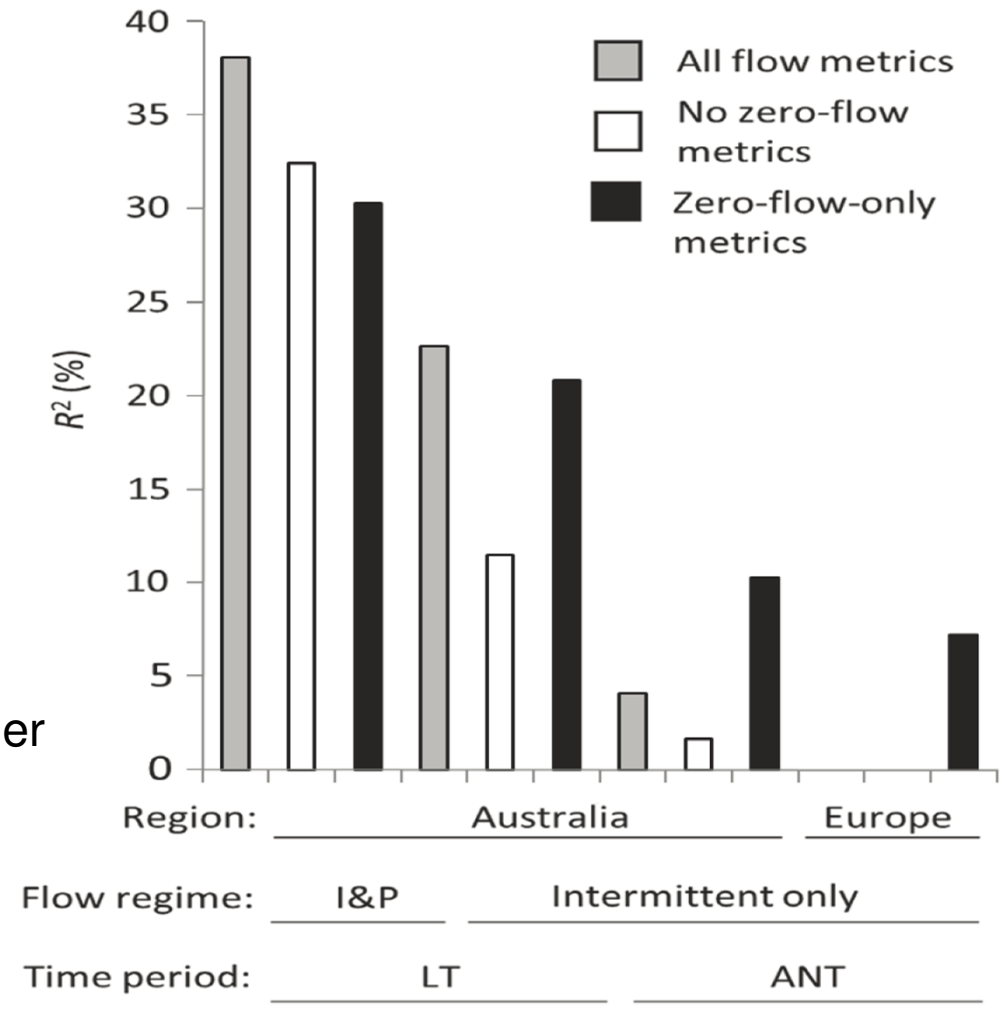
DOI: 10.1111/ecog.02230

Issue

Ecography

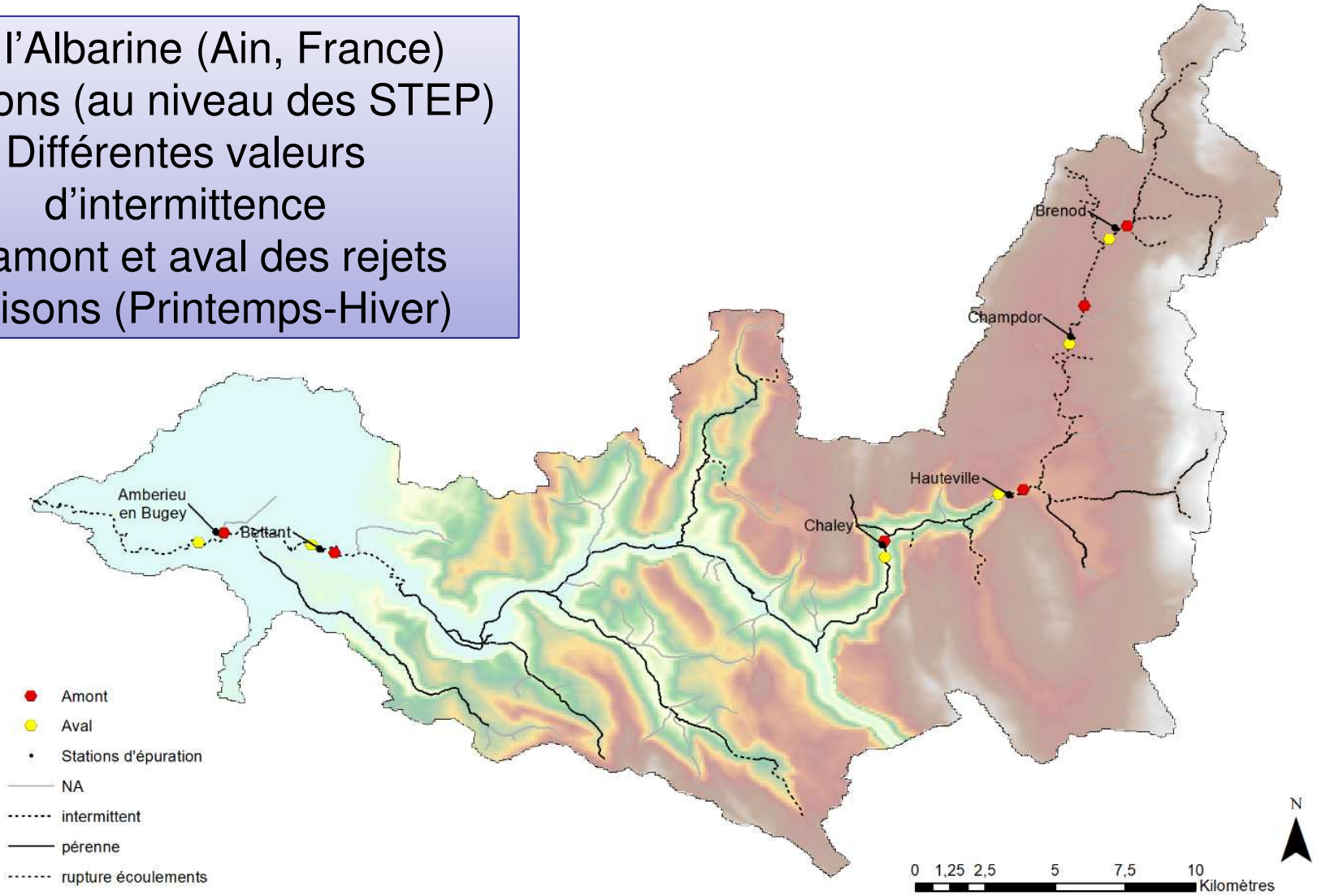
Accepted Article (Accepted, unedited articles published online and citable. The final edited and typeset version of record will appear in future.)

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

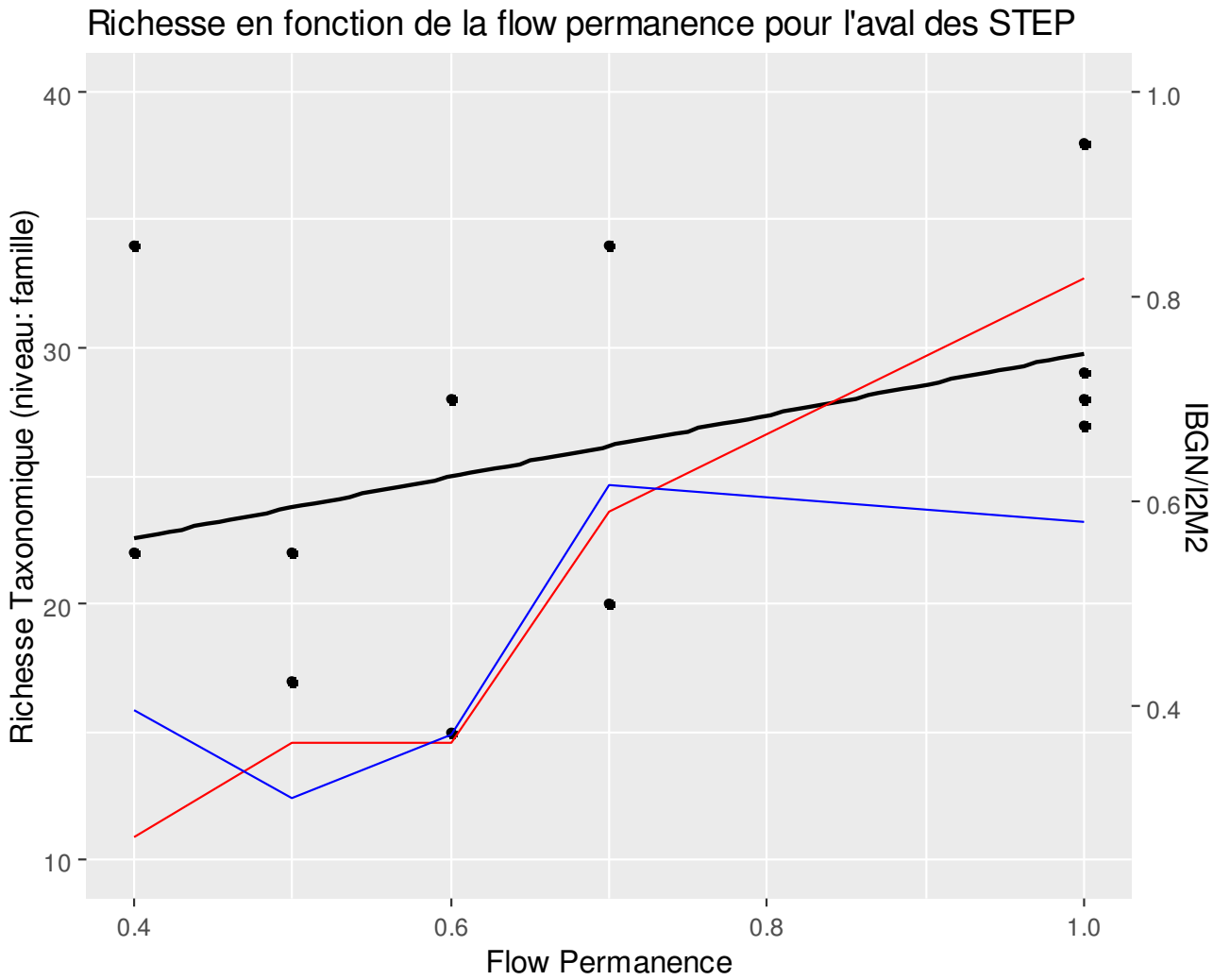


Les outils classiques de bioindication sont inappropriés

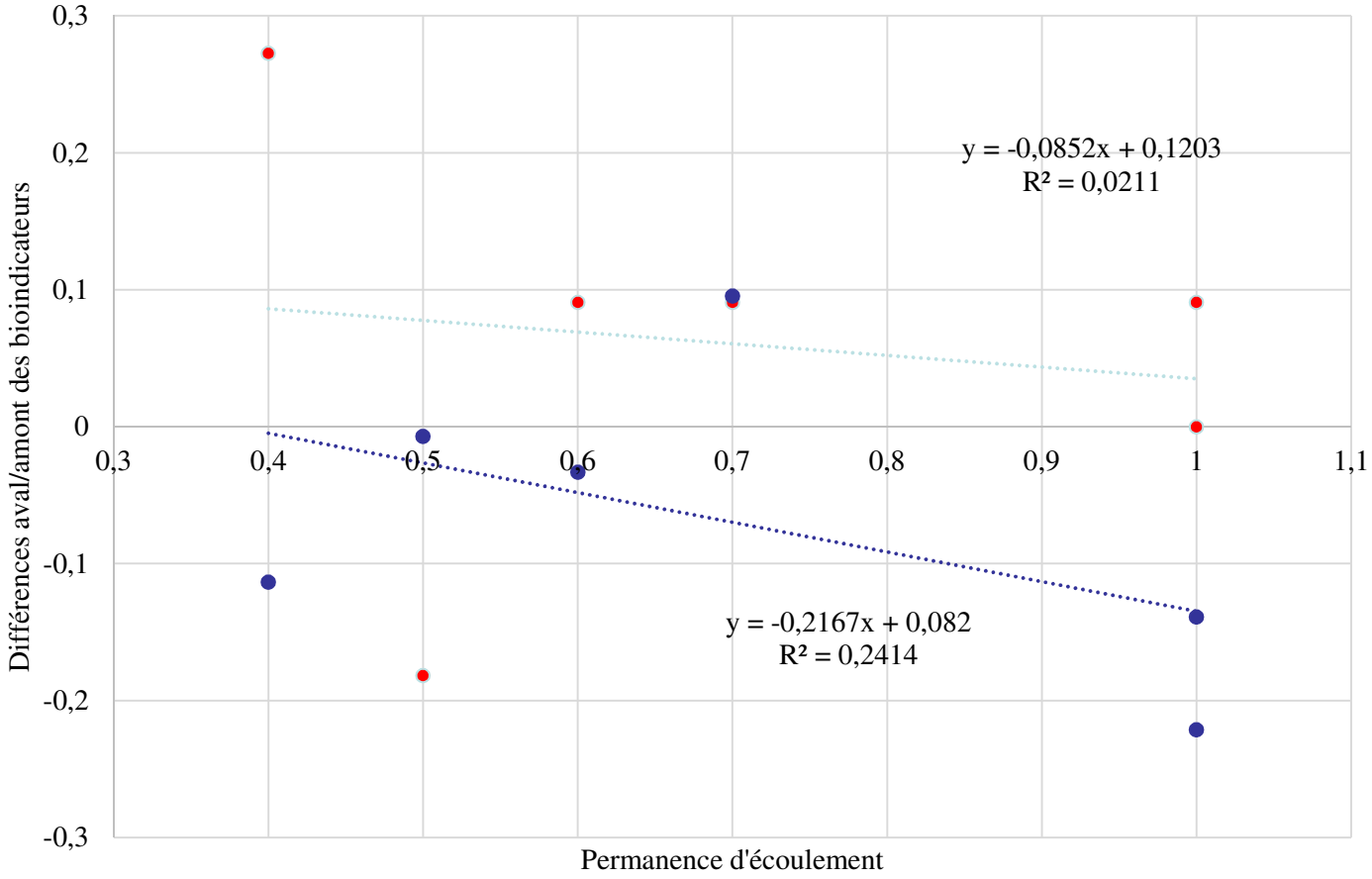
Sur l'Albarine (Ain, France)
6 stations (au niveau des STEP)
Différentes valeurs d'intermittence
En amont et aval des rejets
2 saisons (Printemps-Hiver)



Les outils classiques de bioindication sont inappropriés



Les outils classiques de bioindication sont inappropriés

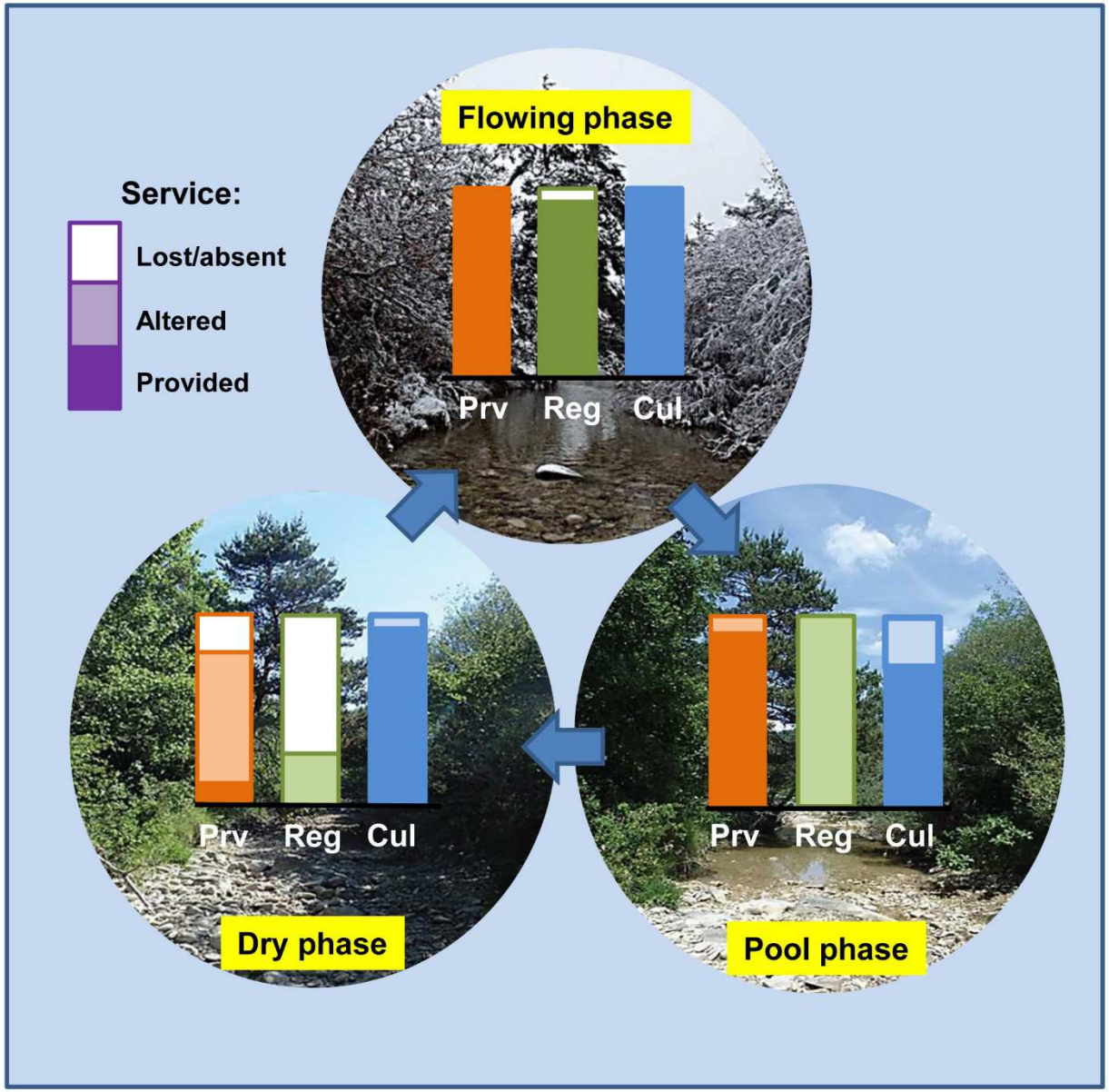


Au plus on a des sites pérennes, au plus une différence des notes est détectée et au plus on est en sites intermittents, au moins la pollution est visible

Implémentation de débits écologiques en IRES?

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

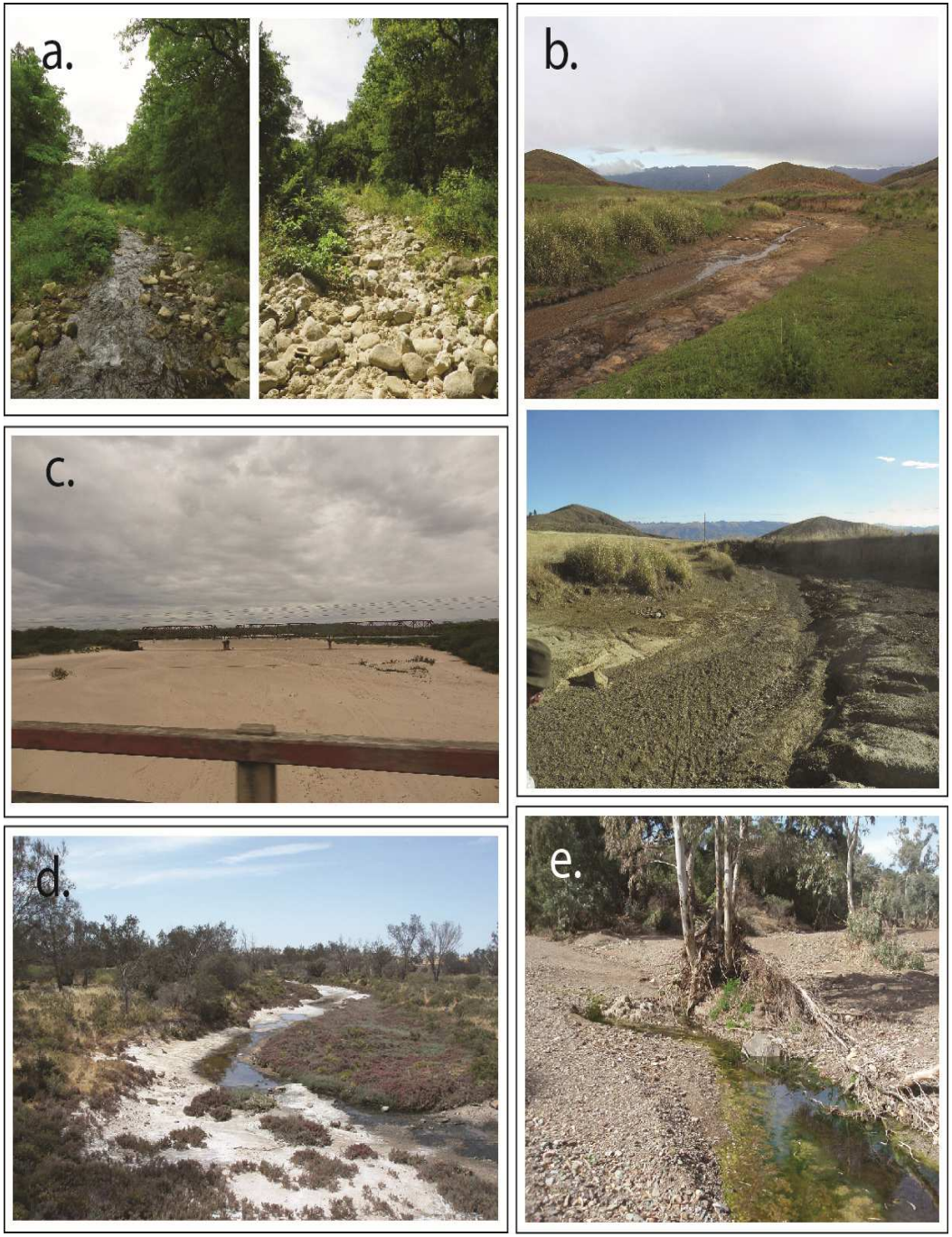
Implémentation de débits écologiques en IRES?



Datry et al. (2018)

Beaucoup de questions et de problèmes…

…mais les solutions se développent!



Les recherches augmentent de manière exponentielle…

Freshwater Biology

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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

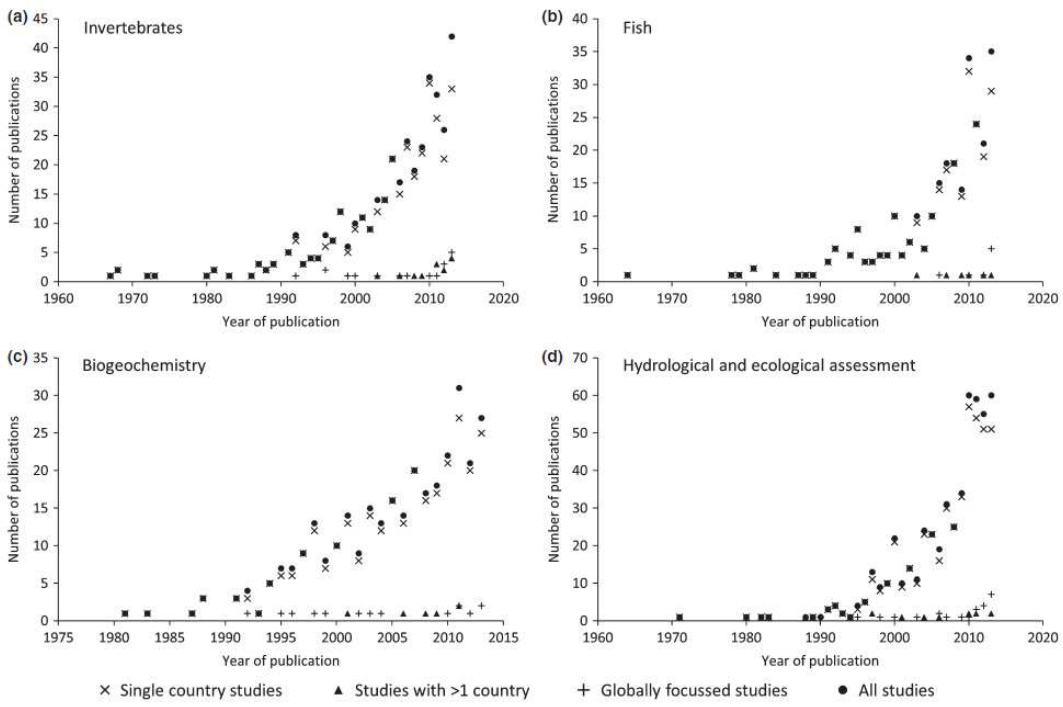

Fig. 2 The number of publications has increased over time for each of the four topics of intermittent river research on which we conducted literature searches: (a) invertebrates, (b) fish, (c) biogeochemistry and (d) hydrological and ecological assessment. See Tables S1 & S2 for detailed information 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?

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

V. Acuña,[1] T. Datry,[2] J. Marshall,[3,4] D. Barceló,[1,5] C. N. Dahm,[6] A. Ginebreda,[5] G. McGregor,[3] S. Sabater,[1,7] K. Tockner,[4,8,9] 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 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. 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, 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 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 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

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

CREDITS: (LEFT) SERGI SABATER; (RIGHT) JAKE HOSEN

[1]Catalan Institute for Water Research, 17003 Girona, Spain. [2]National Research Institute of Science and Technology for Environment and Agriculture (IRSTEA), Aquatic Environments, Ecology and Pollution (UR-MALY), 69626 Villeurbanne, France. [3]Queensland Department of Science, Information Technology, Innovation and the Arts, Brisbane 4001, Australia. [4]Australian Rivers Institute, Griffith University, Nathan 4111, Australia. [5]Water 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. [6]Department of Biology, University of New Mexico, Albuquerque, NM 87131, USA. [7]Institute of Aquatic Ecology, University of Girona, 17071 Girona, Spain. [8]Institute of Biology, Freie Universität Berlin, 14195 Berlin, Germany. [9]Leibniz-Institute of Freshwater Ecology and Inland Fisheries, 12587 Berlin, Germany. [10]Department of Entomology, University of Maryland, College Park, MD 20742, USA. [11]National Socio-Environmental Synthesis Center, Annapolis, MD 21401, USA. *Corresponding author. mpalmer@umd.edu

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

Life TRivers

Implementing the Water Framework Directive to temporary rivers

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News & Events

Welcome to TRivers!

LIFE TRivers studies the hydrology and ecology of **temporary rivers** and aims at creating new tools to improve their management according to the objectives of the EU **Water Framework Directive (WFD)**. The project will contribute to the conservation and restoration of one of the most common river typologies in the Mediterranean Basin, which contains most of Europe´s threatened freshwater biodiversity.

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

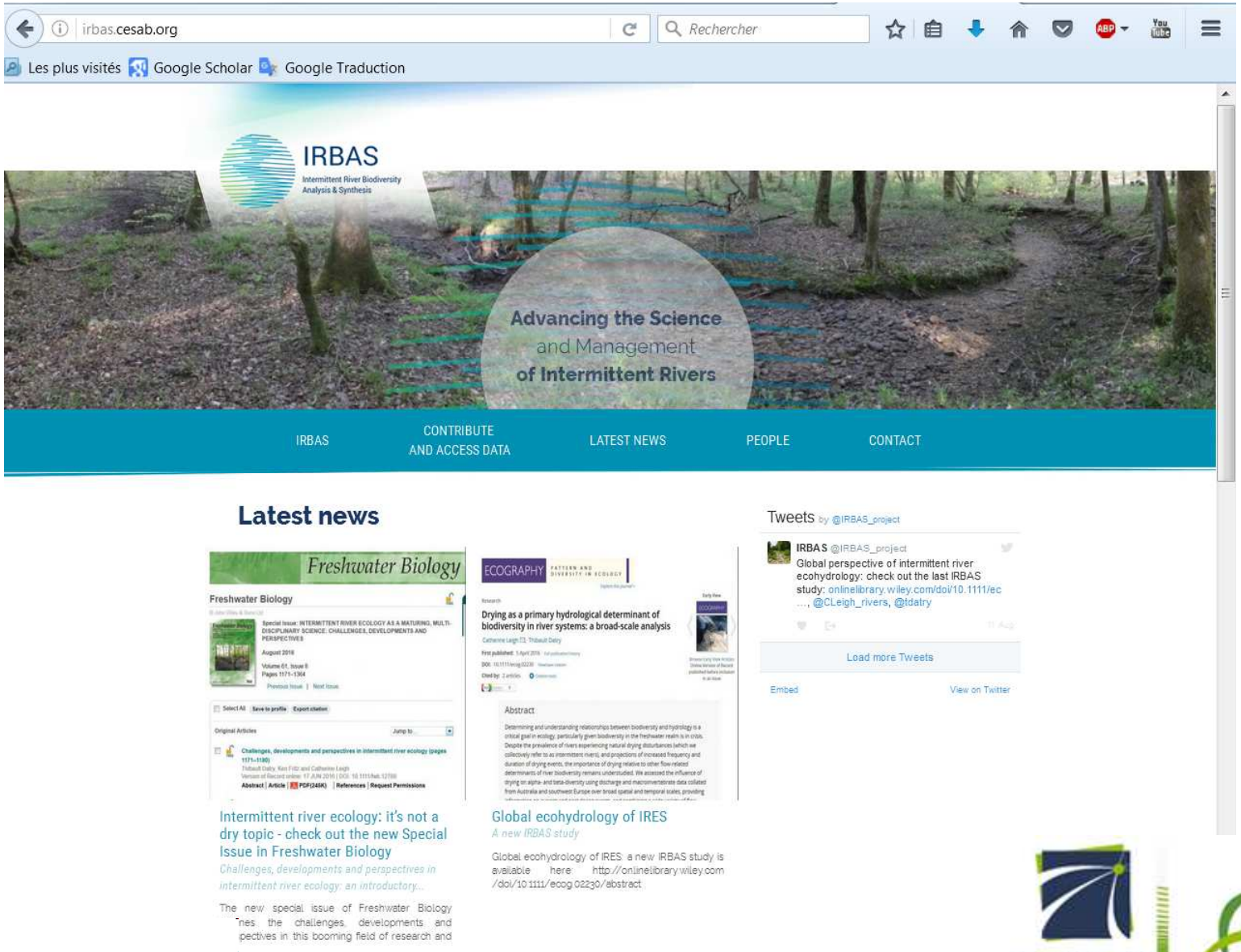
10 May 2017

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

Un accroissement des efforts internationaux



ONEMA
Office national de l'eau et des milieux aquatiques

Irbas.cesab.org

CESAB
CENTRE DE SYNTHÈSE ET D'ANALYSE SUR LA BIODIVERSITÉ

FRB
FONDATION POUR LA RECHERCHE SUR LA BIODIVERSITÉ

Un accroissement des efforts internationaux

SMIRES

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

A Training School on the biogeochemistry of IRES !
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
EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

COST Action CA15113

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

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

Officers

Chair of the Action:
Dr Thibault DATRY (FR)

Vice Chair of the Action:
Dr Gabriel SINGER (DE)

Adminstrative Support of the Action:
Carla PINHO (DE)

Science Officer of the Action:
Dr Deniz KARACA

Administrative Officer of the Action:
Ms Tania GONZALEZ OVIN

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… et des bases de données.

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ORIGINAL RESEARCH

WILEY Ecology and Evolution Open Access

IRBAS: An online database to collate, analyze, and synthesize data on the biodiversity and ecology of intermittent rivers worldwide

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Abstract

Key questions dominating contemporary ecological research and management concern interactions between biodiversity, ecosystem processes, and ecosystem services provi-

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Merci de votre attention!