

Spatial variability in C-N-P concentrations during the fragmentation of an intermittent stream in a small temperate oceanic agricultural catchment

Andrés Casanova¹, Rémi Dupas¹, Anne Jaffrezic¹, Laurent Jeanneau², Alexandrine Pannard³, Ophélie Fovet¹

Research team

- ¹ INRAE - Institut Agro, UMR SAS, 35000 Rennes, France
- ² Geosciences Rennes, 35000 Rennes, France
- ³ UMR ECOBIO, CNRS – Université de Rennes, 35000 Rennes, France

Context

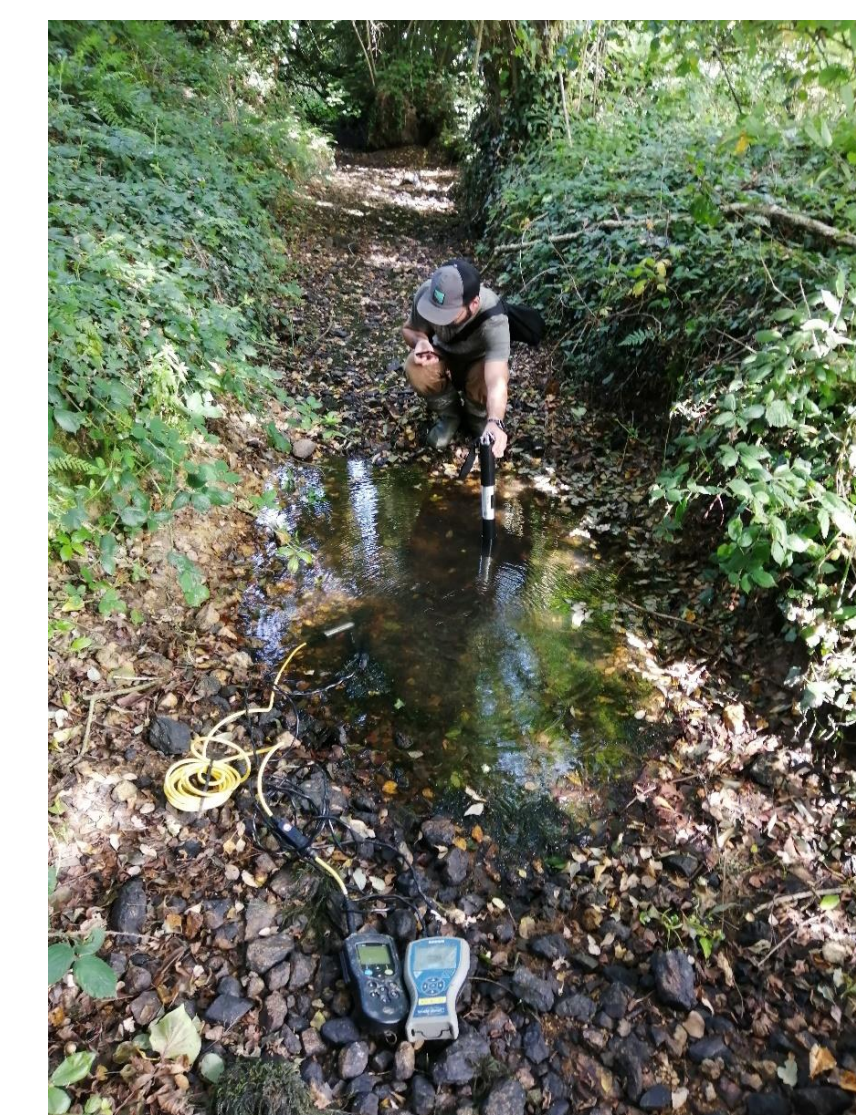
- Intermittent streams in temperate catchments are poorly studied [1].
- Lack of knowledge on C-N-P dynamics in intensive agricultural catchments and intermittent headwater streams.

Objectives

- Quantify spatial variability in C-N-P concentrations during stream fragmentation.
- Analyse patterns in C-N-P concentrations in flowing stream stretches and isolated pools (IP) [2].

Materials and methods

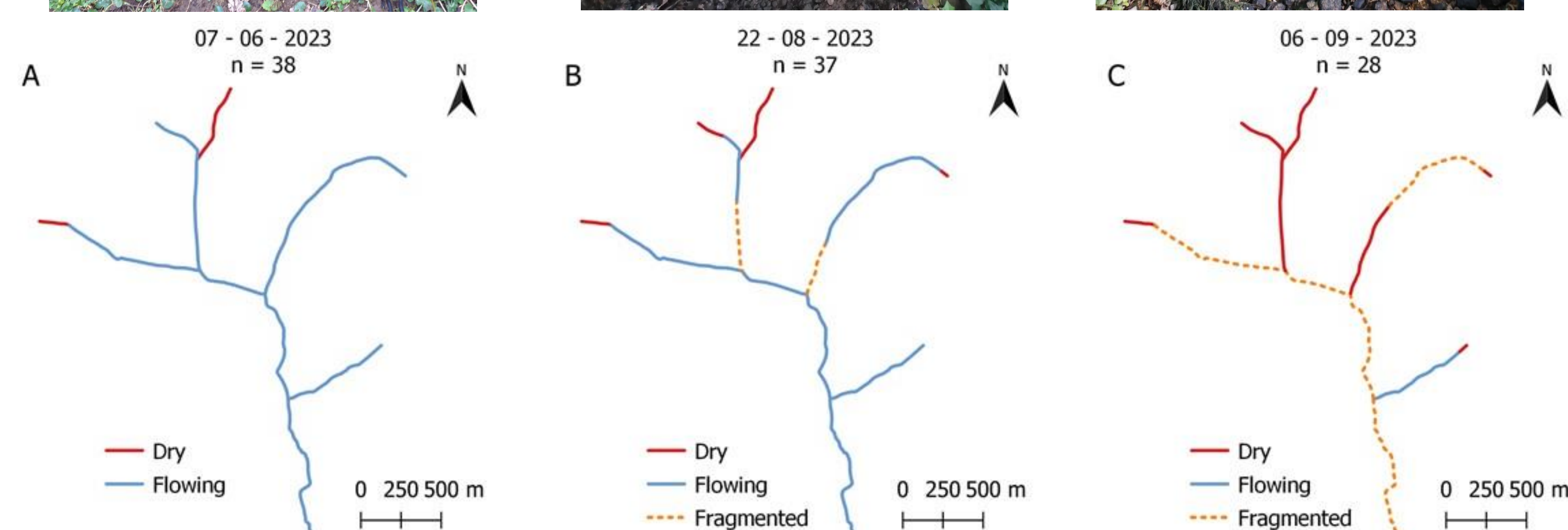
- Study site: Kervidy-Naizin catchment, 7km² [3].
- Sampling: ~40 points sampled 3 times during flow recession (spring-summer 2023).
- Laboratory analysis: Major anions, NO₃⁻, DOC, TP, PO₄³⁻
- Physico-chemical parameters: Conductivity, redox potential, 3D fluorescence, T°, DO, pH



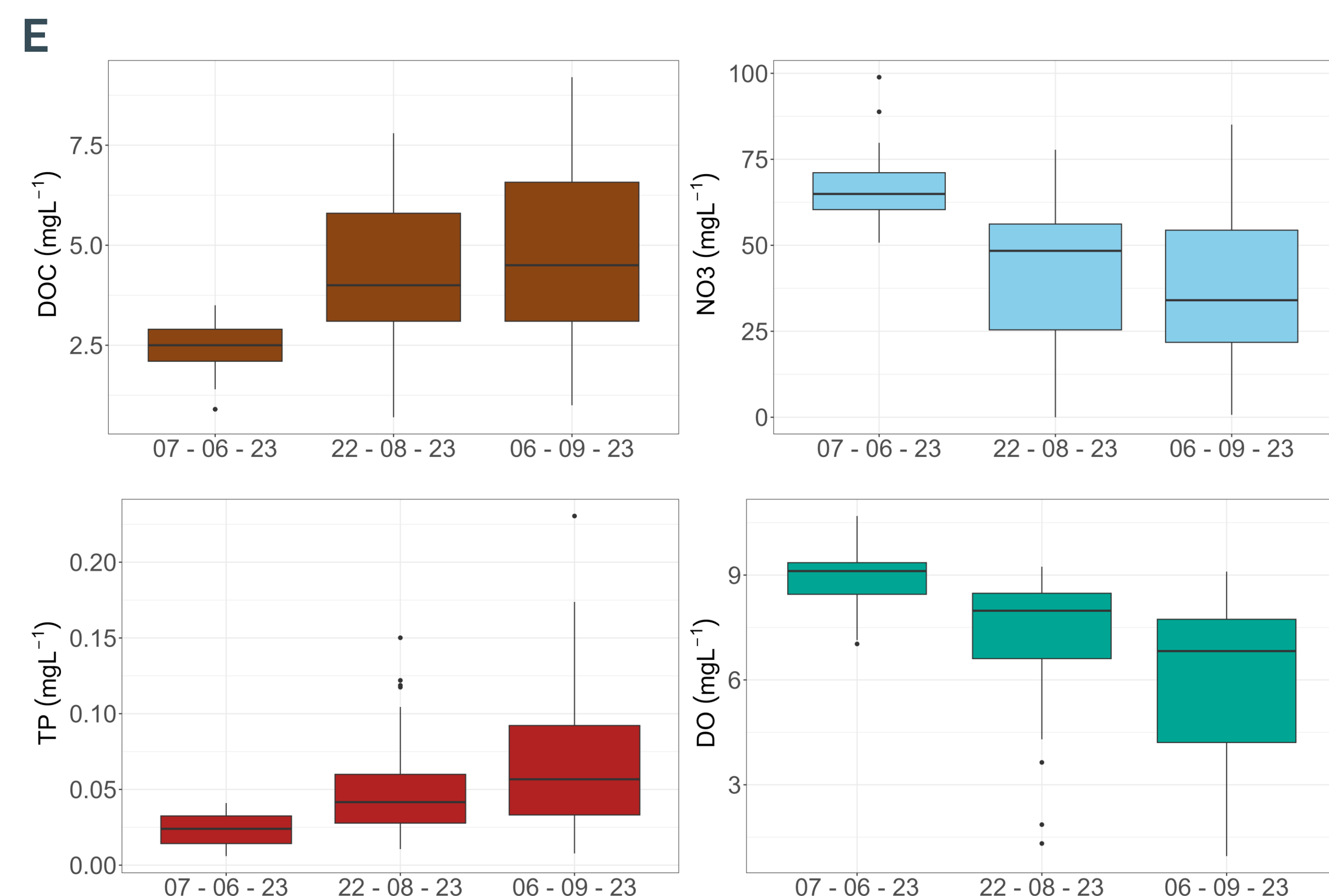
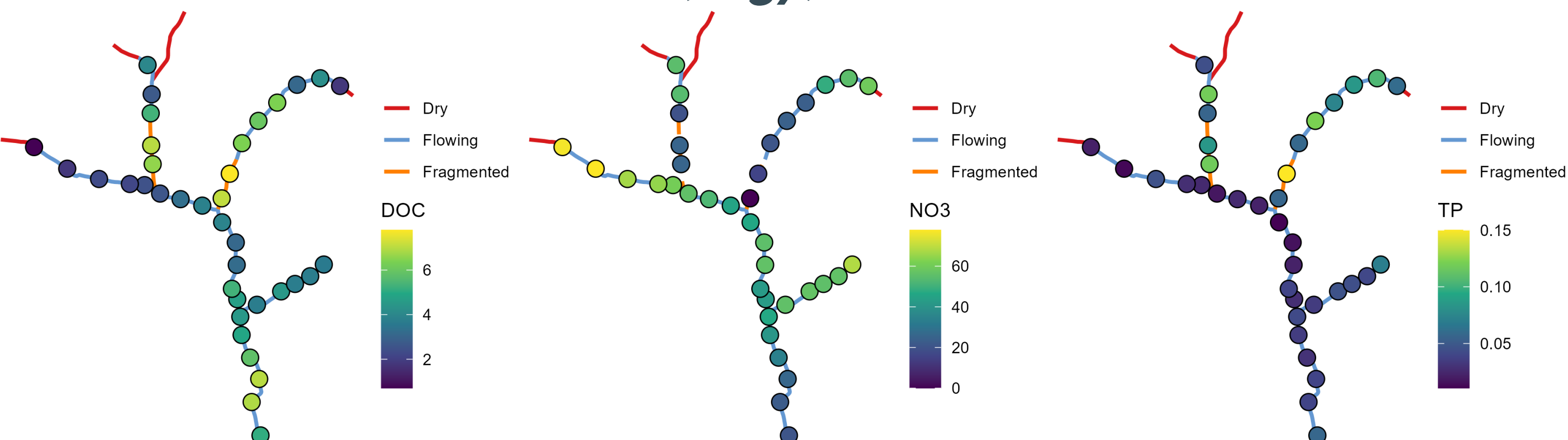
Results

Spatial Coefficient of Variation			
	07/06/2023	22/08/2023	06/09/2023
Cl	7.72	8.84	10.89
NO ₃	14.75	41.78	65.61
SO ₄	36.50	46.64	52.28
TP	43.59	66.16	73.75
Si	14.86	17.24	22.33
DOC	26.54	40.76	49.08
Conduc	22.02	12.57	10.29
pH	5.66	3.81	3.67
Redox	140.08	--	23.52
DO	9.51	26.01	43.47
T	8.63	6.05	7.47

- Stream fragmentation (A-C) increased from northeastern stretches.
- During stream fragmentation: Spatial variability in concentrations increased for most water quality parameters (D), especially DOC, NO₃⁻, and TP.



Sampling campaign of 22 - 08 - 23 (n=37)



- During the three field campaigns, DOC concentrations exhibited a consistent spatial distribution, characterized by high values upstream and low values downstream. Conversely, NO₃⁻ displayed an inverse pattern ($r=-0.91$, $p<0.05$).
- Dissolved oxygen showed a noticeable decrease over time (E) suggesting an increase in the rate of microbial metabolism.
- In IP, the concentrations of DOC and TP showed an upward trend, while NO₃⁻ concentrations seemed to decrease (F).

Conclusions and perspectives

- Stream fragmentation suggests a prevalence of subsurface flow dynamics in upstream region.
- The IP act as accumulators for solutes concentrations, particularly DOC and TP [4], meanwhile, NO₃⁻ is reduced via denitrification.
- IP are exposed to varying conditions, leading to divergent evolutions in solute concentrations. Redox processes seems to play a significant role in this concentrations changes.
- The rewetting phase of the catchment will be assessed in a subsequent campaign.

2nd TERENO-OZCAR Conference
Bonn, 2023

Acknowledgments:
We thank François M., Purco R. & Lorenzo R., for the assistance during the field trips, and to Céline B. & Mikaël F. for their assistance on the lab work and the equipment preparation.

References



- [1] Datry, T., Bonada, N., Boulton, A.J., 2017. General Introduction. Intermittent Rivers and Ephemeral Streams, pp. 1-20.
- [2] Arce, M.I., Sánchez-Montoya, M.d.M., Gómez, R., 2015. Nitrogen processing following experimental sediment rewetting in isolated pools in an agricultural stream of a semiarid region. Ecological Engineering 77, 233-241. 10.1016/j.ecoleng.2015.01.035.
- [3] Fovet, O., Ruiz, L., Gruau, G., Akkal, N., Aquilina, L., Busnot, S., Dupas, R., Durand, P., Fauchoux, M., Fauvel, Y., Flechard, C., Gilliet, N., Grimaldi, C., Hamon, Y., Jaffrezic, A., Jeanneau, L., Labasque, T., Le Henaff, G., Mérot, P., Molénat, J., Petitjean, P., Pierson-Wickmann, A.-C., Squidant, H., Viaud, V., Walter, C., Gascuel-Oudou, C., 2018. AgrHyS: An Observatory of Response Times in Agro-Hydro Systems. Vadose Zone Journal 17, 1-16. 10.2136/vzj2018.04.0066.
- [4] Bonada, N., Cañedo-Argüelles, M., Gallart, F., von Schiller, D., Fortuño, P., Latron, J., Llorens, P., Múrria, C., Soria, M., Vinyoles, D., Cid, N., 2020. Conservation and Management of Isolated Pools in Temporary Rivers. Water 12.

UMR 1069 SAS - Sol, Agro et hydrosystème, Spatialisation
65 rue de Saint-Brieuc, CS 84215,
35042 Rennes Cedex
T. +33 (0)2 23 68 54 28
institut-agro.fr/rennes-angers