



XVIII SYMPOSIUM ON PESTICIDE CHEMISTRY “Next generation solutions and sustainable frontiers”

➤ Passive samplers to facilitate the assessment and monitoring of contamination in freshwater environments

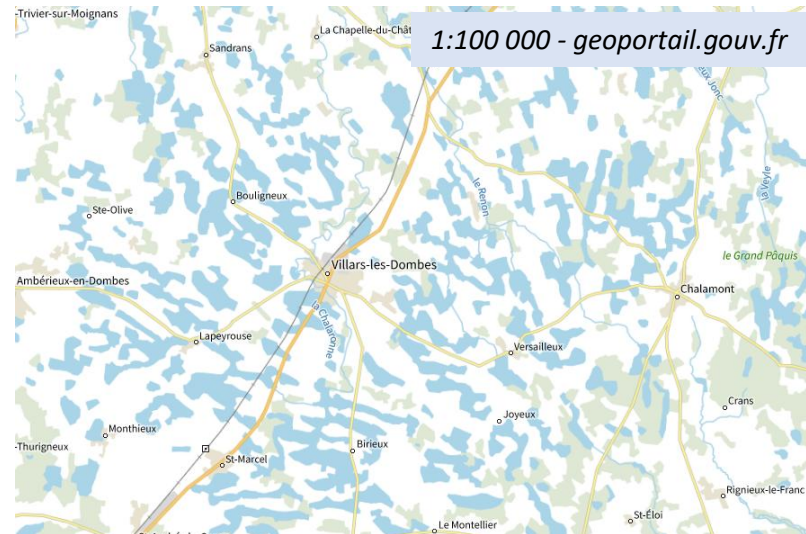
Christelle Margoum, Benoit Sarrazin, Yannick Boissieux, Anaé Degache, Alexandra Gruat, Céline Guillemain, Thibaud Pandelakis and Véronique Gouy-Boussada



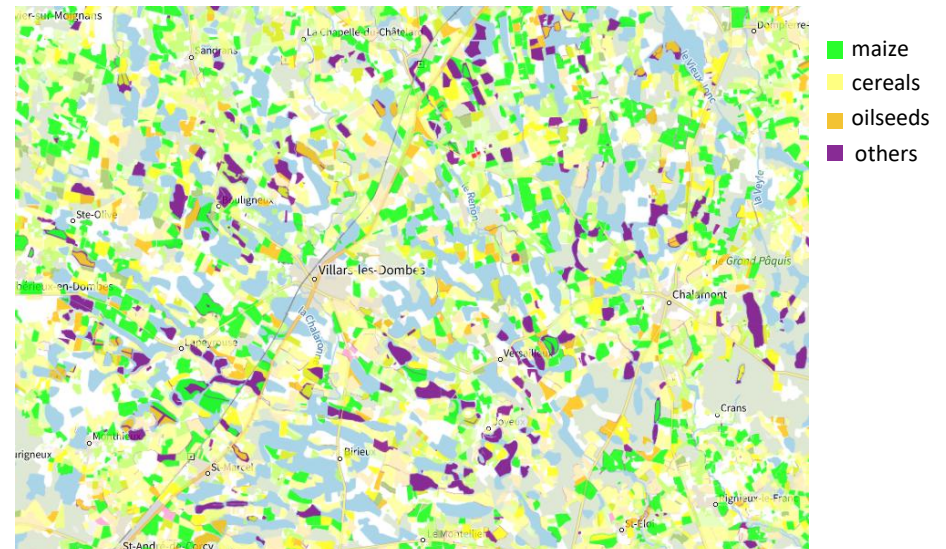
➤ Context: the specific situation in the Dombes area



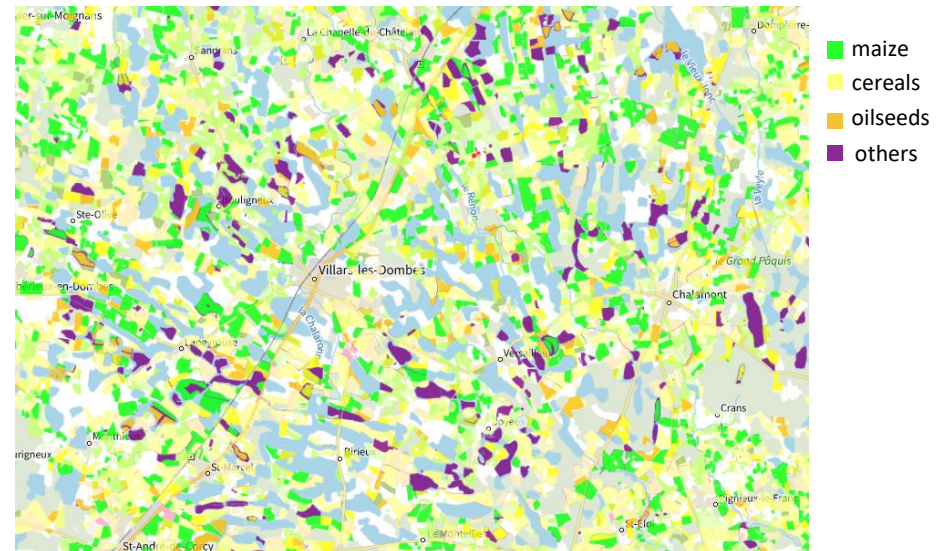
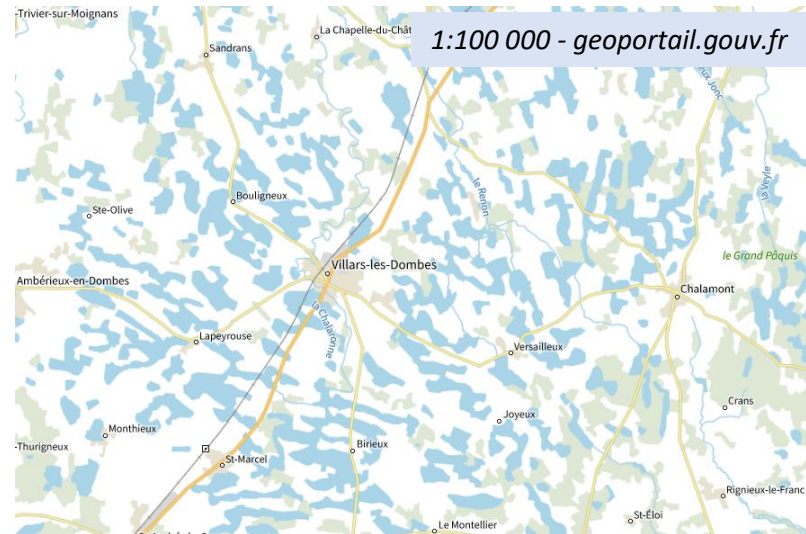
➤ Context: the specific situation in the Dombes area



- Dombes:**
- high density of ponds and ditches
 - agricultural lands, fisheries
 - soil vulnerability to surface runoff



➤ Context: the specific situation in the Dombes area



Dombes:

- high density of ponds and ditches
- agricultural lands, fisheries
- soil vulnerability to surface runoff

Key issues:

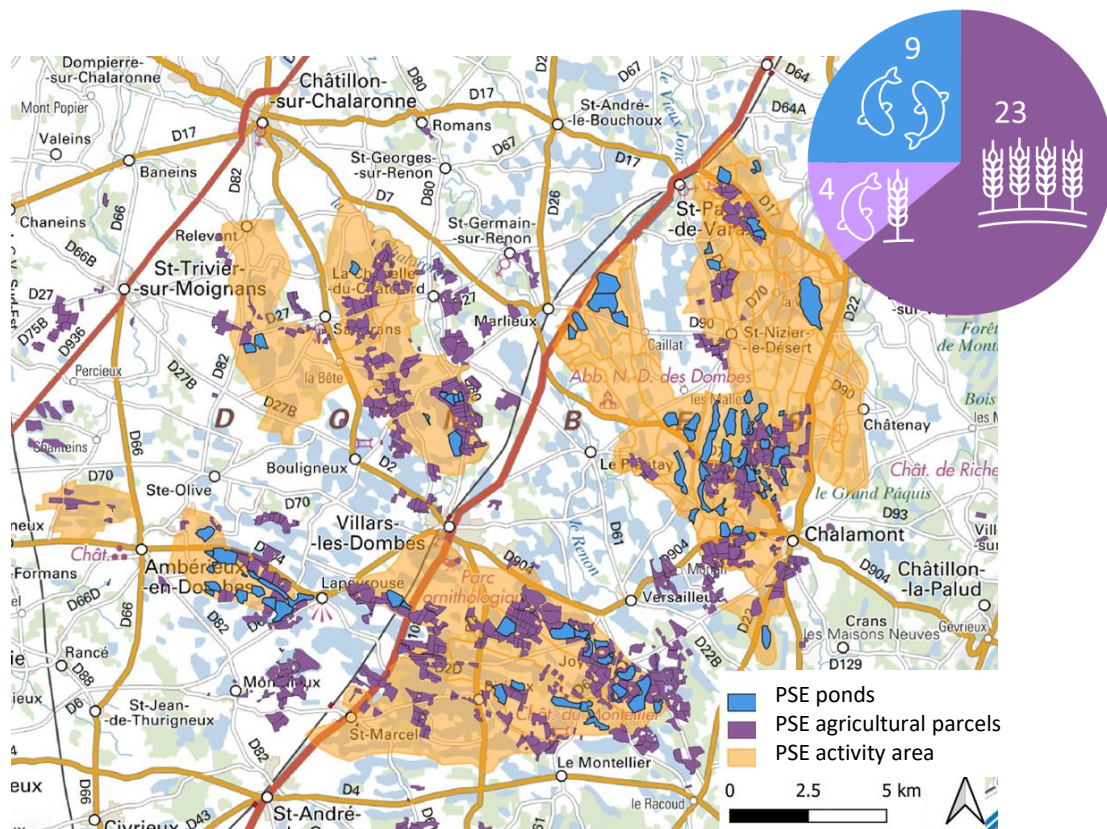
- preservation of biodiversity
- improvement of water quality
- considering agricultural and fish farming activities

➔ adopt more **sustainable practices**

➔ **agri-environmental measures** supported by financial incentives, such as Payments for Services in Environment (PSE)

➤ An overview of the PSE approach in the Dombes area

36 farms engaged in 2021



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XVIII Symposium on Pesticide Chemistry, Cremona

2026-09-02 C. Margoum

➤ An overview of the PSE approach in the Dombes area

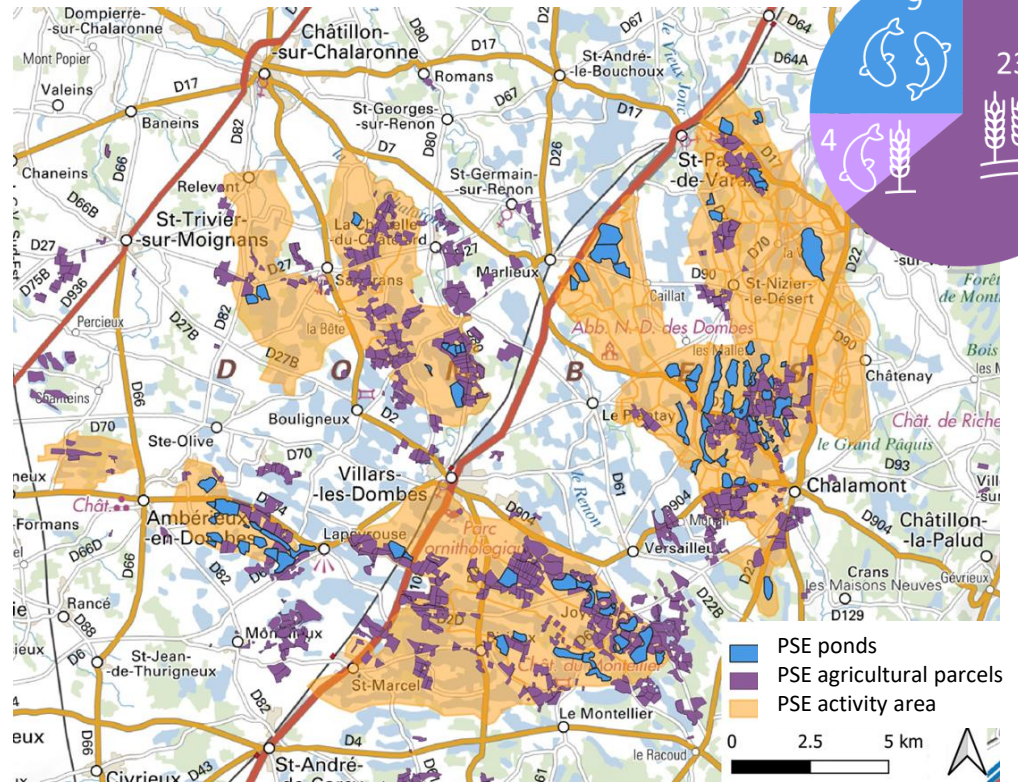
36 farms engaged in 2021

90 ponds: 1,114 ha of water

3,631 ha of agricultural land

Mixed cropping and livestock farming

~18% of the total area under cultivation



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➤ Objectives of the study

How can we assess the impact of incentive schemes aiming to improve water quality in a vulnerable environment?



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Monitoring of the quality of aquatic environments (2023–2027) across two sub-catchment areas with high rates of PSE contract agreements:

- through an appropriate **water sampling strategy**
- combined with an extensive understanding of the **hydrological functioning** of pond systems
- and supported by **knowledge about pesticide use**



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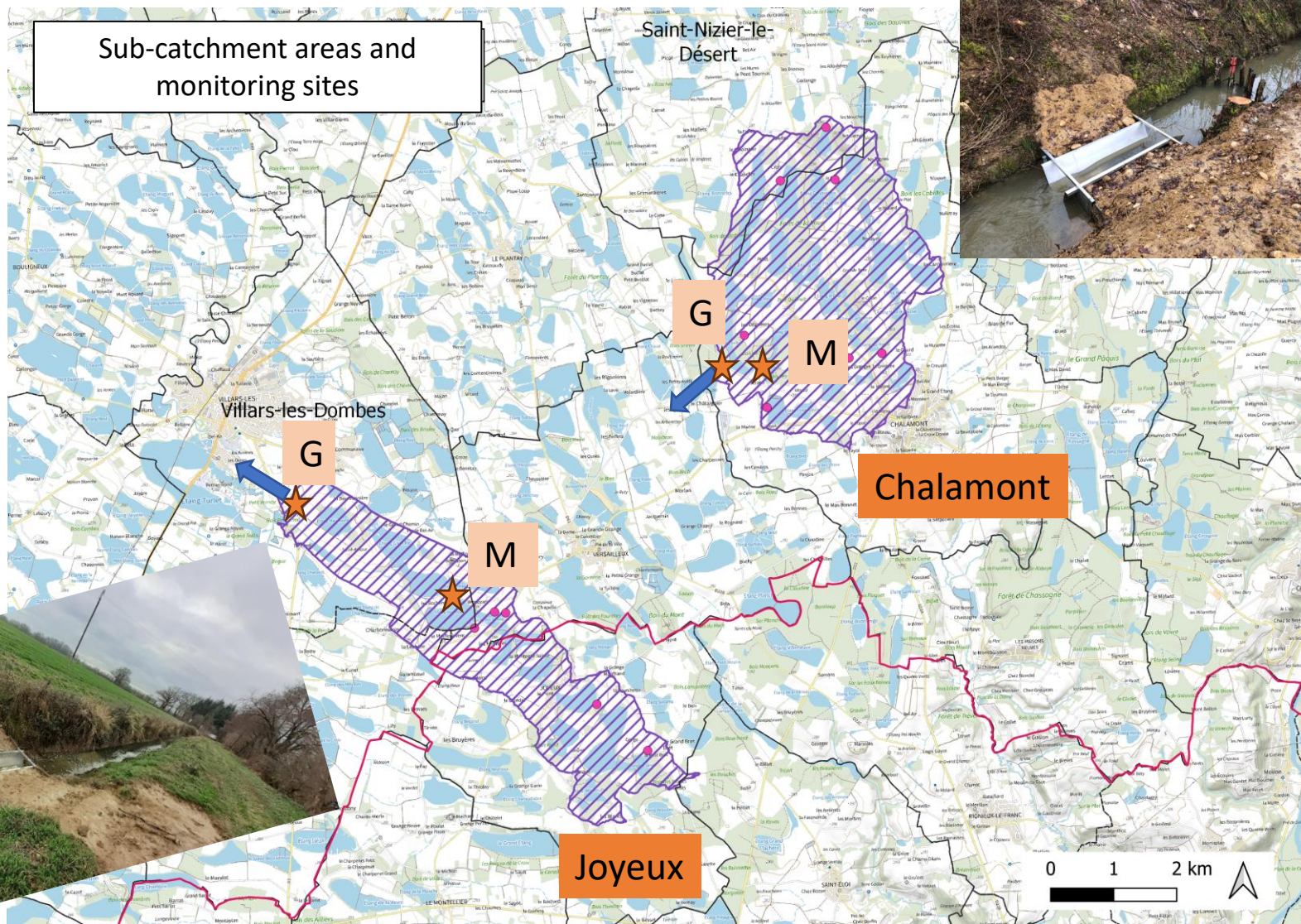
Monitoring of the quality of aquatic environments (2022–2027) across two sub-catchment areas with high rates of PSE contract agreements:

- through an appropriate **water sampling strategy**
- combined with an extensive understanding of the **hydrological functioning** of pond systems
- and supported by **knowledge about pesticide use**

- test the feasibility and benefits of deploying passive sampling tools in real-world field conditions
- assess if such monitoring approaches can help to highlight improvements in water quality

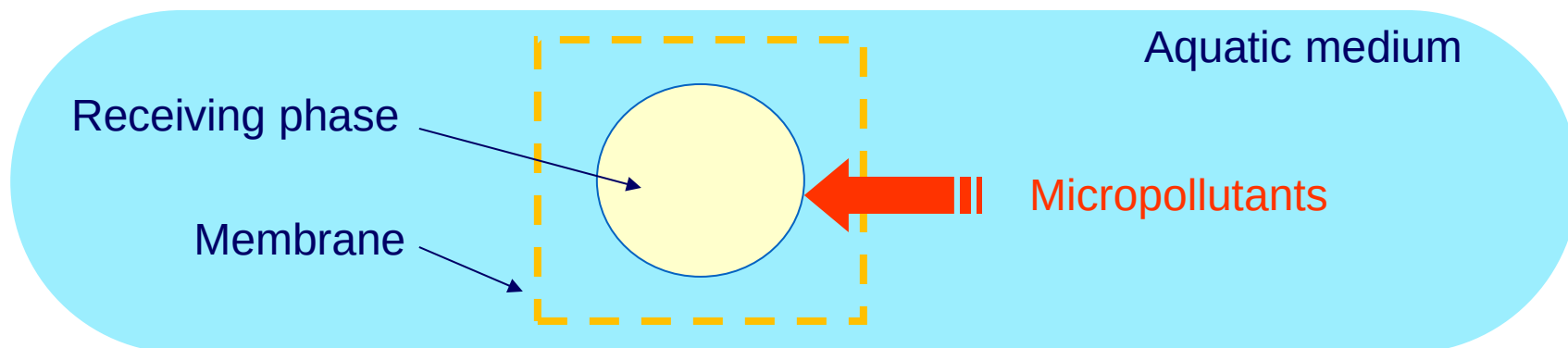


➤ Introduction to the study sites



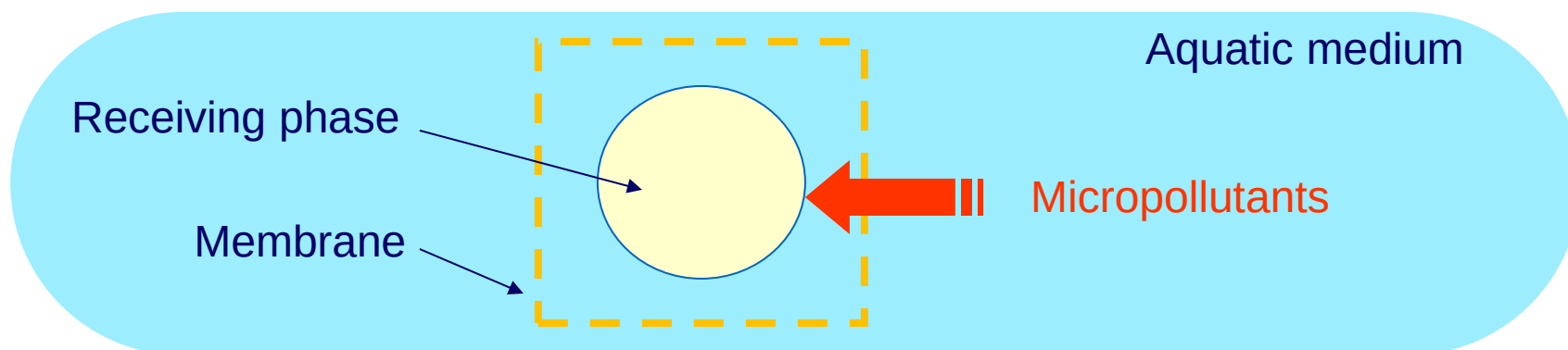
➤ Passive sampling strategy

A cost-effective alternative for the monitoring of the aquatic environments



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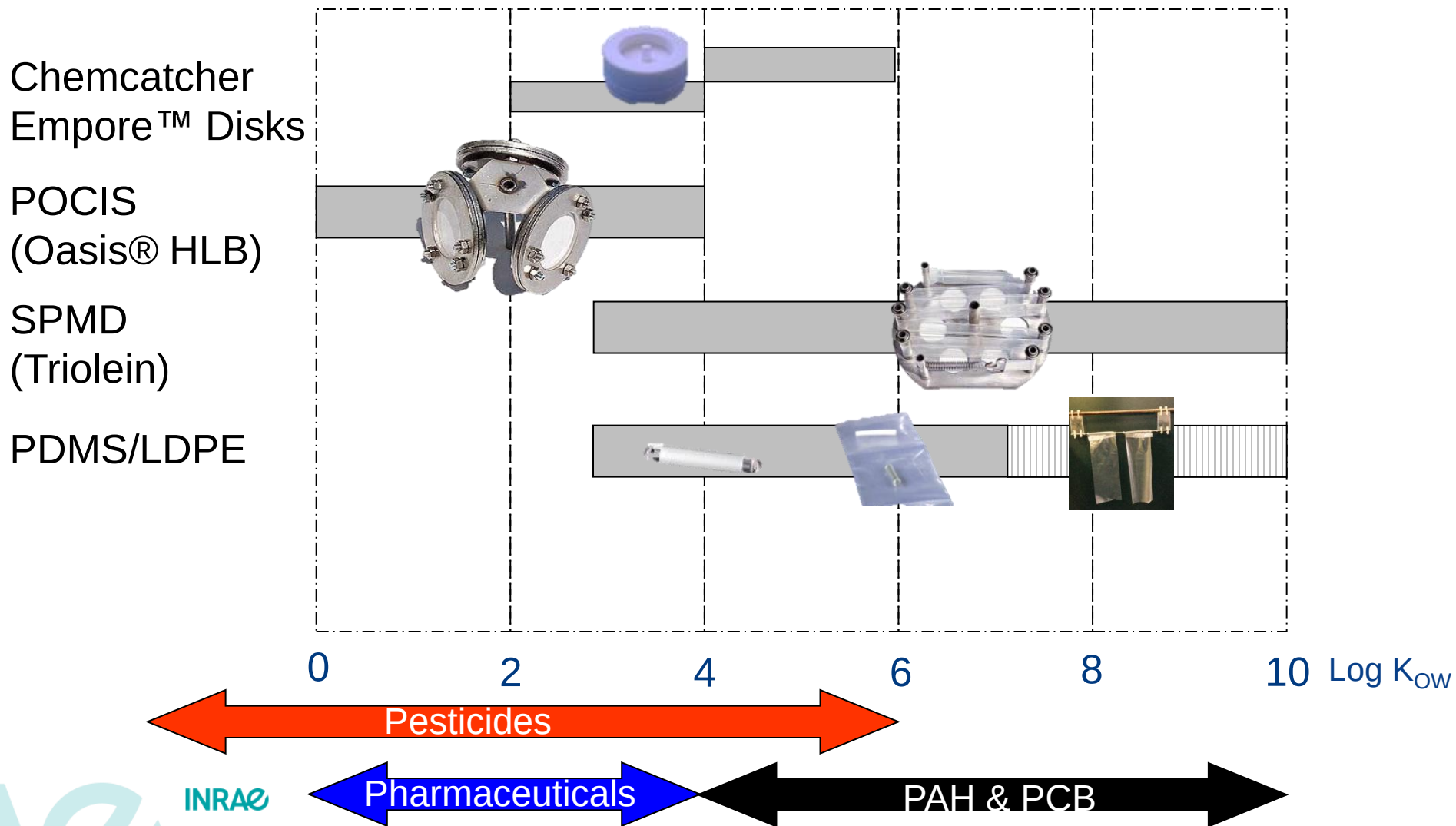


Placed in hydrosystems: continuous sampling of micropollutants

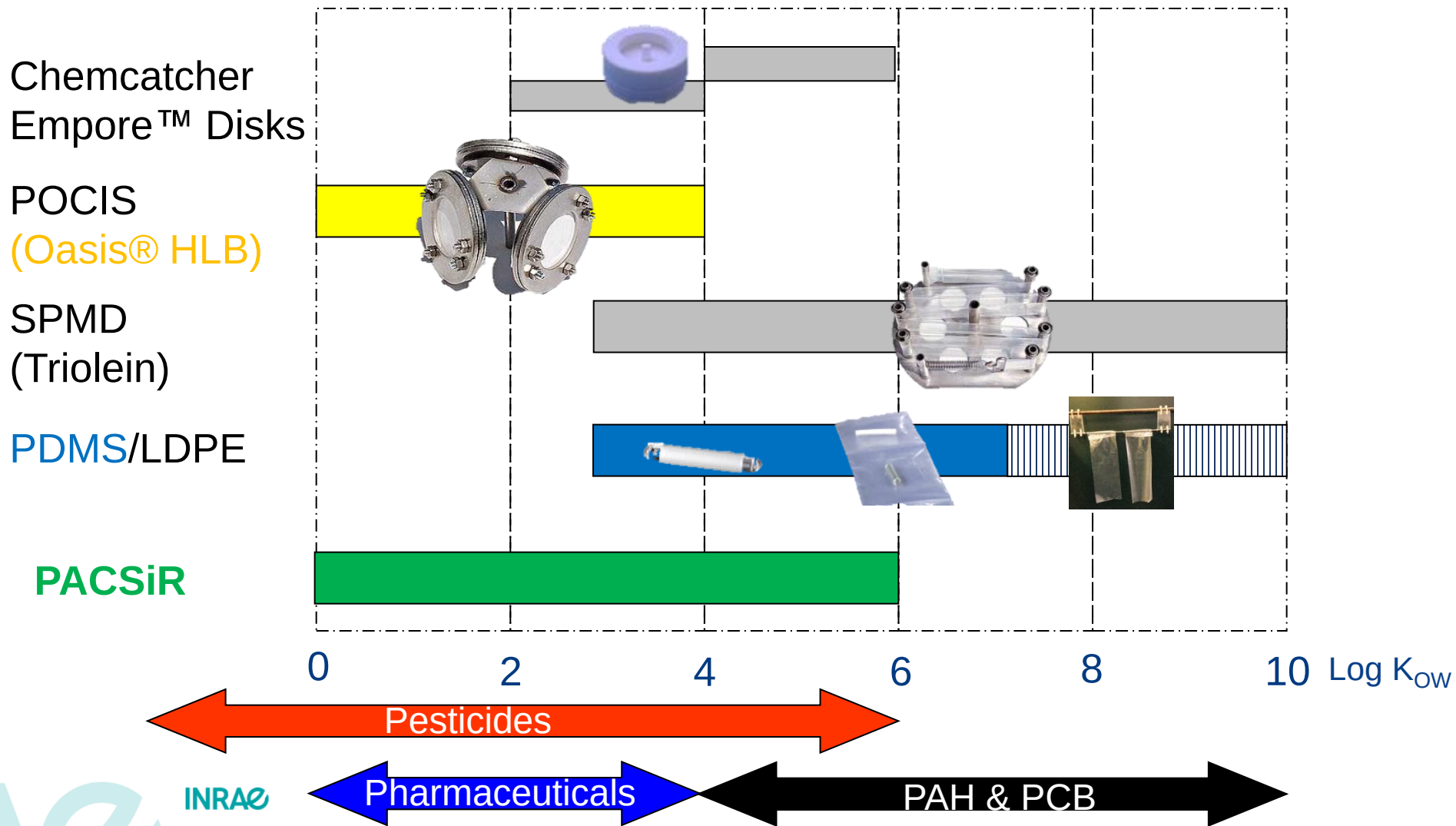
- ☺ Time-weighted average concentration
- ☺ Lower quantification limit
- ☺ Cost effective

- ☹ One average concentration
- ☹ Lab calibration needed (for quantification)

➤ Different passive samplers for organic contaminants



➤ Different passive samplers for organic contaminants



➤ PACSiR passive sampler

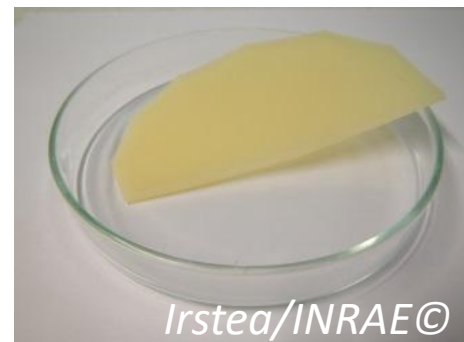
Formulation of the receiving phase



Silicone rubber



Porous copolymer
(Oasis® HLB)



Composite material

**PACSiR : Polar/Apolar
Composite Silicone Rubber**

➤ PACSiR passive sampler

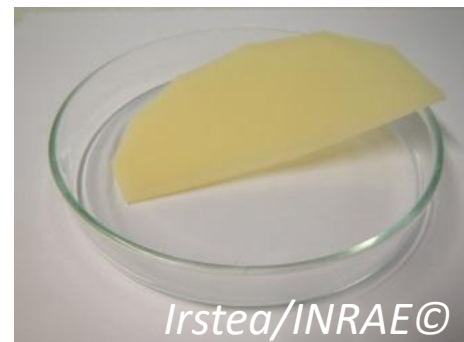
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**PACSiR : Polar/Apolar
Composite Silicone Rubber**

Design of small PACSiR rods



2 cm



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➤ In situ deployment and analysis



+



rods

2 cm x 3 mm

No membrane

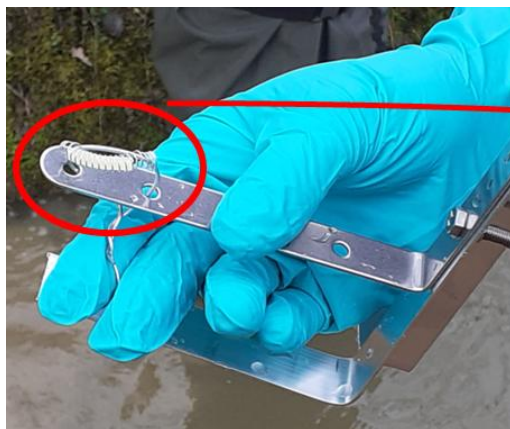
Small size

Deployment and renewal
every **2 weeks**

+ **field blanks** (contam. check)



**Continuous monitoring of
water contamination**



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+



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2 cm x 3 mm

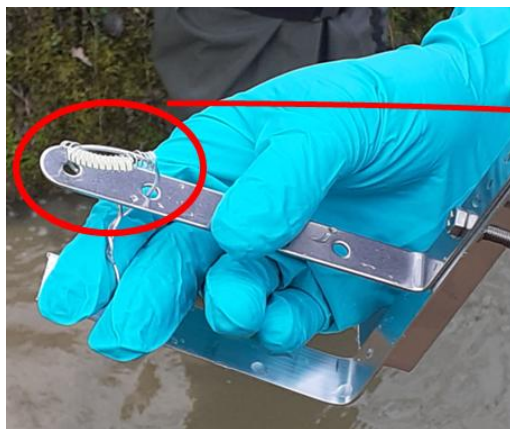
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**Continuous monitoring of
water contamination**



After retrieval, **store in the freezer**
until selection for analysis

Liquid desorption
200 μ L acetonitrile/methanol
ultrasonic extraction 15 min

LC-MS analysis
(RPLC C18, ESI+)

**40 pesticides analysed
(F, H, I)**



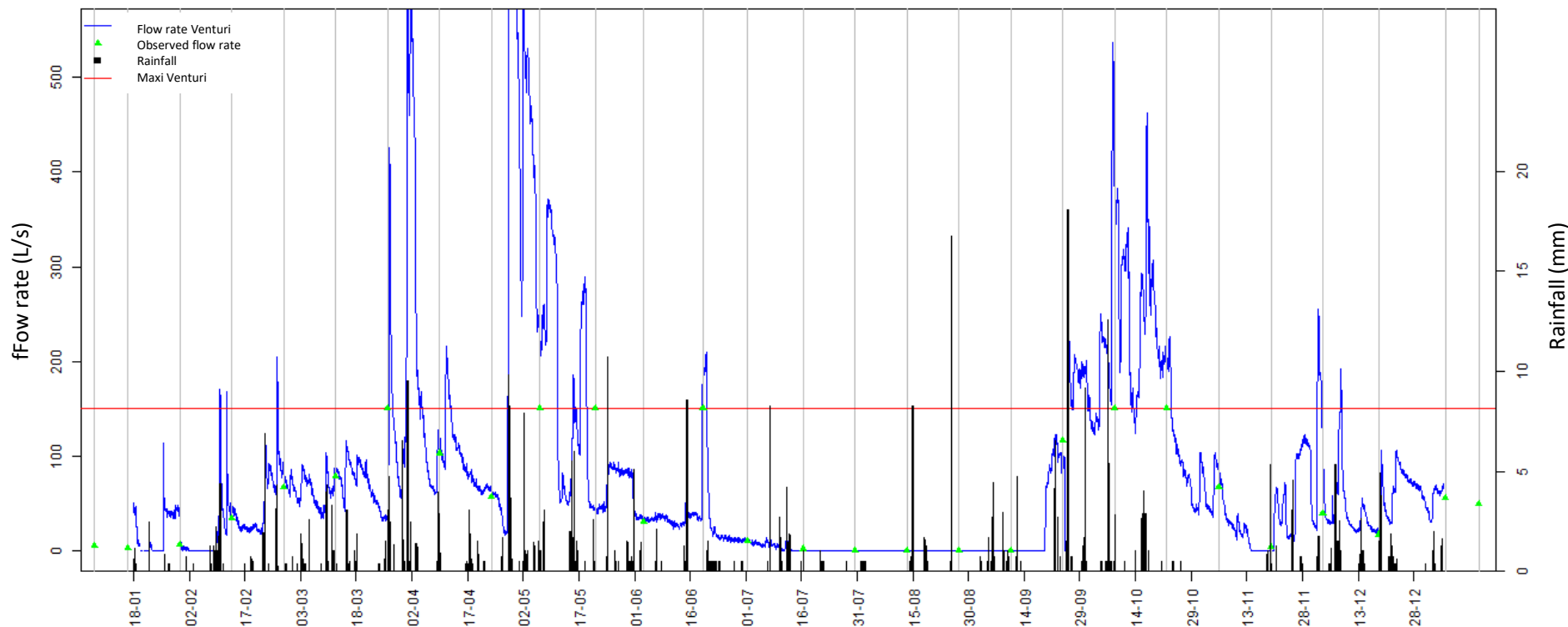
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➤ Selection of PACSiR samples for analysis

based on **retrospective** considerations: pesticide application periods, hydro-meteorological conditions and pond maintenance

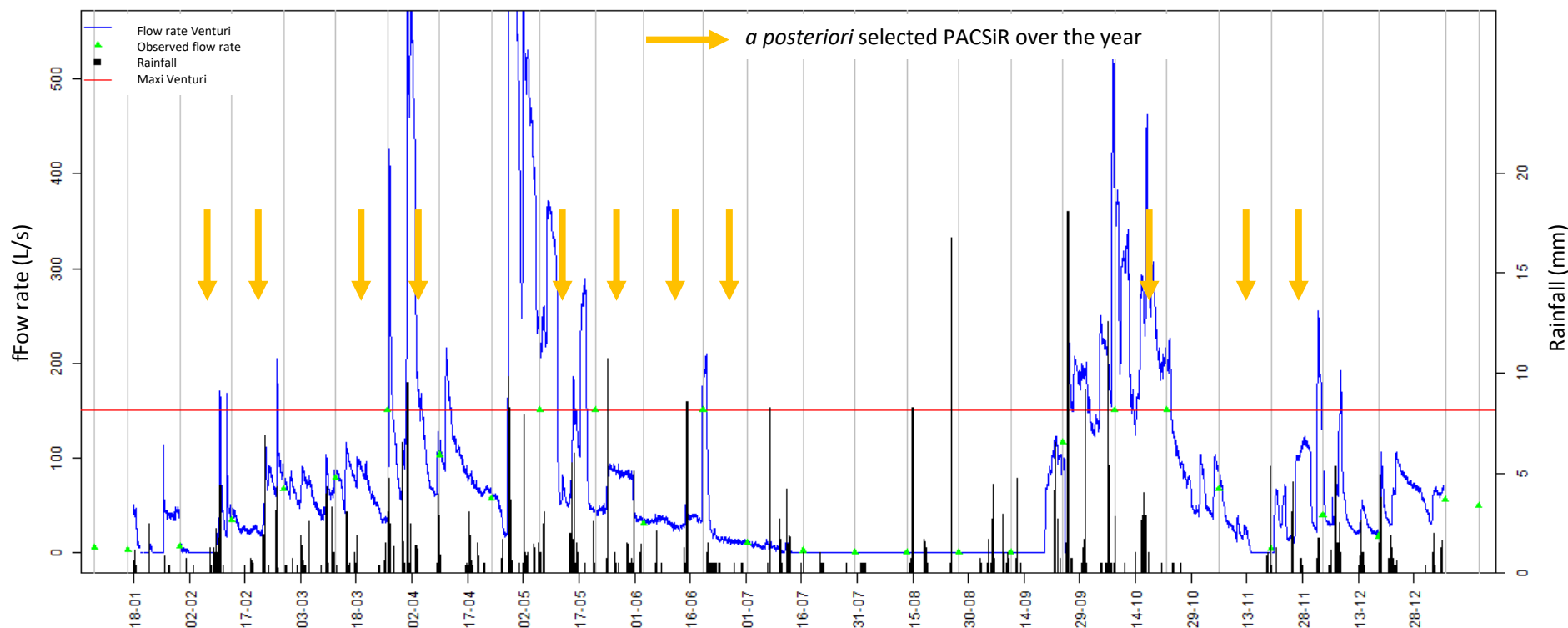
ex. Chalamont G (2024)



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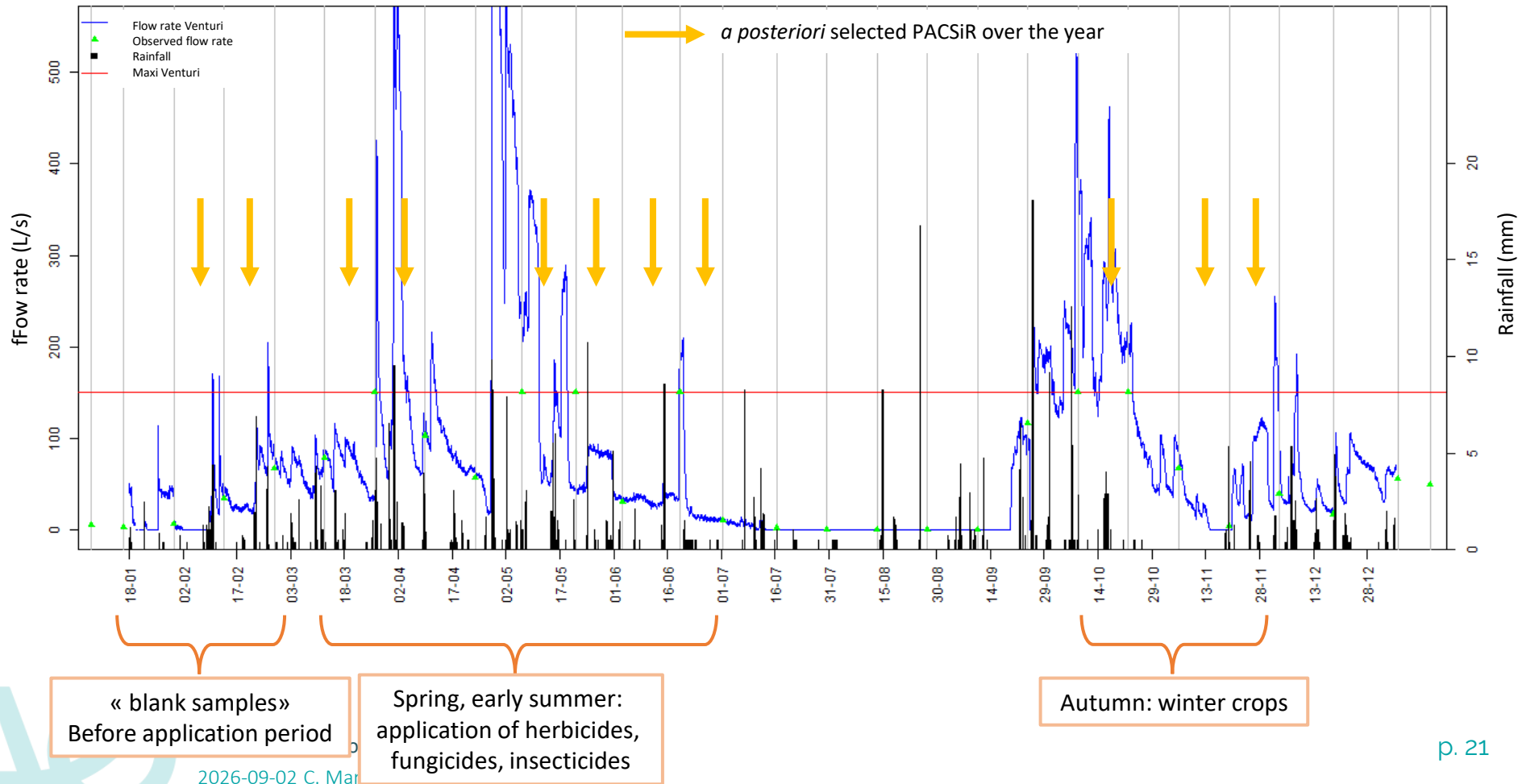
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based on **retrospective** considerations: pesticide application periods, hydro-meteorological conditions and pond maintenance

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➤ Some results from three years of monitoring

Pesticides analysed (2023-2025)

	2023	2024	2025
Acetochlore - H			
Aclonifen -H			
Atrazine -H			
Azoxystrobin - F			
Boscalide -F			
Carbendazime - F			
Chlorfenvinfos - I			
Chlorpyrifos ethyl - I			
Chlorpyrifos methyl -I			
Chlortoluron - H			
DCMPU -H_TP			
Difenoconazole - F			
Diflufenican - H			
Dimethomorphe -F			
Diuron - H			
Fenoxycarb - I			
Flazasulfuron - H			
Fluazinam - F			
Fludioxonil - F			
Flufenoxuron - H			

	2023	2024	2025
Flurtamone - H			
Imidaclopride - I			
Indoxacarb - I			
Isoproturon - H			
Isoproturon monodemethyl -H_TP			
Isoxabene - H			
Linuron - H			
Metamitrone - H			
Metazachlor - H			
Metolachlor - H			
Norflurazon - H			
Oryzalin - H			
Procymidone - F			
Propyzamide - H			
Simazine - H			
Spiroxamine - F			
Tebuconazole - F			
Terbuthylazine -H			
Terbuthylazine déséthyl - H_TP			
Terbuthylazine-hydroxy - H_TP			

F - fungicides (n=10)
I - insecticides (n=6)
H - herbicides (n=20)
TP - transformation products (n=4)

quantified (ng/L) at least once a year
 < limit of quantification
 present, not calibrated (ng/PACSiR)
 analysed, not detected/quantified
 non analysed

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Azoxystrobine - F			
Boscalide -F			
Carbendazime - F			
Chlorfenvinfos - I			
Chlorpyrifos ethyl - I			
Chlorpyrifos methyl -I			
Chlortoluron - H			
DCMPU -H_TP			
Difenoconazole - F			
Diflufenican - H			
Dimethomorphe -F			
Diuron - H			
Fenoxycarb - I			
Flazasulfuron - H			
Fluazinam - F			
Fludioxonil - F			
Flufenoxuron - H			

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Isoproturon - H			
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Isoxabene - H			
Linuron - H			
Metamitrone - H			
Metazachlor - H			
Metolachlor - H			
Norflurazon - H			
Oryzalin - H			
Procymidone - F			
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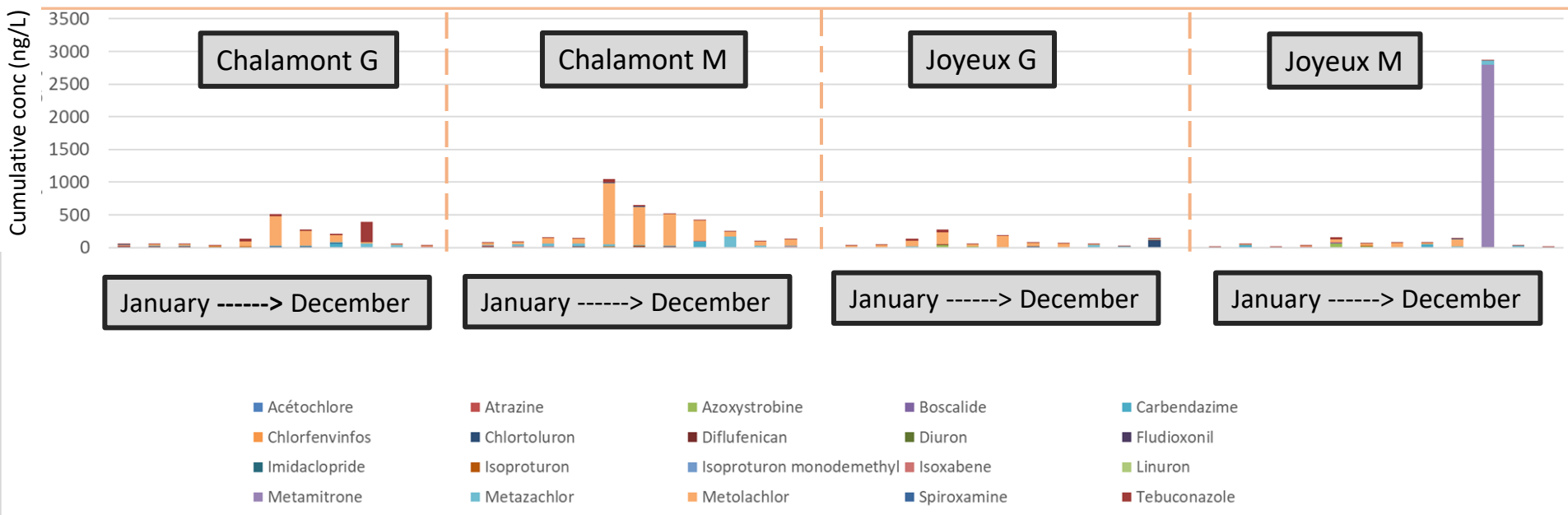
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quantified (ng/L) at least once a year
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 present, not calibrated (ng/PACSiR)
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2023: 37 pesticides analysed, 62% det/quantif
 2024: 36 pesticides analysed, 56% det/quantif
 2025: 30 pesticides analysed, 67% det/quantif

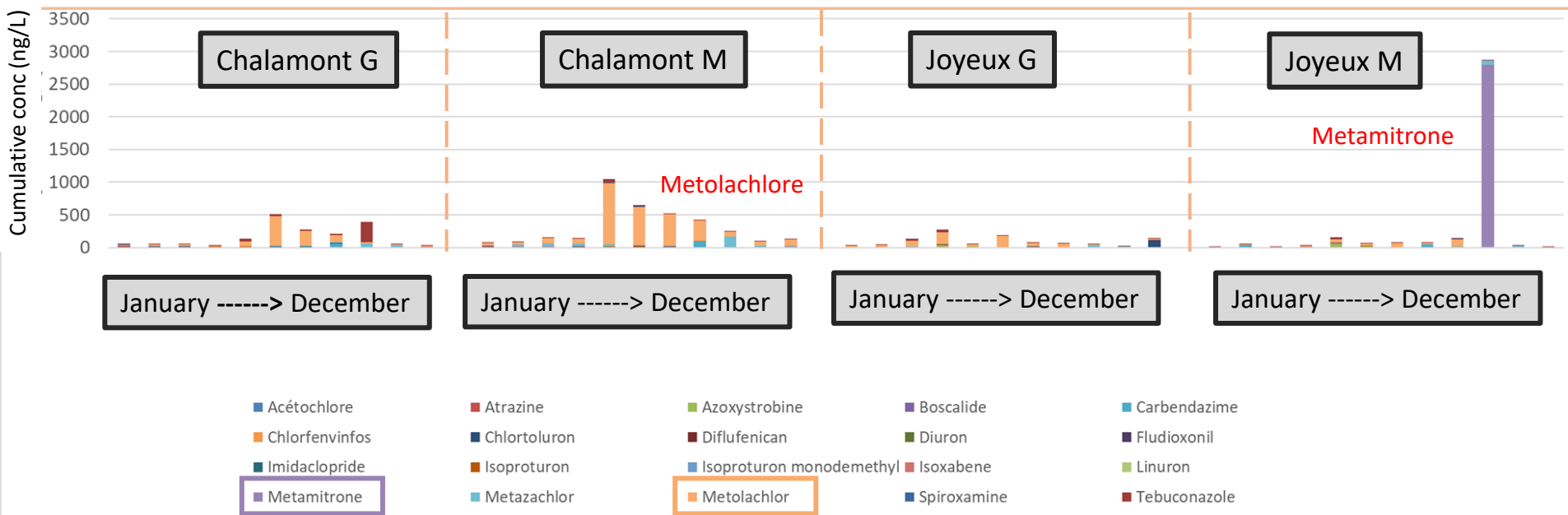
➤ Spatio-temporal contamination in 2024

Selected PACSiR samplers



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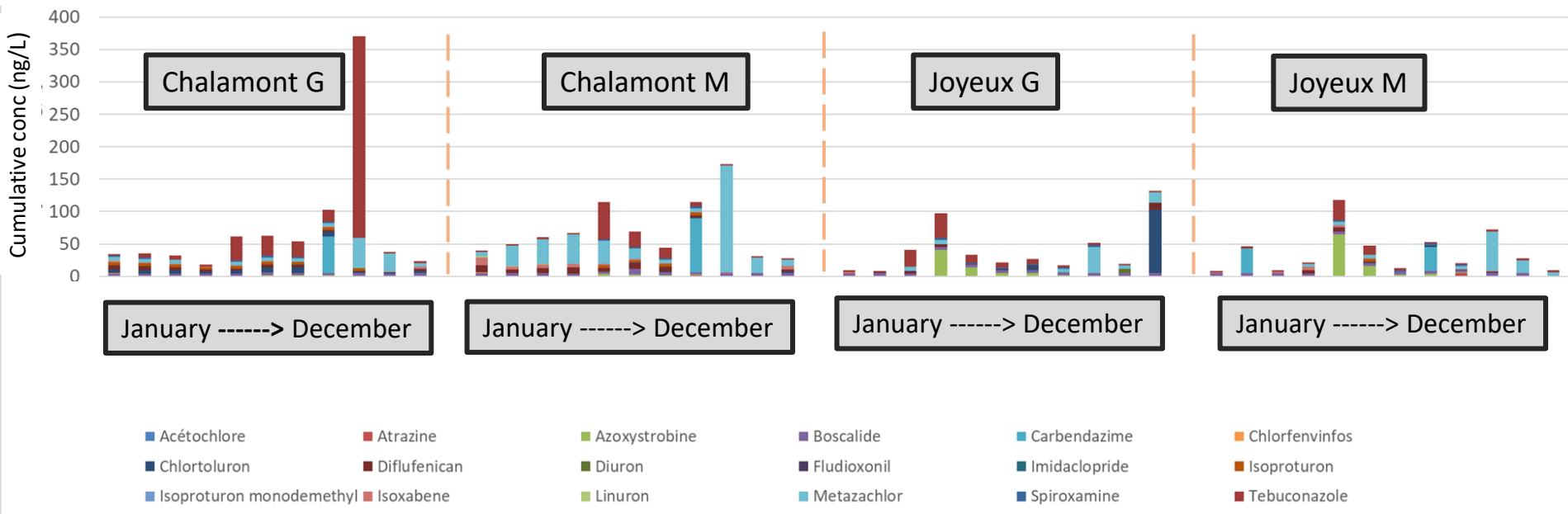
Selected PACSiR samplers



- Σ (conc.) and nature of quantified pesticides vary between sites and throughout the year
- detection of diffuse pollution (ex. metolachlore) and peak pollution (metamitrone)
- predominance of herbicides

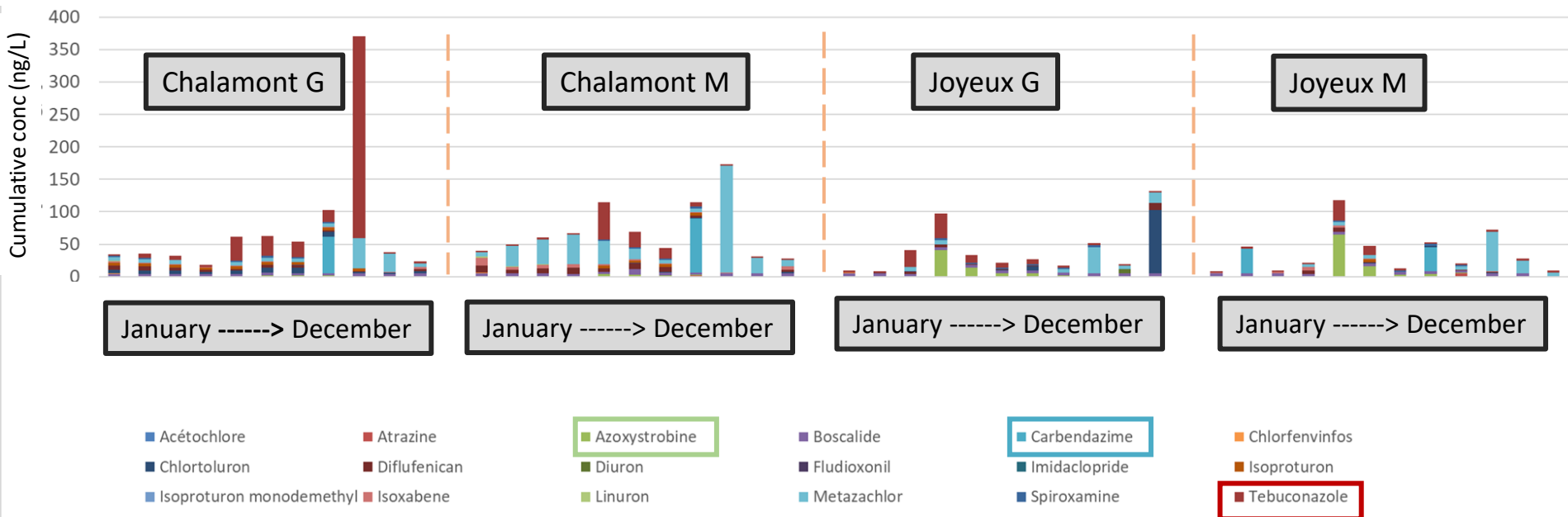
➤ The same results, without metolachlore and metamitrone

Selected PACSiR samplers (2024)



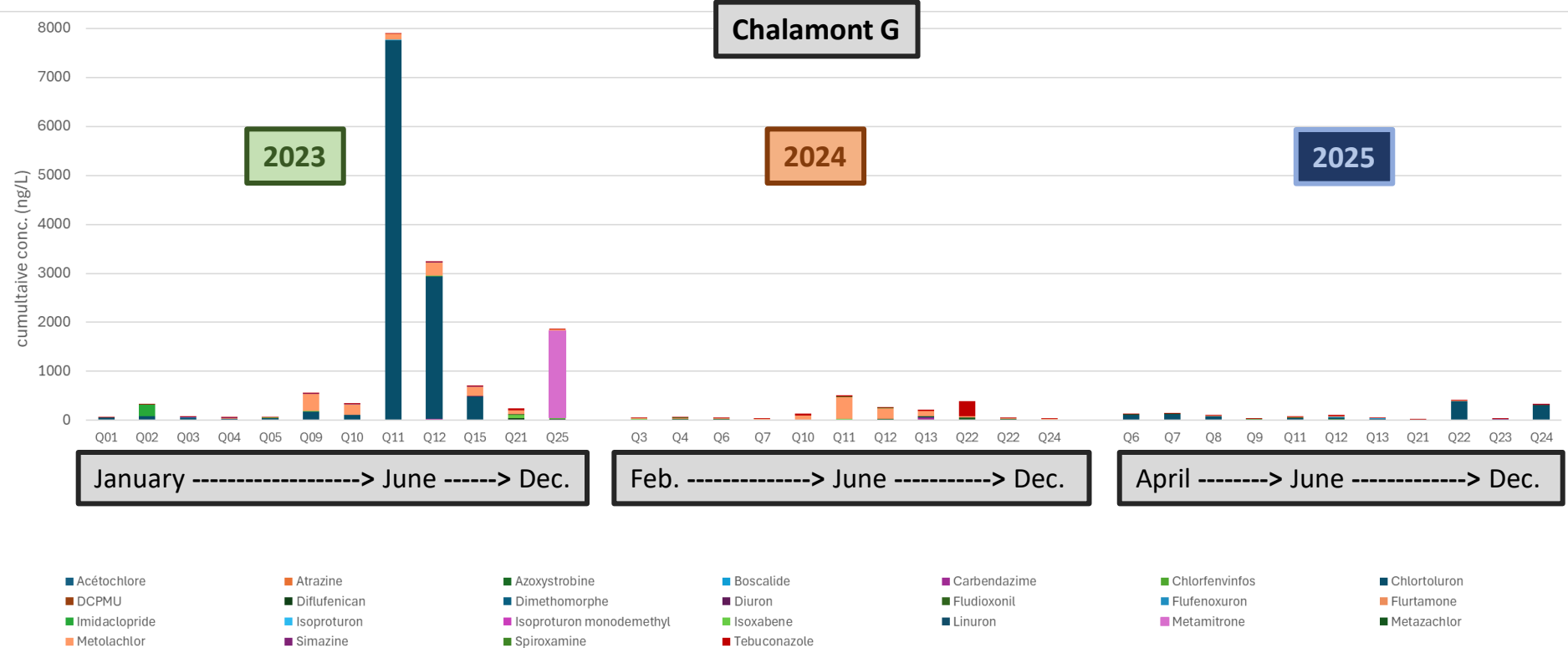
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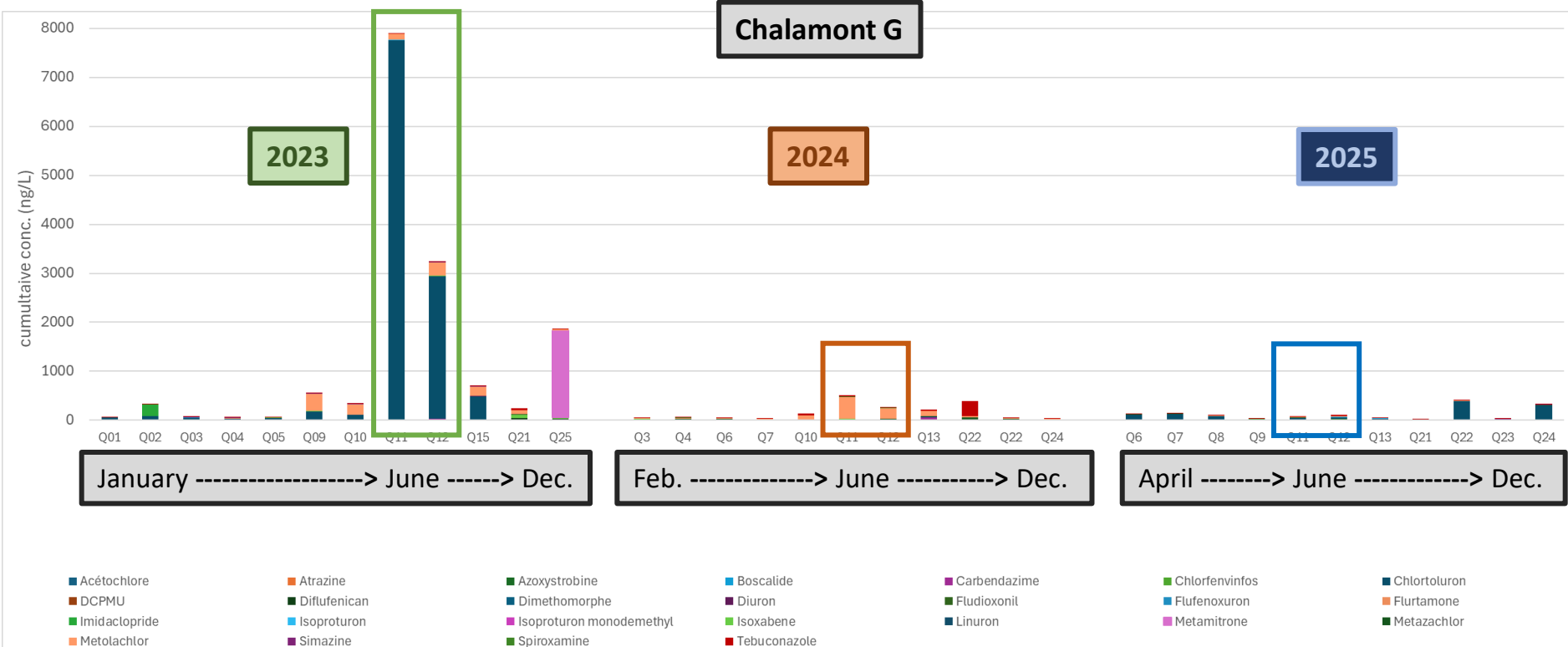


- display of fungicides throughout the year (tebuconazole, azoxystrobine and carbendazime)
- variability between sites, even within the same catchment area
- average concentration generally less than 100 ng/L

➤ Inter-annual variability in concentrations



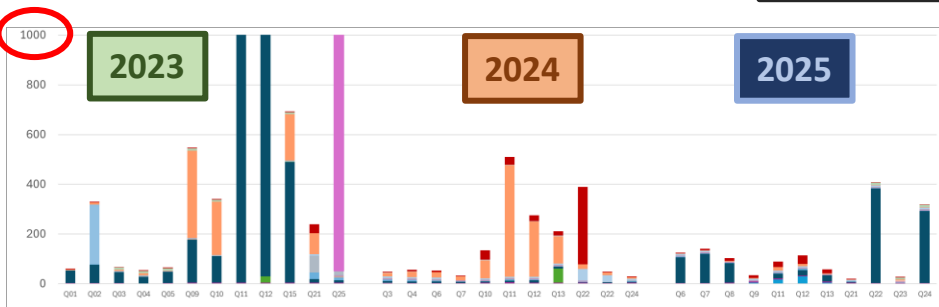
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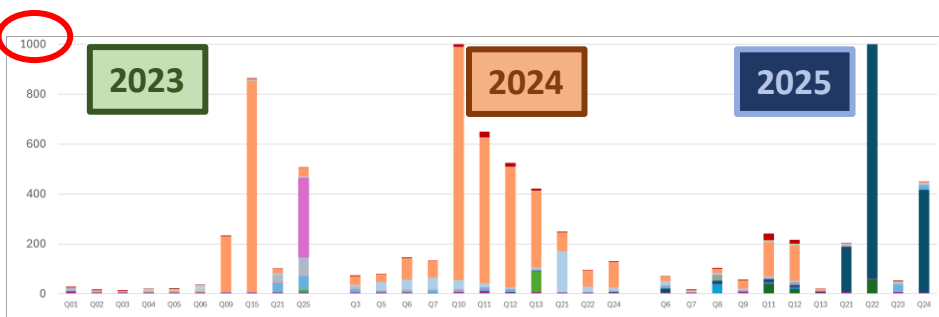
- a decreasing trend in contamination at the outlet, possibly due to:
 - partial ban of certain substances (chlortoluron)
 - hydrometeorological conditions
- but...

➤ Inter-annual variability in concentrations

Chalamont G

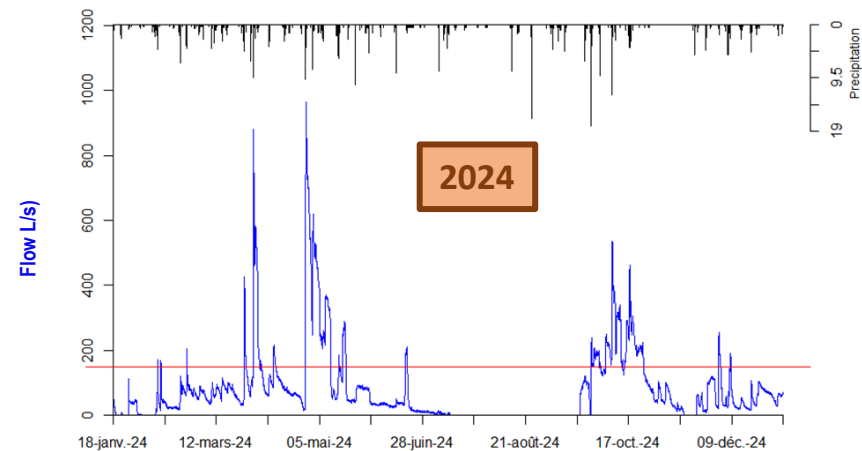
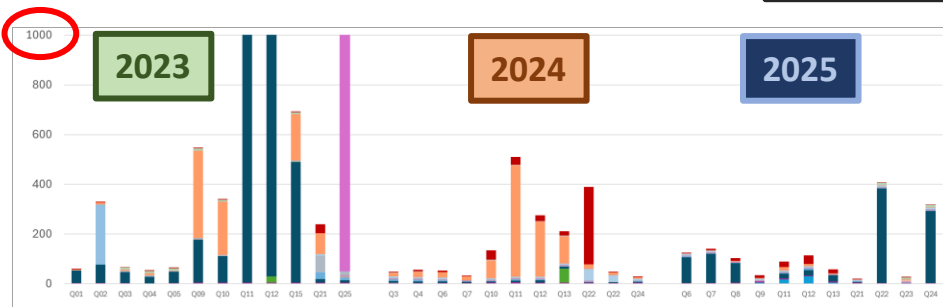


Chalamont M

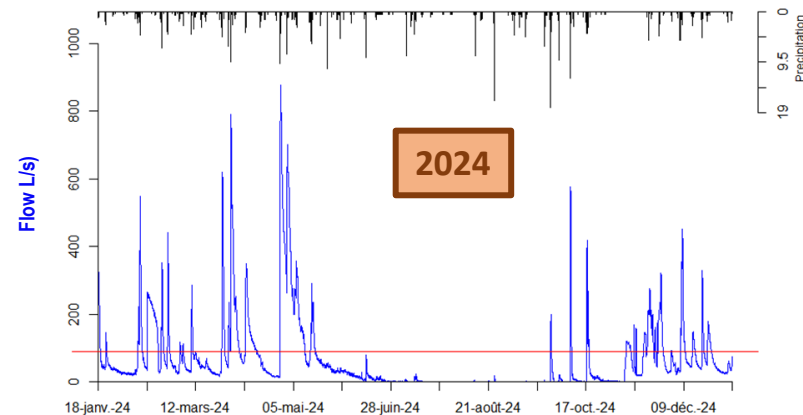
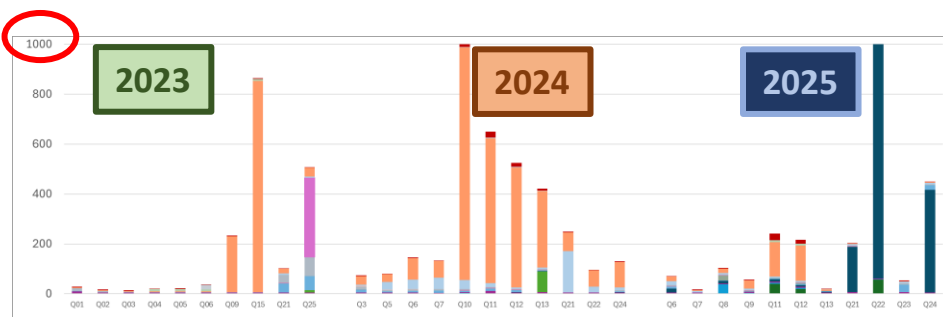


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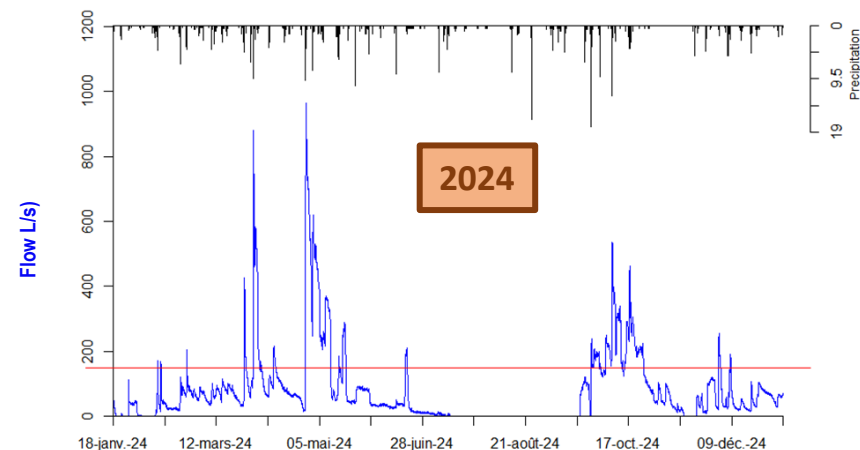
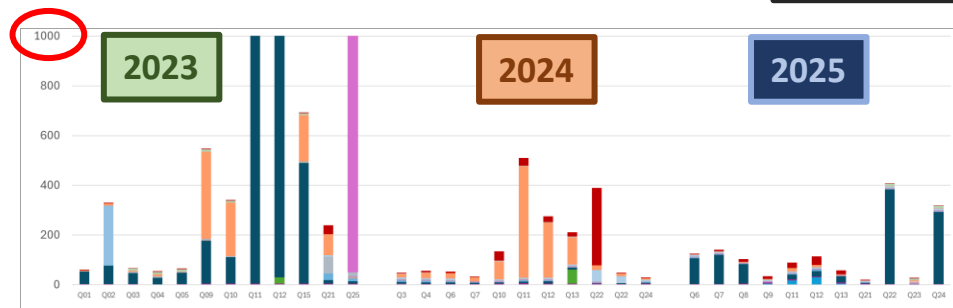


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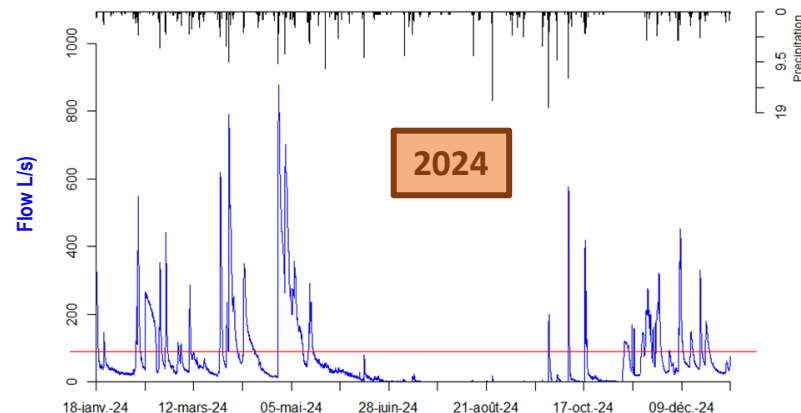
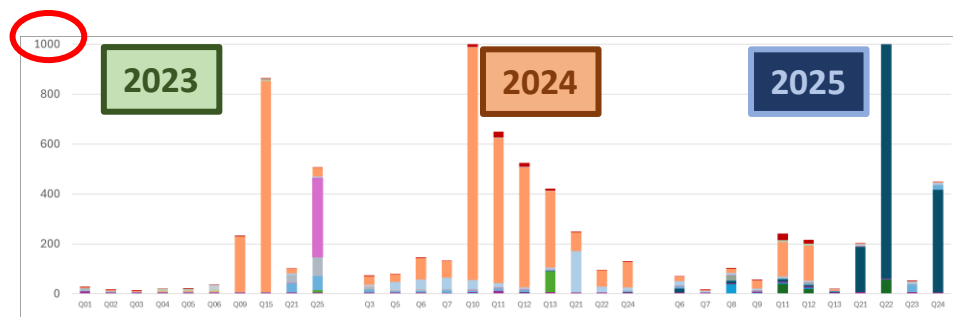


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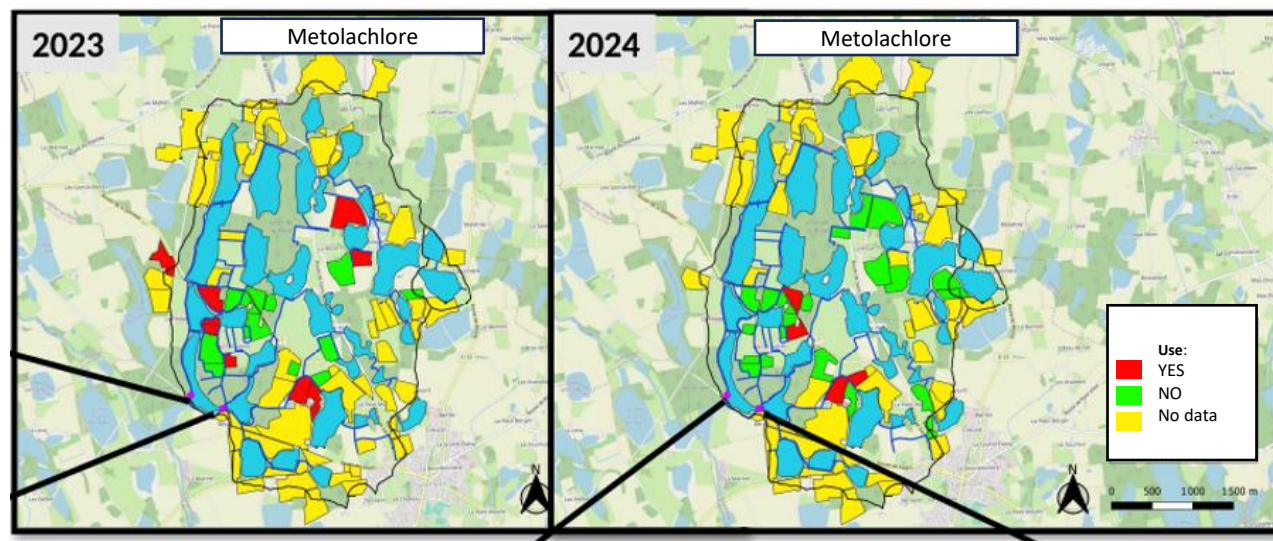


Chalamont M



- concentration variations depend largely on the site (local pesticide transfer)

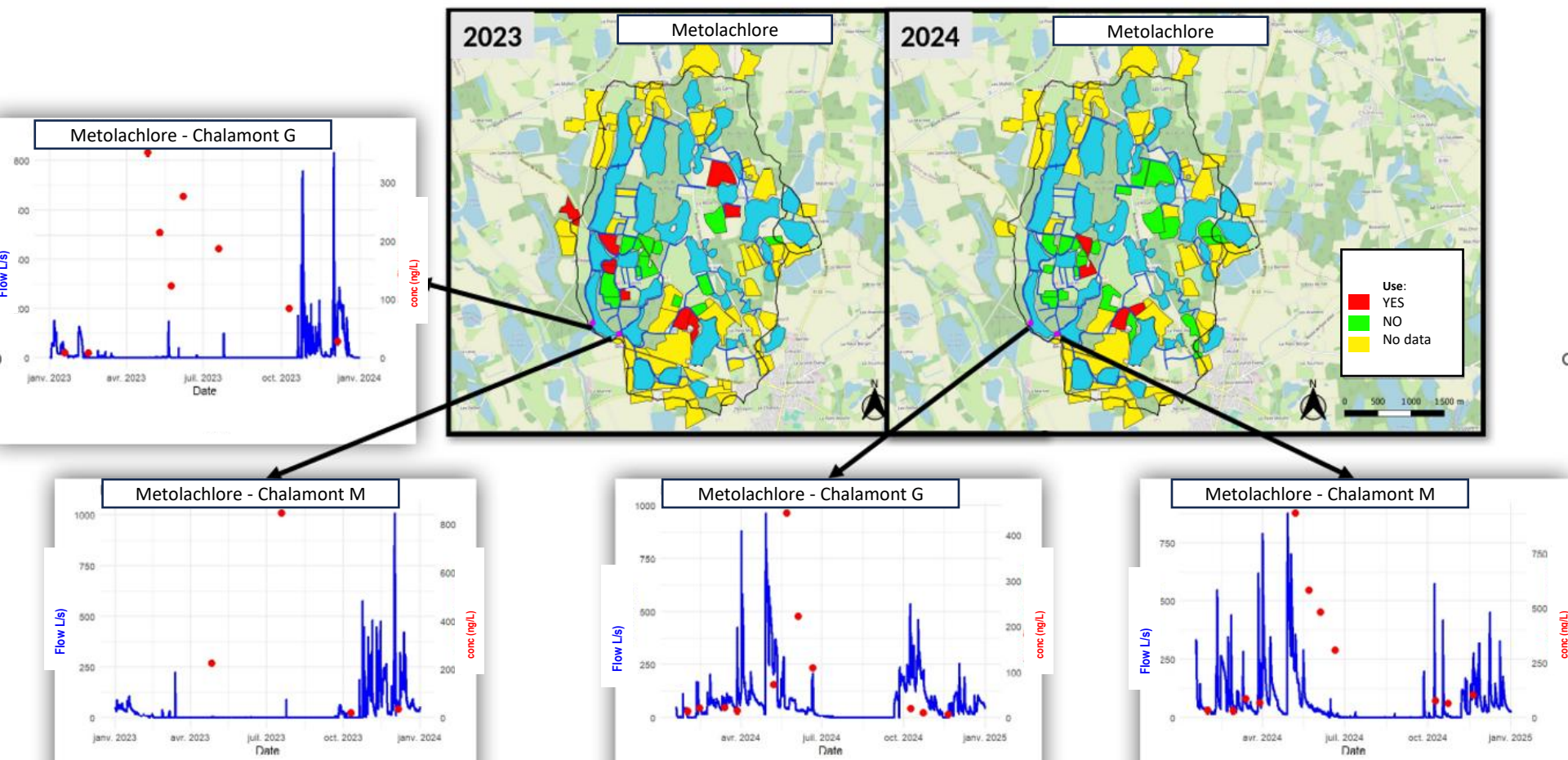
➤ Considering also agricultural practices - Chalamont



Maxime GOUBY, Tiphaine GUERIN, Anaïs MATHEZ (2025)



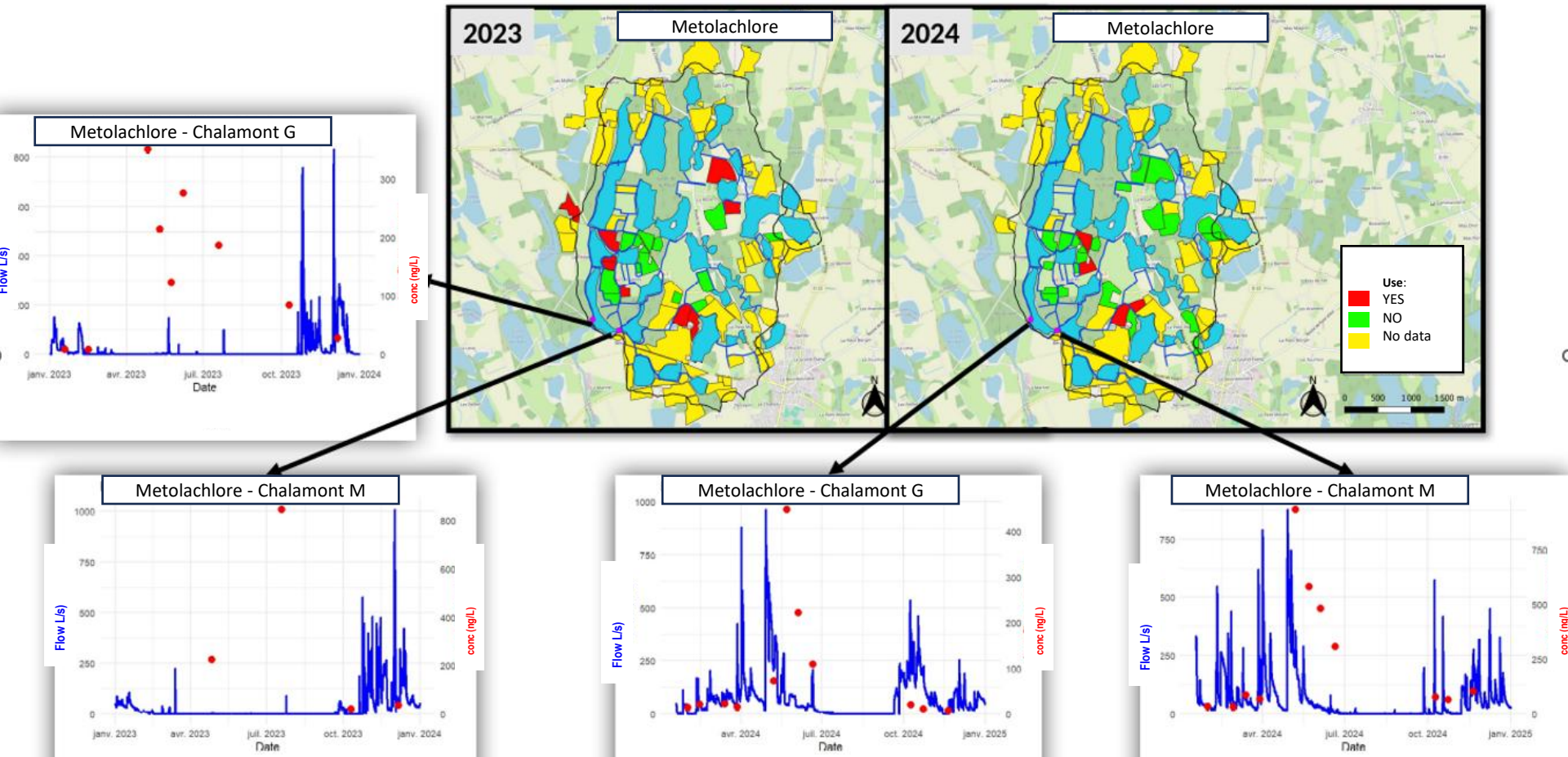
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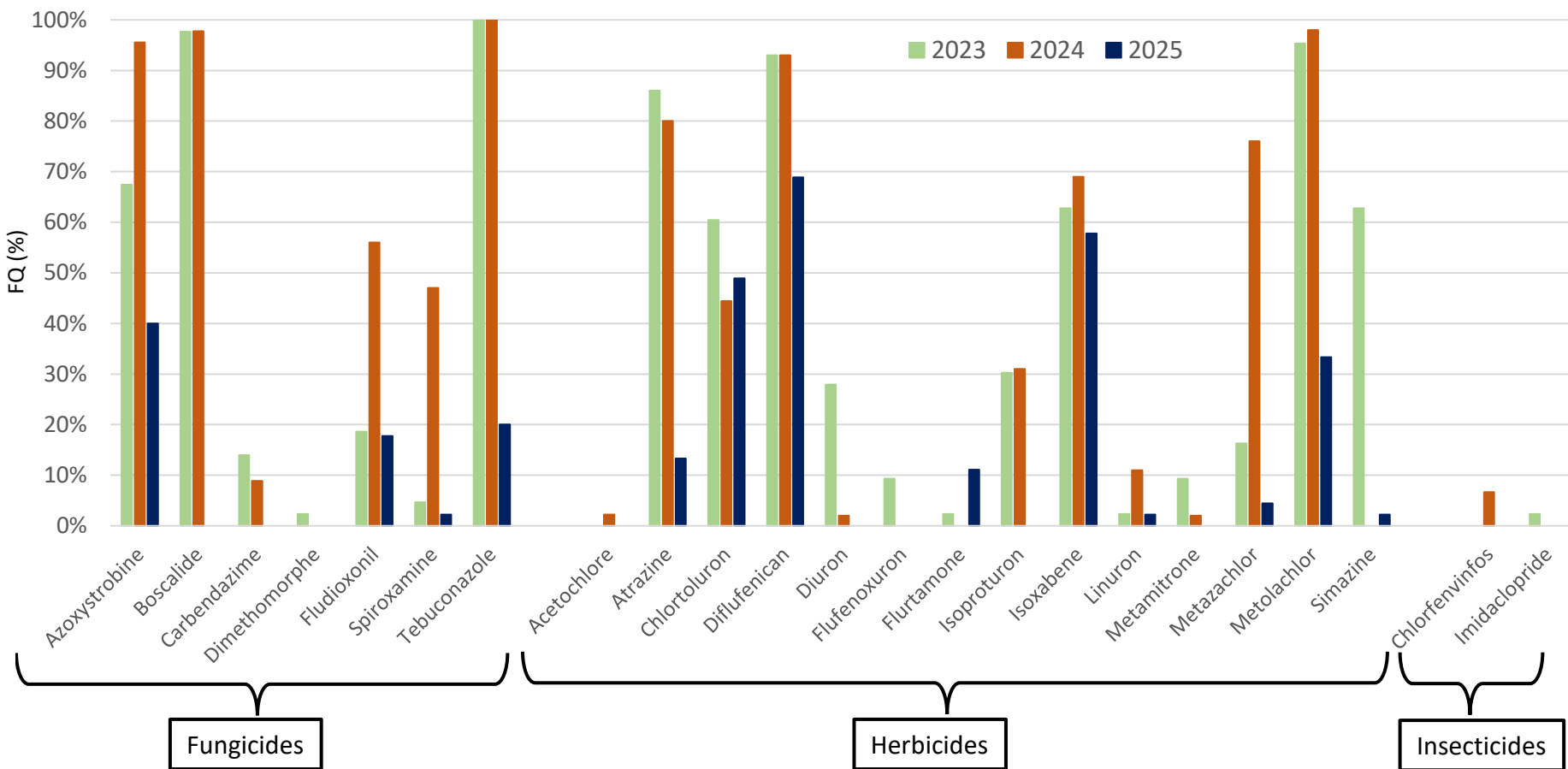
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- Concentration peaks in spring are consistent with application periods of metolachlore
- 2023 vs. 2024 : less parcel treated in 2024 but higher conc levels at outlet
- ... not so easy to interpret

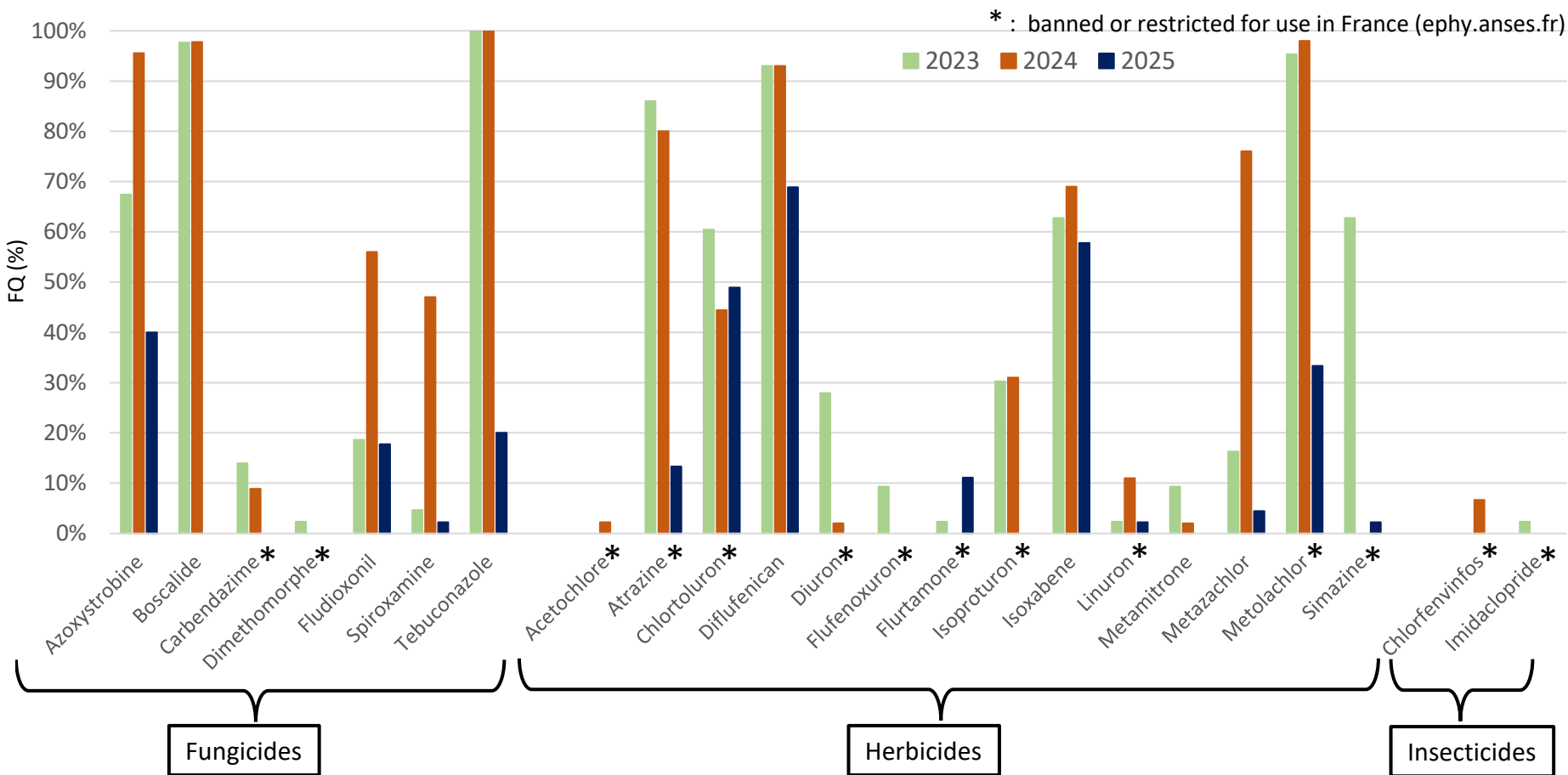
➤ Frequency of pesticide quantification

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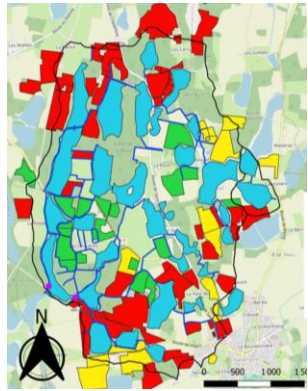
Banned substances are still quantified in surface waters

The FQ of all substances appears to be decreasing over the years.

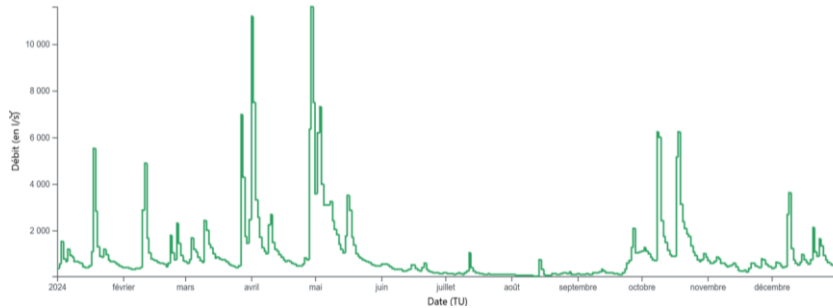
The year 2024 seems to be a special one. To be confirmed with ongoing monitoring.

➤ How can we assess the impact of agricultural practices on water quality?

Using a **multidisciplinary approach**



+



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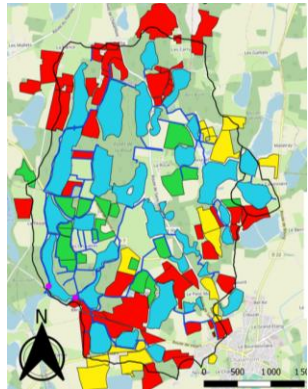
land use and
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practices

rainfall, hydrometry and the formulation
of hypotheses on main transfer pathways

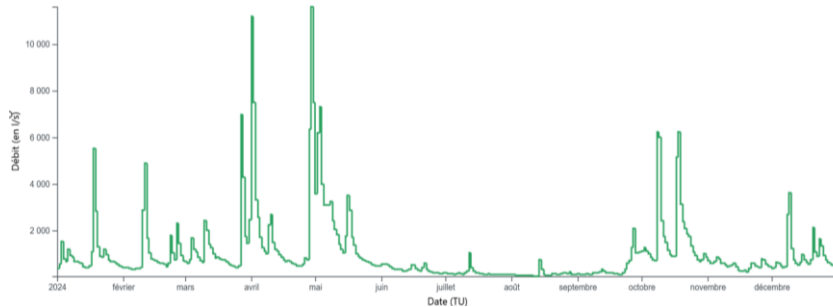
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passive sampling
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And **long-term monitoring**, over several years to compensate meteorological and crop-related variables

➤ Take home messages

Benefits of a sampling strategy based on the PACSiR passive sampler :

- small low-cost, easy-to-use passive sampler for organic contaminants at ultra-trace level ($\text{LoQ} \ll 1 \text{ ng/L}$) in aquatic environments
- enables continuous acquisition of average (every two weeks) concentrations
- ability to store and retrospectively select samples for analysis: more targeted analyses and lower costs associated, in case of long-term monitoring
- the combination with land use knowledge and hydrological data makes it useful for both research and operational purposes

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On going work :

- Combining PACSiR to non target screening analysis (non-calibrated pesticides, transformation products...)

➤ Thank you for your attention



 **LA DOMBES**
communauté de communes

ISARA 

 **Syndicat des Rivières**
Dombes
Chalaronne
Bords de Saône


**RÉPUBLIQUE
FRANÇAISE**
*Liberté
Égalité
Fraternité*


**agence
de l'eau**
RHÔNE
MÉDITERRANÉE
CORSE


**Syndicat mixte
Veyre Vivante**

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