ENGEES
L'école de l'eau et de l'environnement

SWAT Soil & Water Assessment Tool

International SWAT Conference – Strasbourg – July 2024

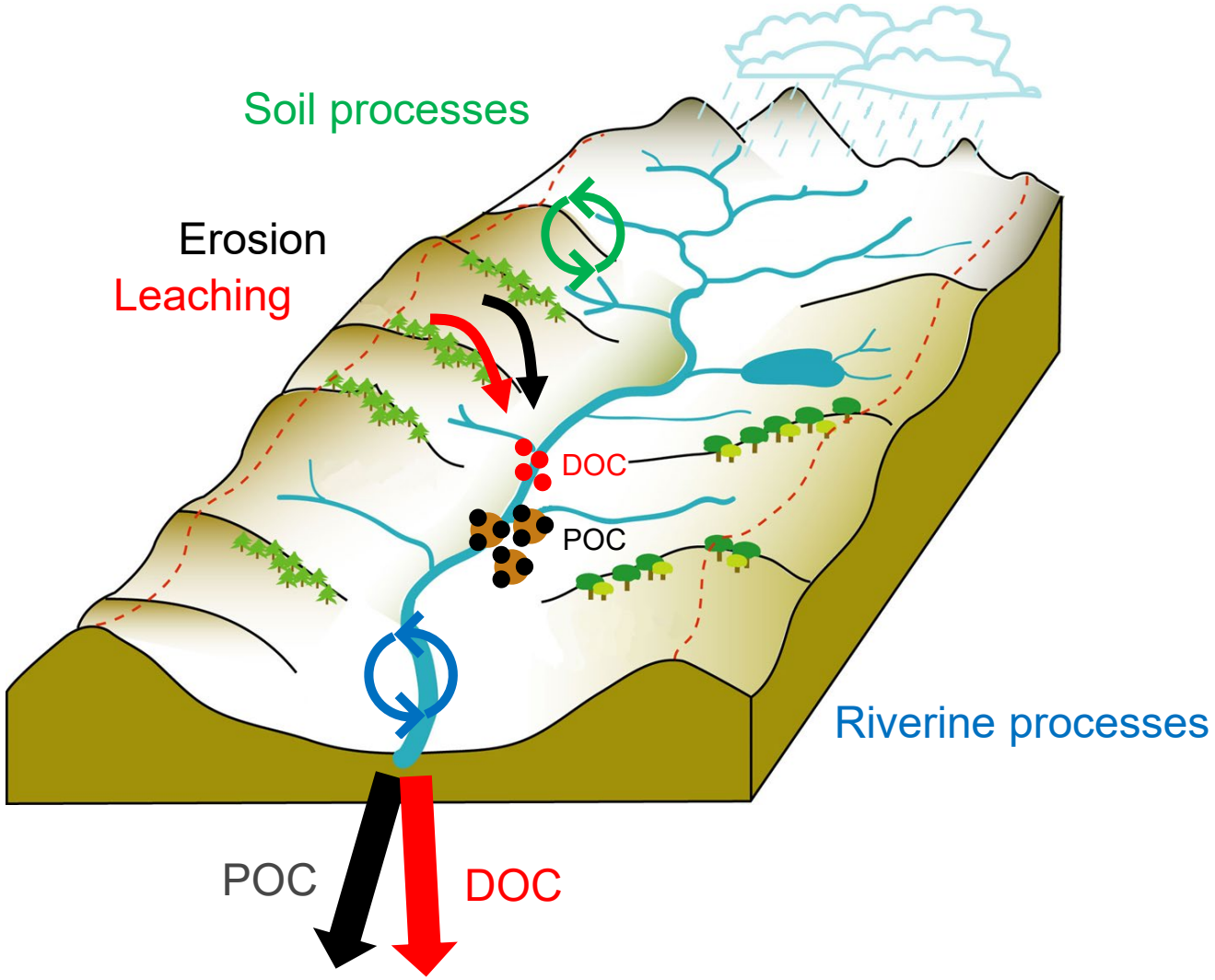
Using **SWAT-C** to predict **organic carbon** dynamics in a **large French catchment** under multiple anthropogenic pressures

Clément Fabre[1,*], Olivier Boutron[1],
Sabine Sauvage[2], José-Miguel Sánchez-Pérez[2]

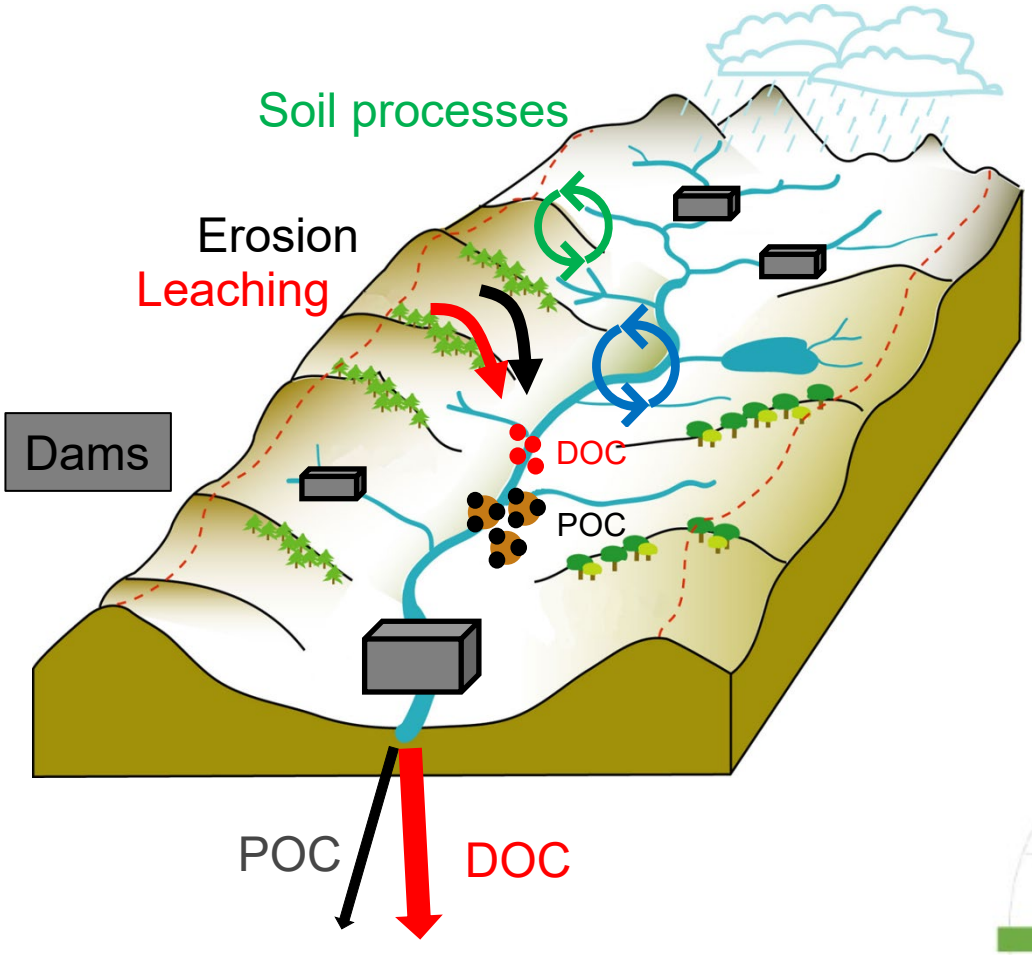
CRBE
CENTRE DE RECHERCHE SUR LA BIODIVERSITÉ ET L'ENVIRONNEMENT

cnrs

Tour du Valat
Research institute for the conservation of Mediterranean wetlands

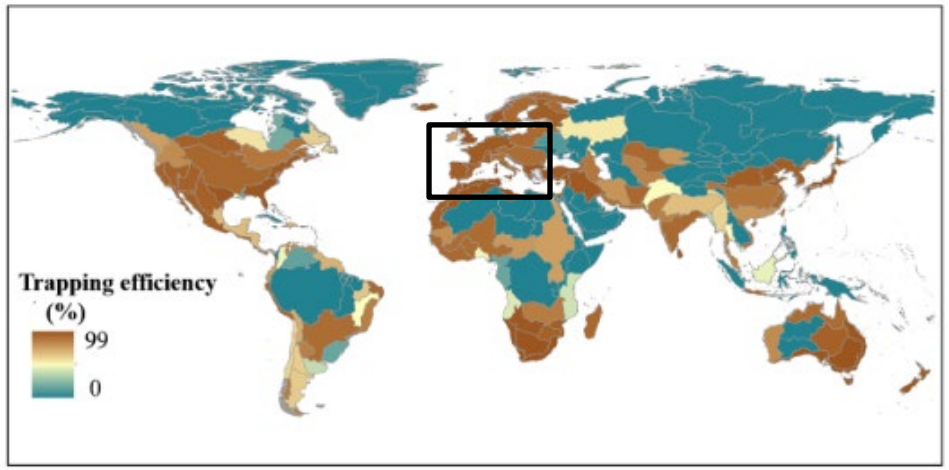


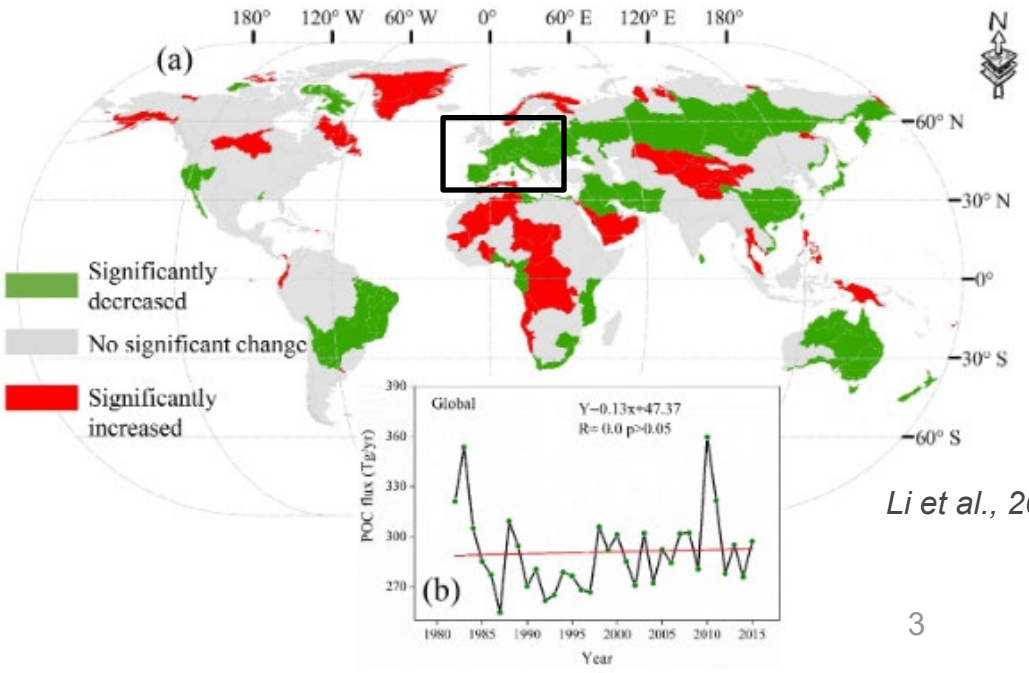
+ associated pollutants



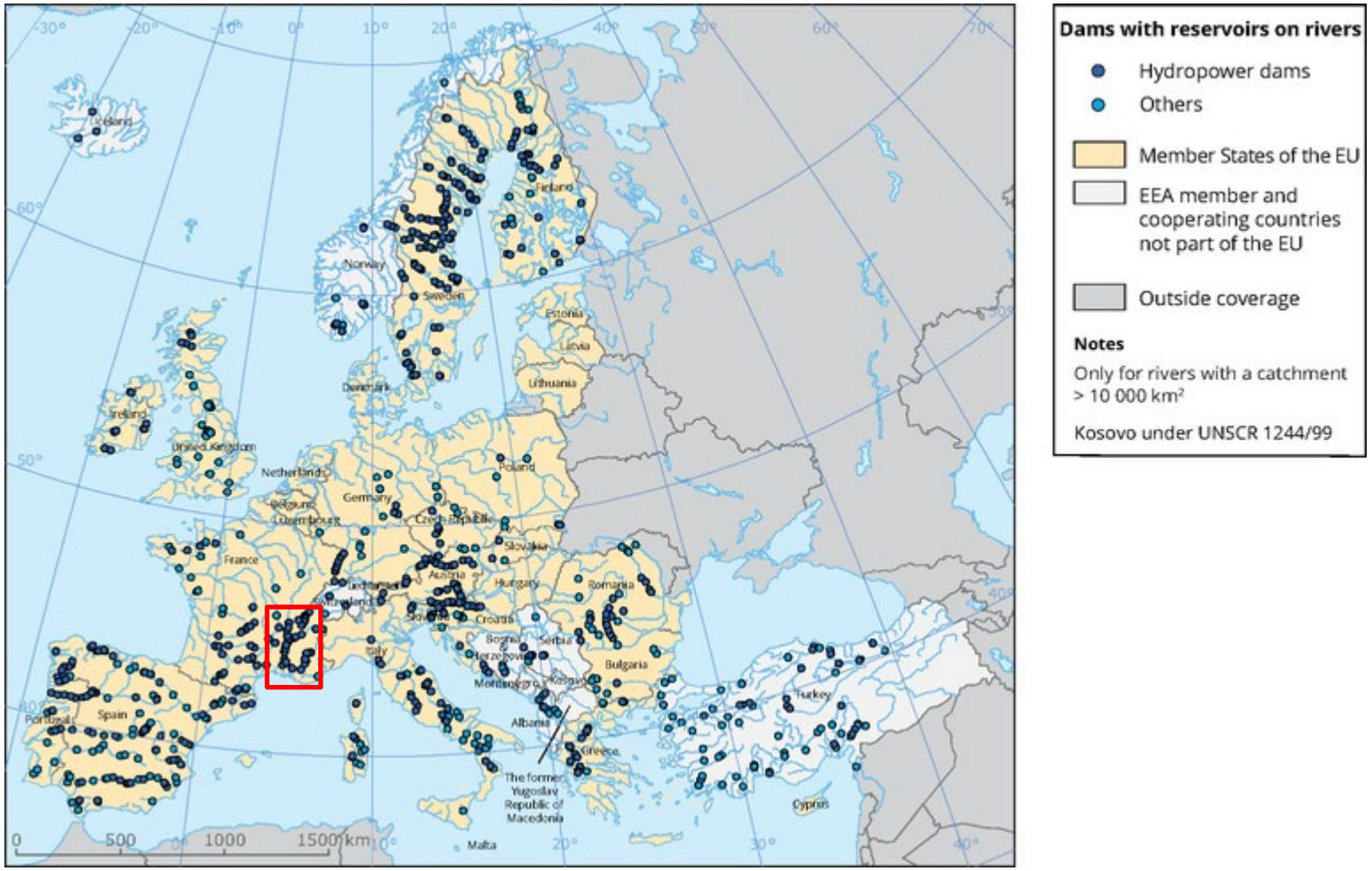
-13% of TOC (1970-2000)

Maavara et al., 2017





Li et al., 2021



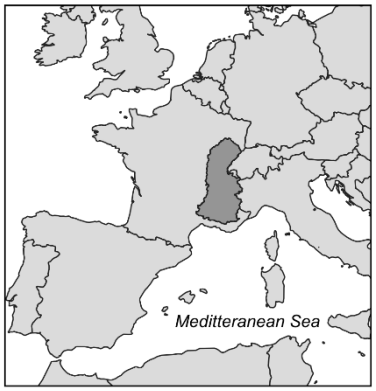
European Environment Agency

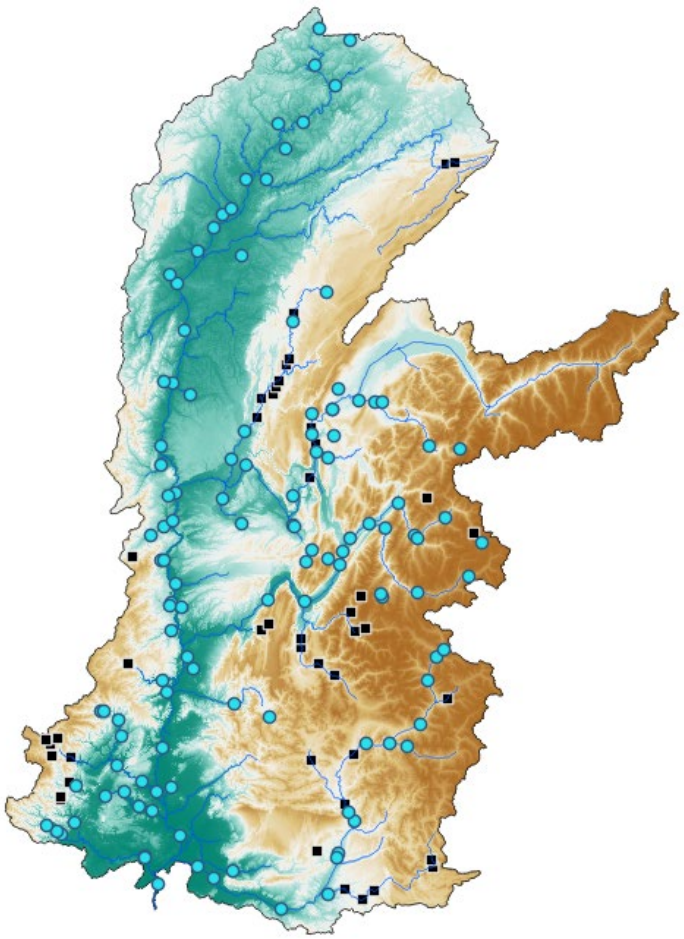
Objectives

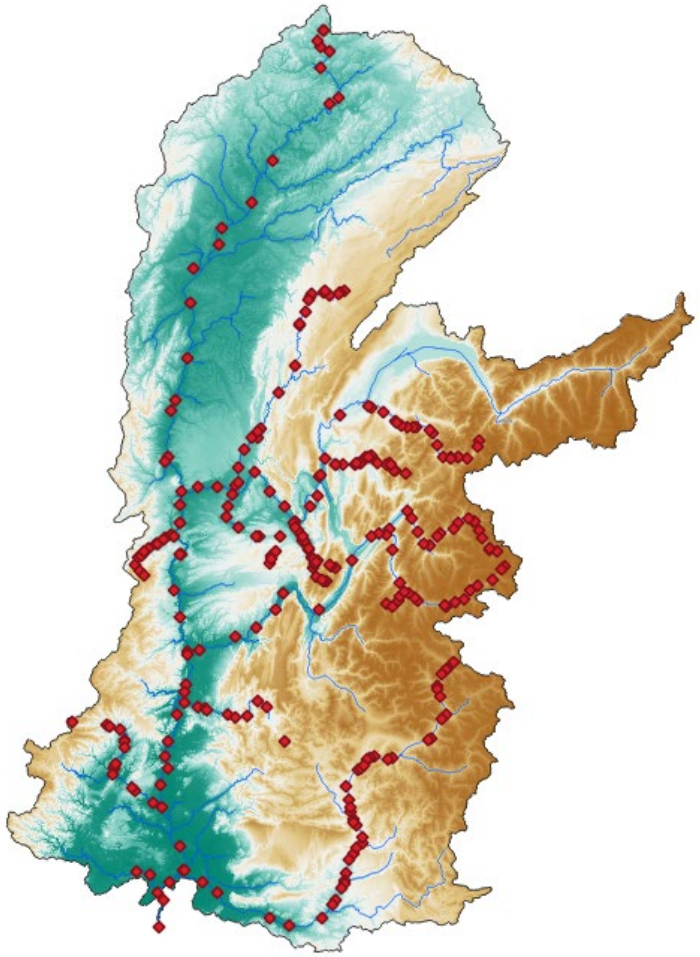
- What are the dynamics of POC and DOC fluxes in a large French catchment affected by anthropogenic pressures?

- How anthropogenic activities (especially dams) affect OC cycle?

The Rhône River

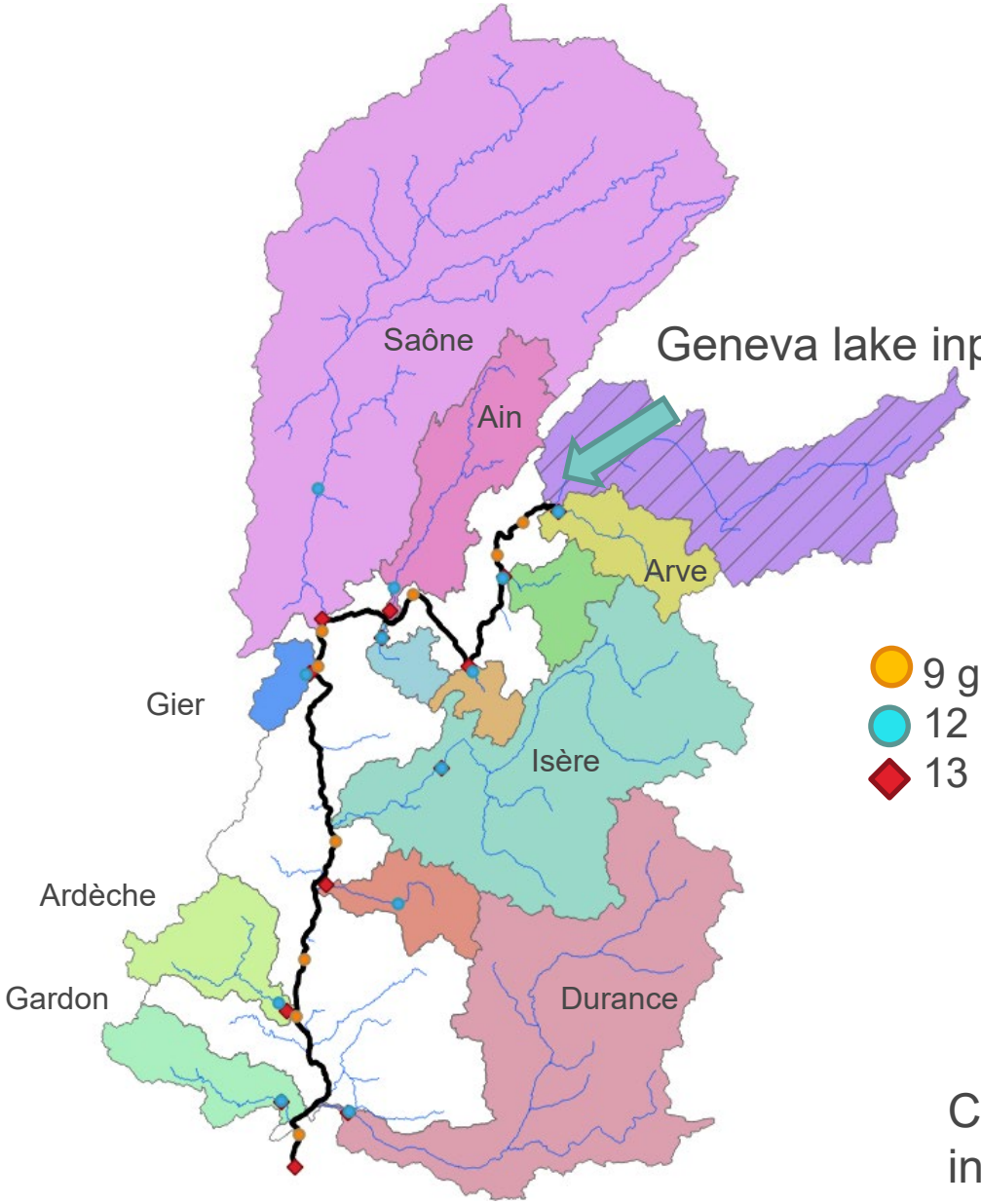






- Main dams (~50)
- Gauging stations (~120 – French Water Agency)
- Sampling stations (~280 – ~1 sample a month, TSS, POC, and DOC)

Main subcatchments & observed data selected for calibration

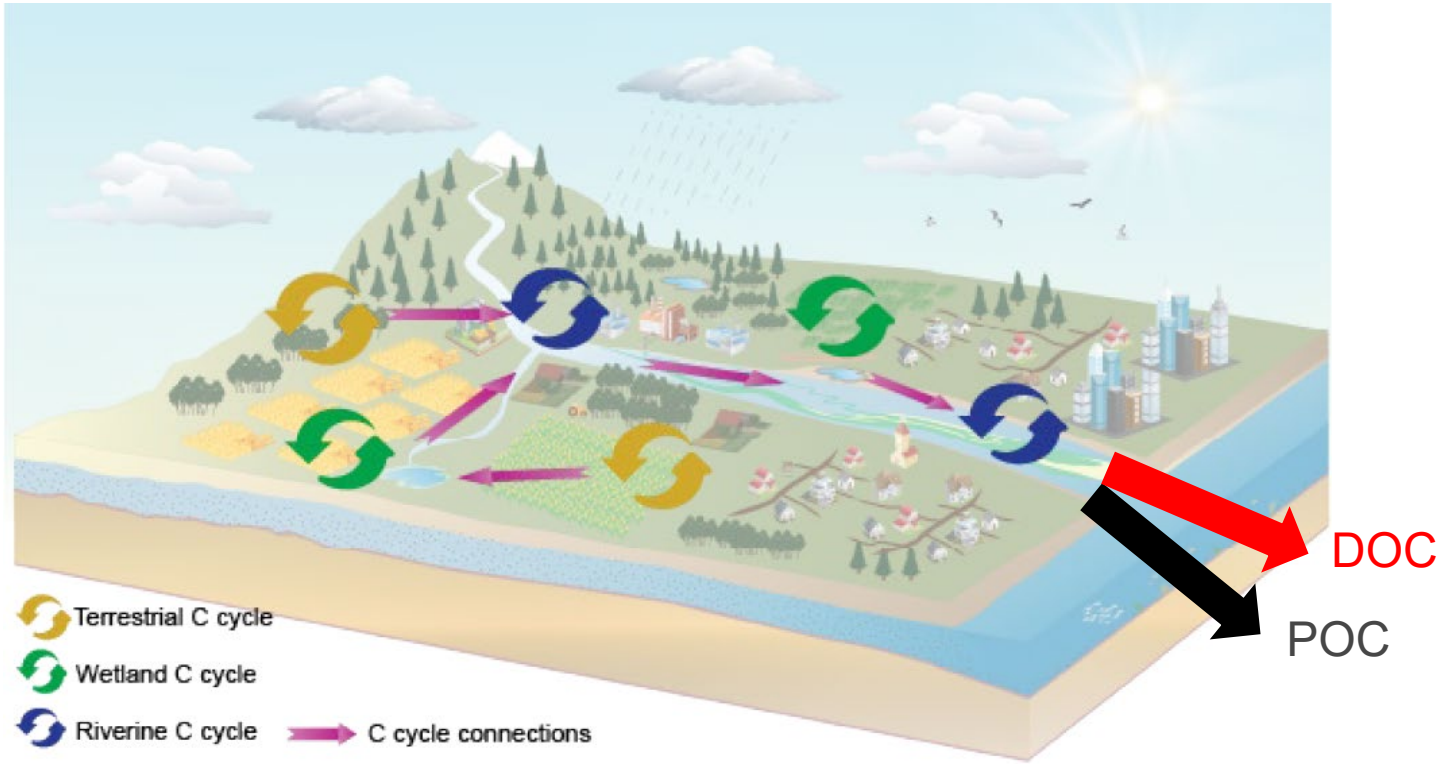


- 9 gauging stations on the Rhône corridor
- 12 gauging stations to calibrate the main subcatchments
- 13 sampling sites for sediment, POC, and DOC

Period: 2002-2020

Calibration from upstream to downstream & independant for each subcatchment

The SWAT-C model

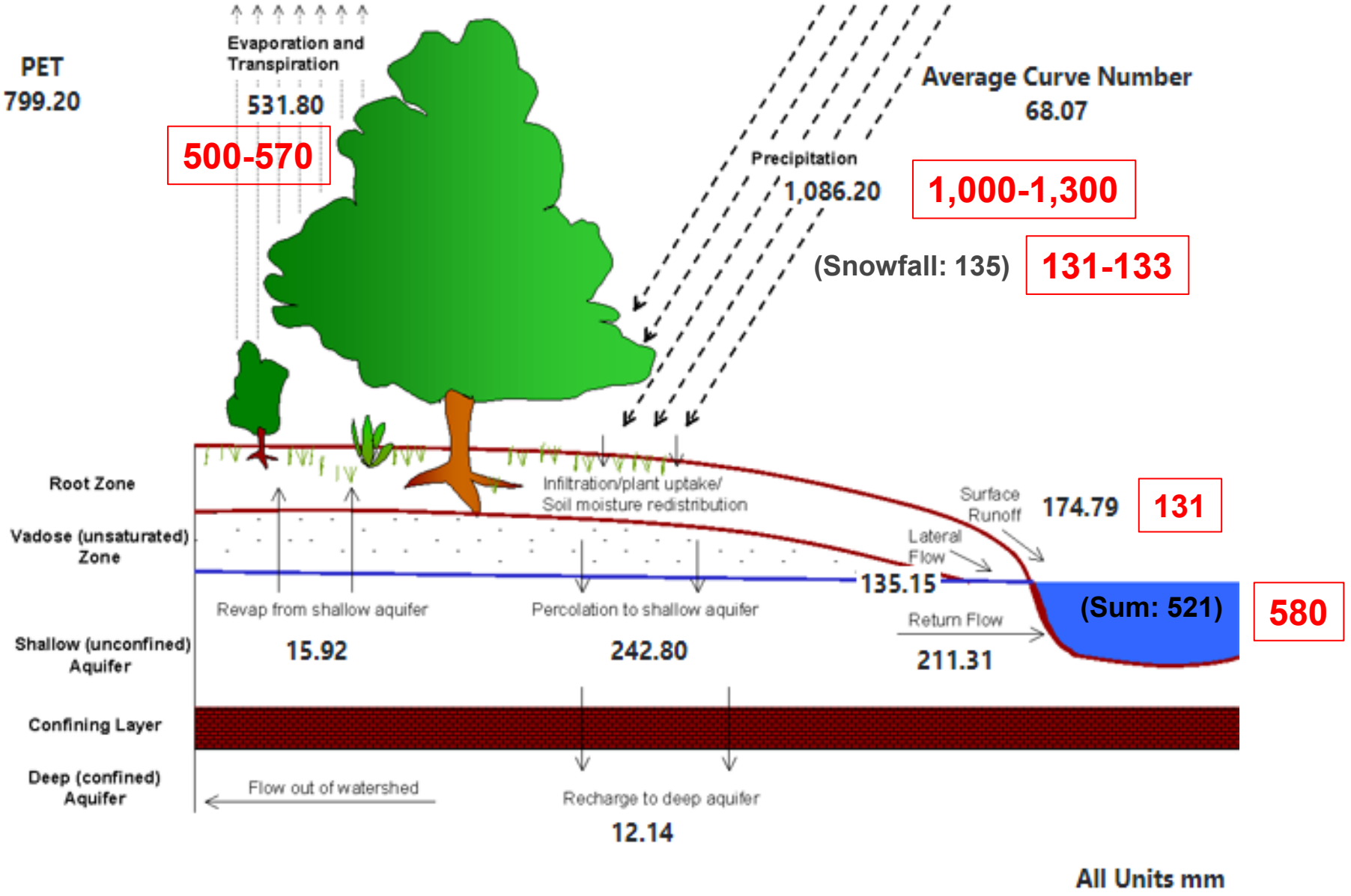


River Modelling:

- Labile and refractory POC and DOC

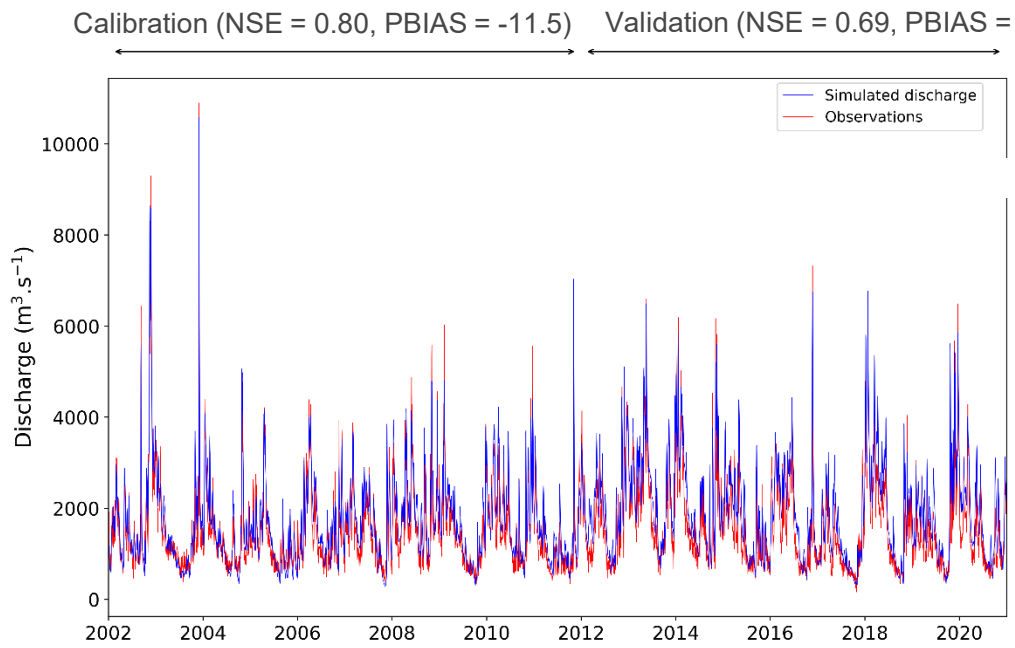
- Manual calibration based on literature
- Hydrology: Automatic calibration using R-SWAT (Nguyen et al., 2022)
  - Selection based on the best NSE
  - 1st round: 25 runs to restrain the interval
  - 2nd round: 100 runs to refine the interval

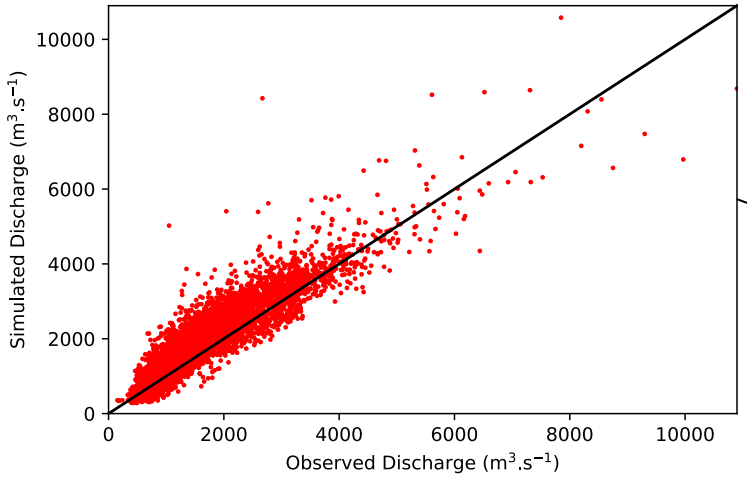
Hydrology	Snow	SFTMP, SMTMP, SMFMX, SMFMN, TIMP, SNOCOVMX, SNO50COV
	Evapotranspiration	IPET, ESCO
	Groundwater	ALPHA_BF, GWQMN, REVAPMN
	Soils	SOL_AWC
	Surface runoff	SURLAG
	Management	CN2
Sediment	Erosion	USLE_K1 & USLE_K2
Organic carbon	OC production	Er_POC_para, peroc_DIC_para, peroc_DOC_para, part_DOC_para, hlife_doc_para

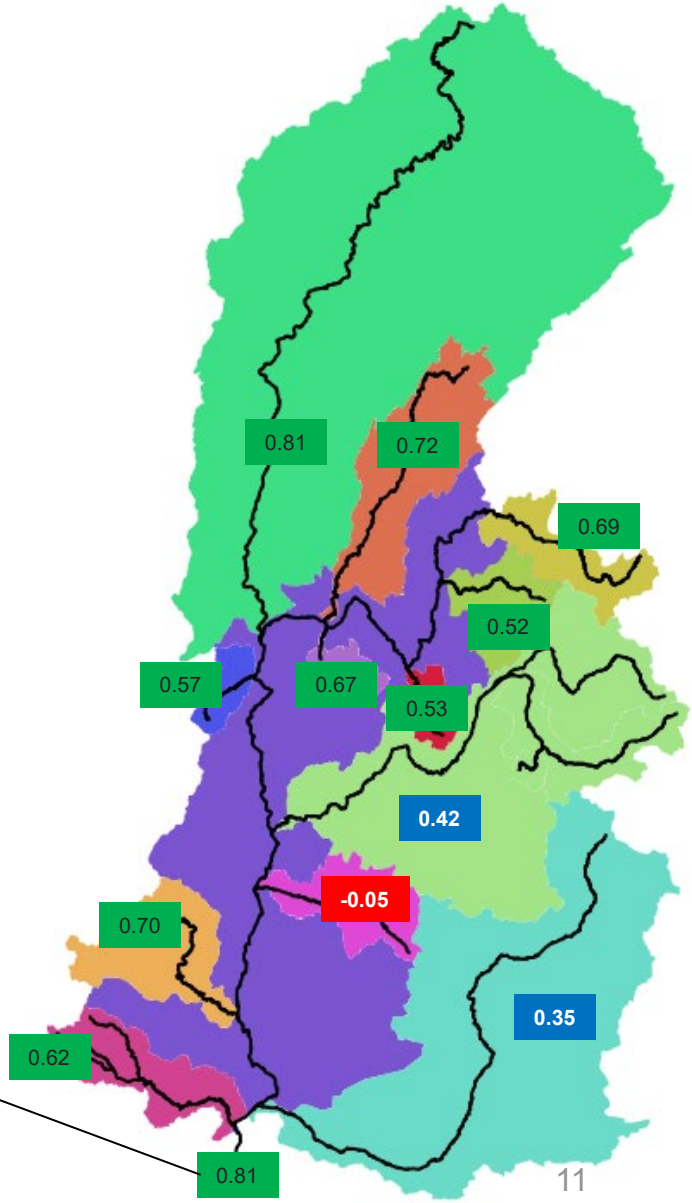


References: Habets et al., 1999; Etchevers et al., 2002; Greuell (2015) in: IMPACT2C

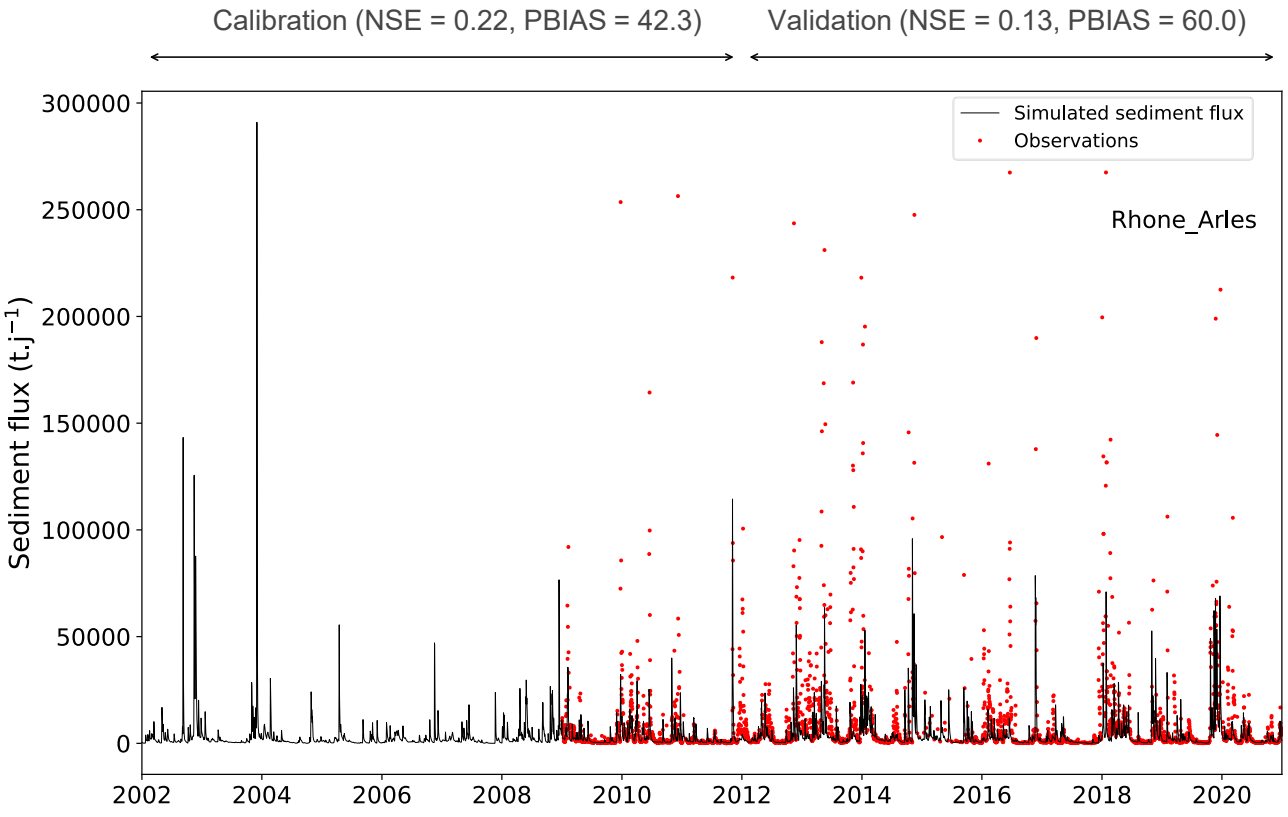
Hydrology

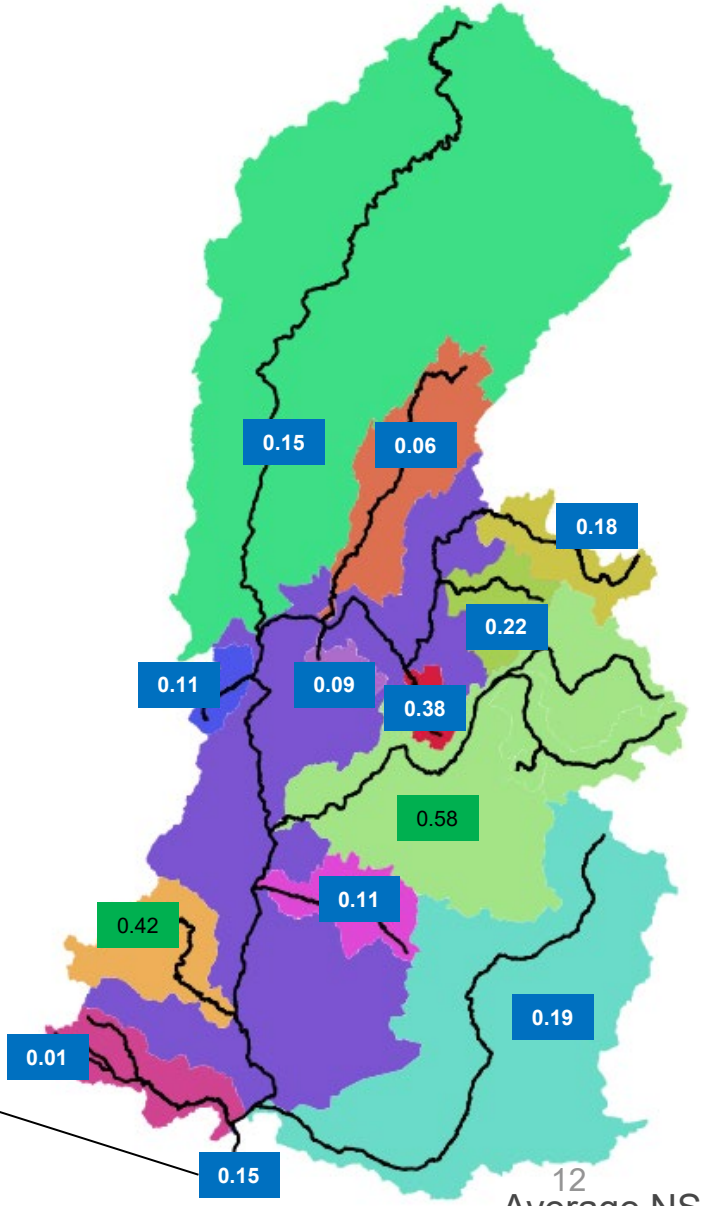

Calibration (NSE = 0.80, PBIAS = -11.5)
Validation (NSE = 0.69, PBIAS = -22.0)
Simulated discharge
Observations
Discharge ($m^3.s^{-1}$)
0
2000
4000
6000
8000
10000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020


Simulated Discharge ($m^3.s^{-1}$)
Observed Discharge ($m^3.s^{-1}$)
0
2000
4000
6000
8000
10000

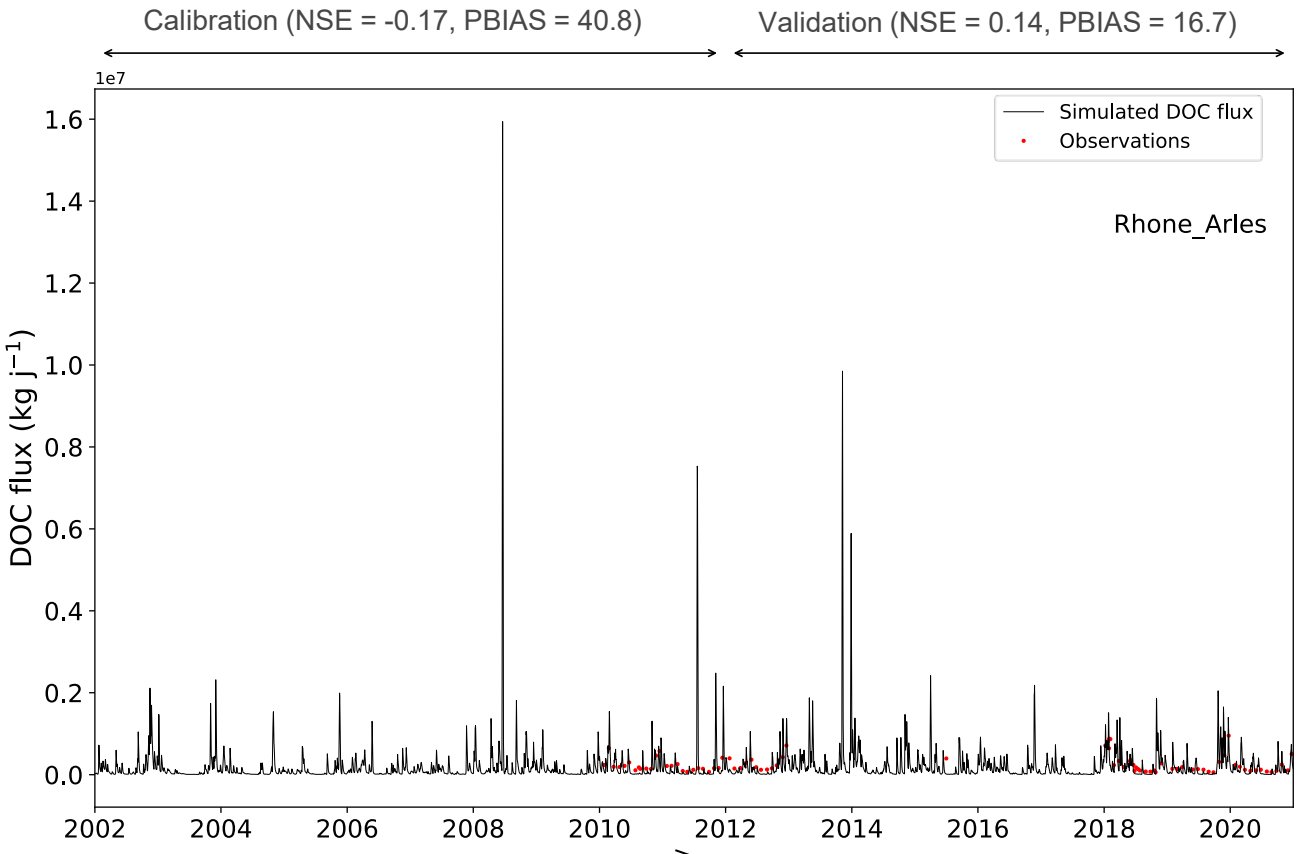

Average NSE
0.81
0.72
0.69
0.52
0.57
0.67
0.53
0.42
-0.05
0.70
0.35
0.62
0.81

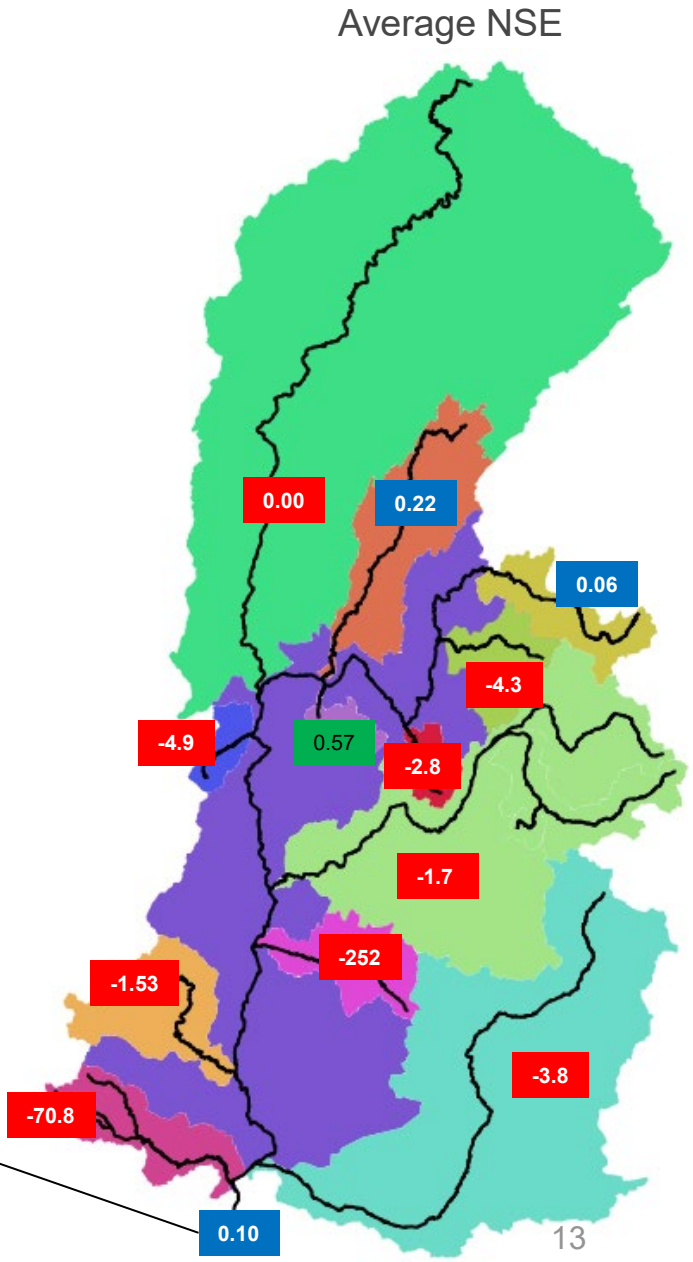
Sediment


Calibration (NSE = 0.22, PBIAS = 42.3)
Validation (NSE = 0.13, PBIAS = 60.0)
Simulated sediment flux
Observations
Rhone_Arles
Sediment flux (t.j^{-1})
300000
250000
200000
150000
100000
50000
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020


0.15
0.06
0.18
0.22
0.11
0.09
0.38
0.58
0.11
0.42
0.19
0.01
0.15
Average NSE

DOC



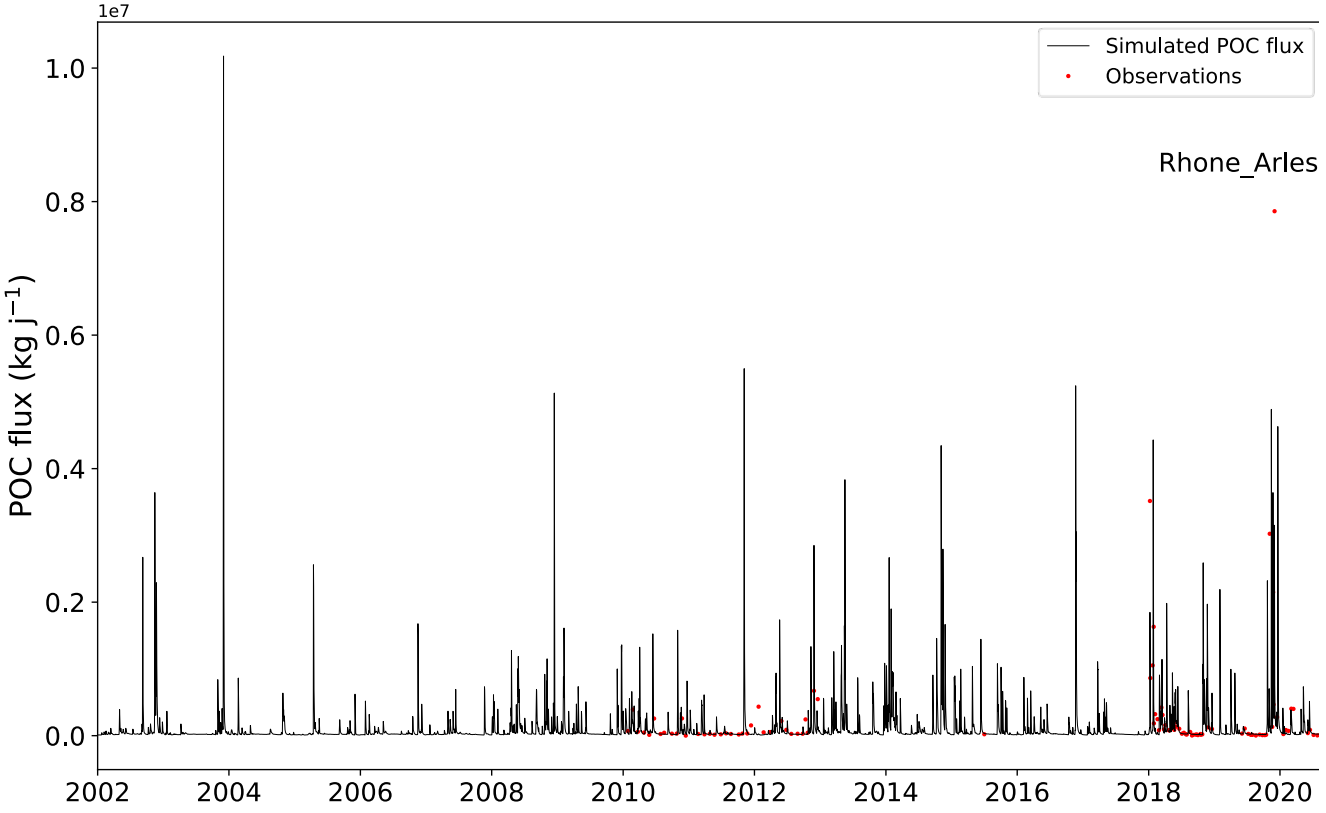


Parameters for DOC and POC: Basin-scale parameters

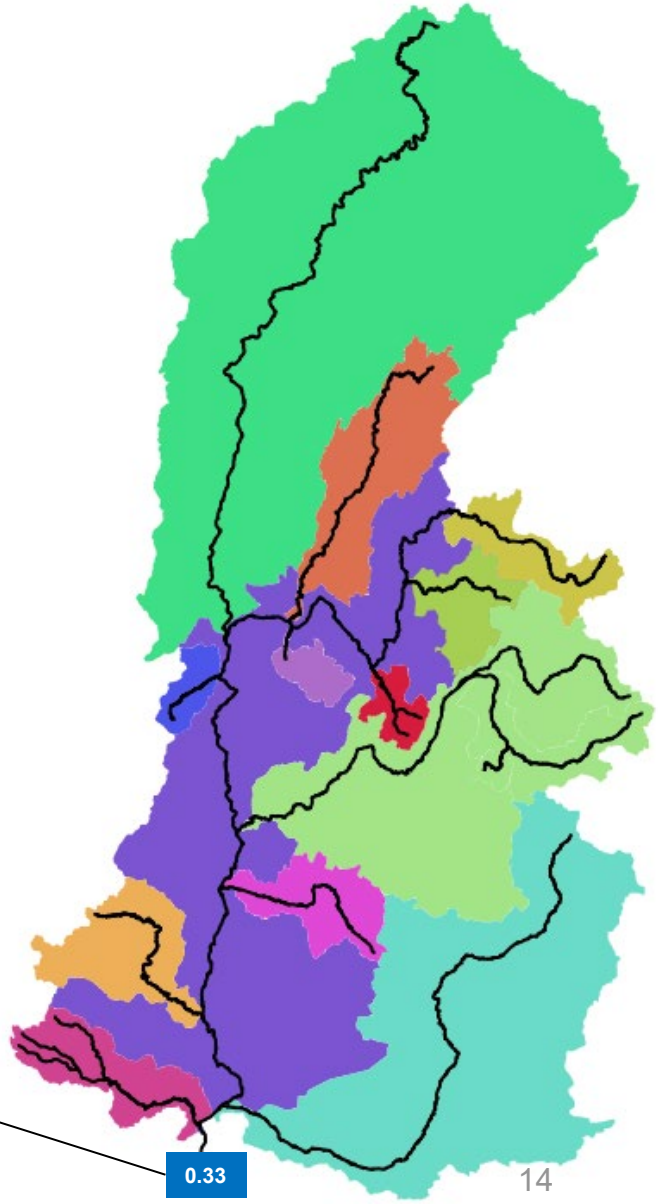
POC

Calibration (NSE = 0.19, PBIAS = 31.5)

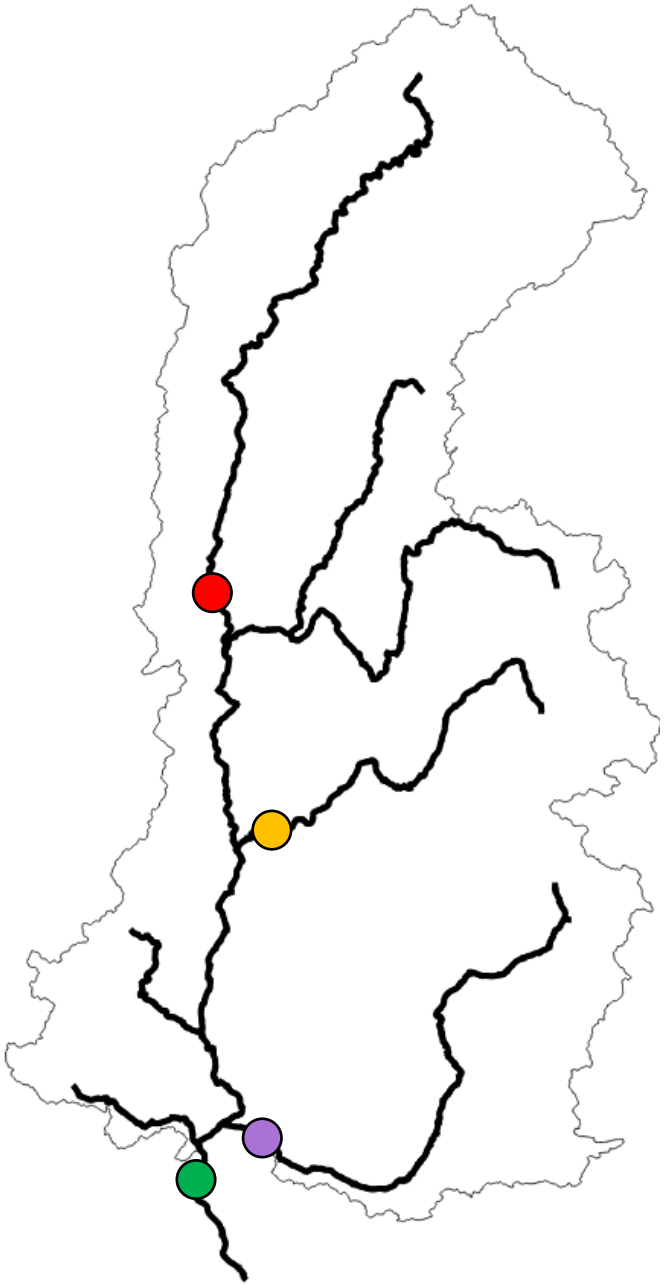
Validation (NSE = 0.32, PBIAS = 42.4)

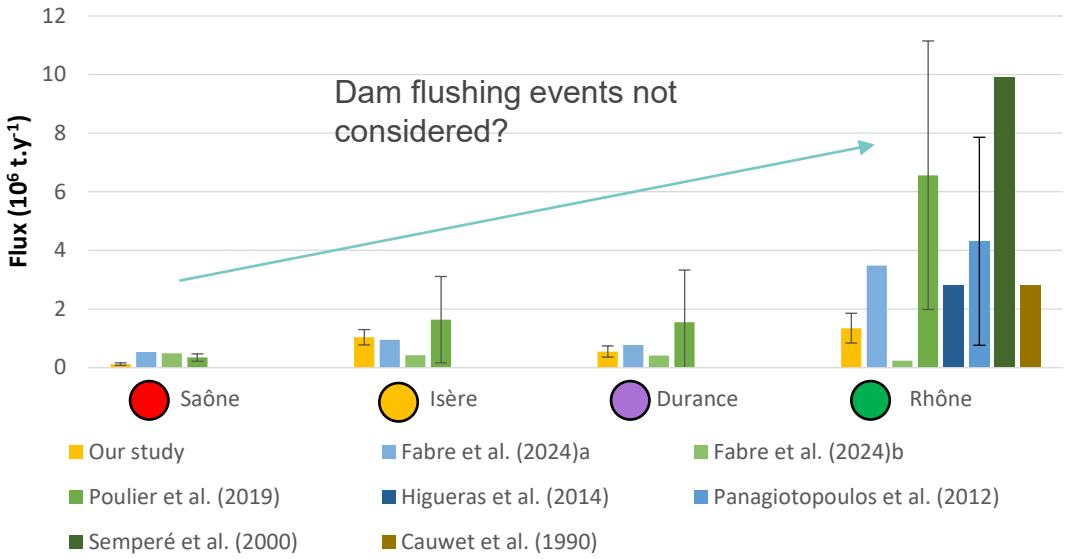


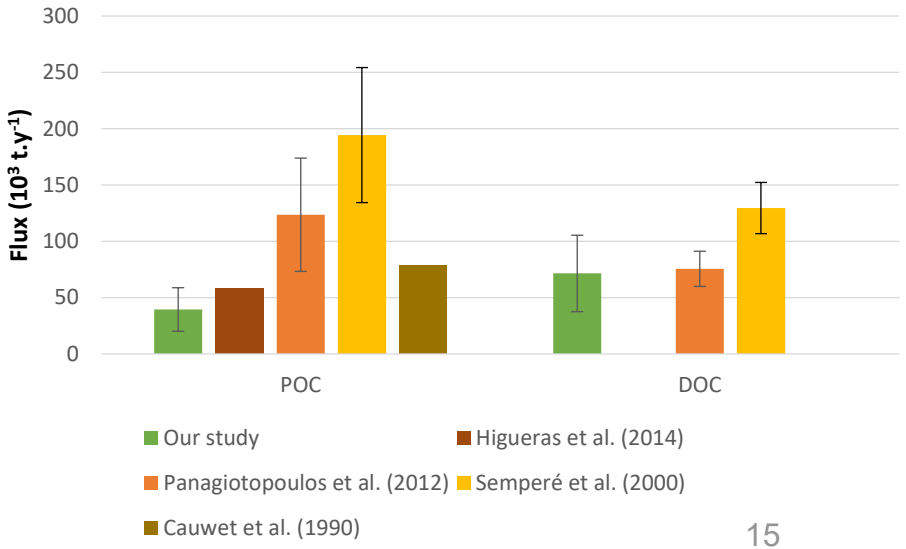
Average NSE



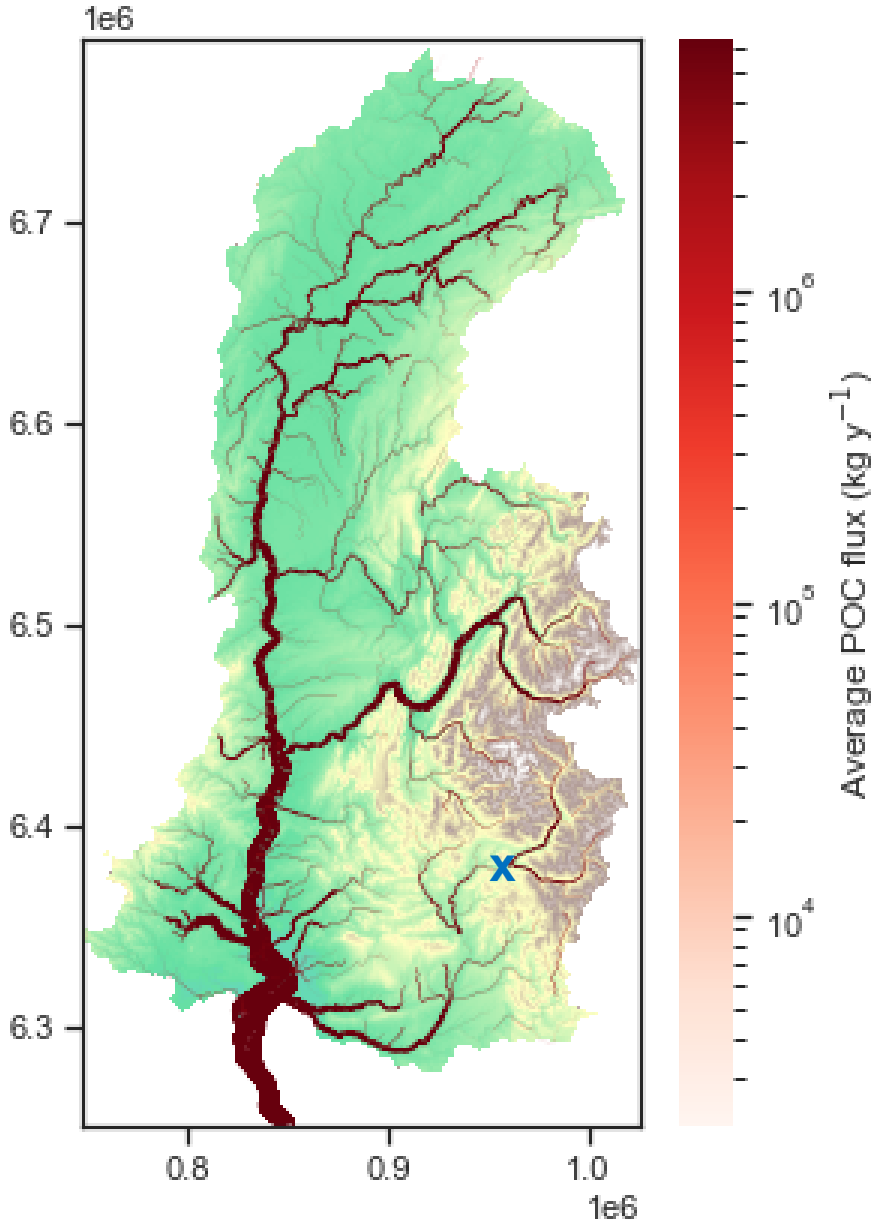
Sediment and OC balance

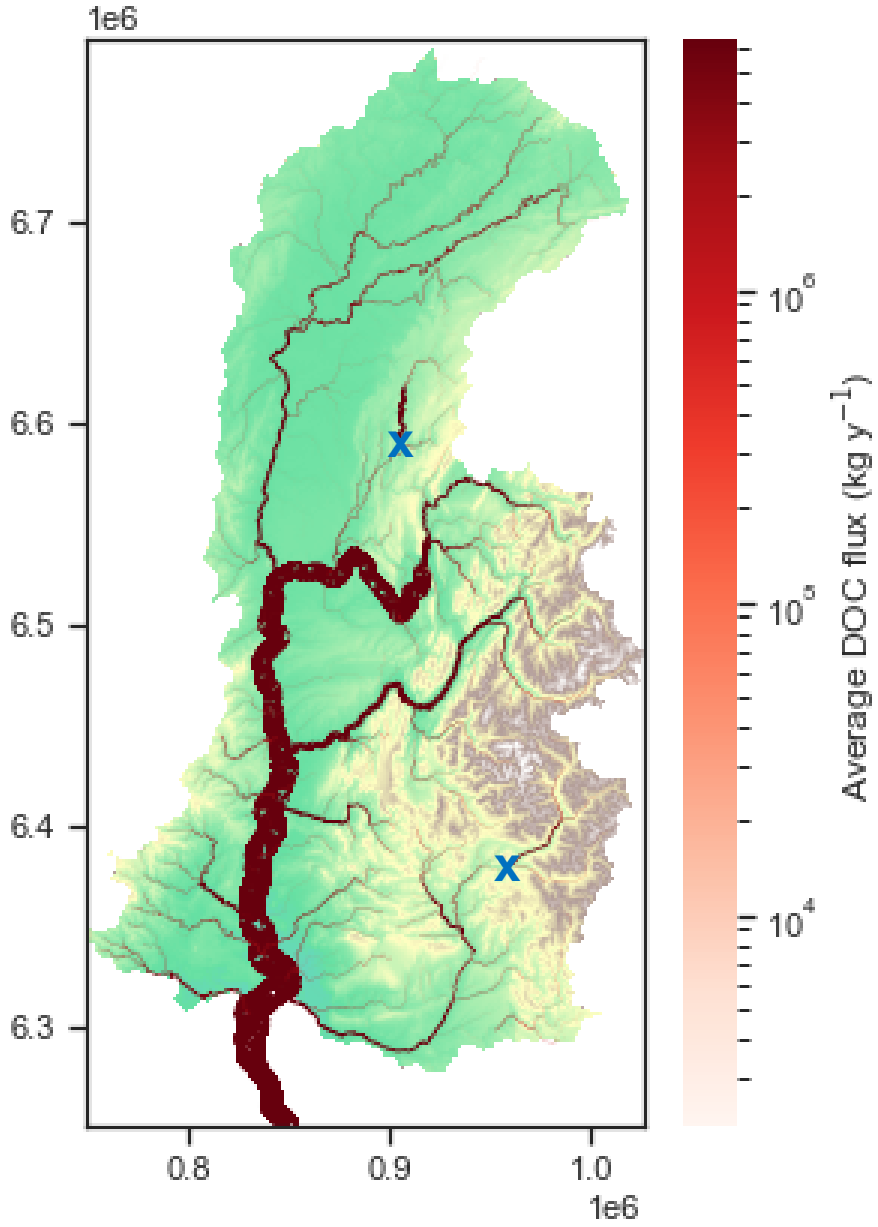




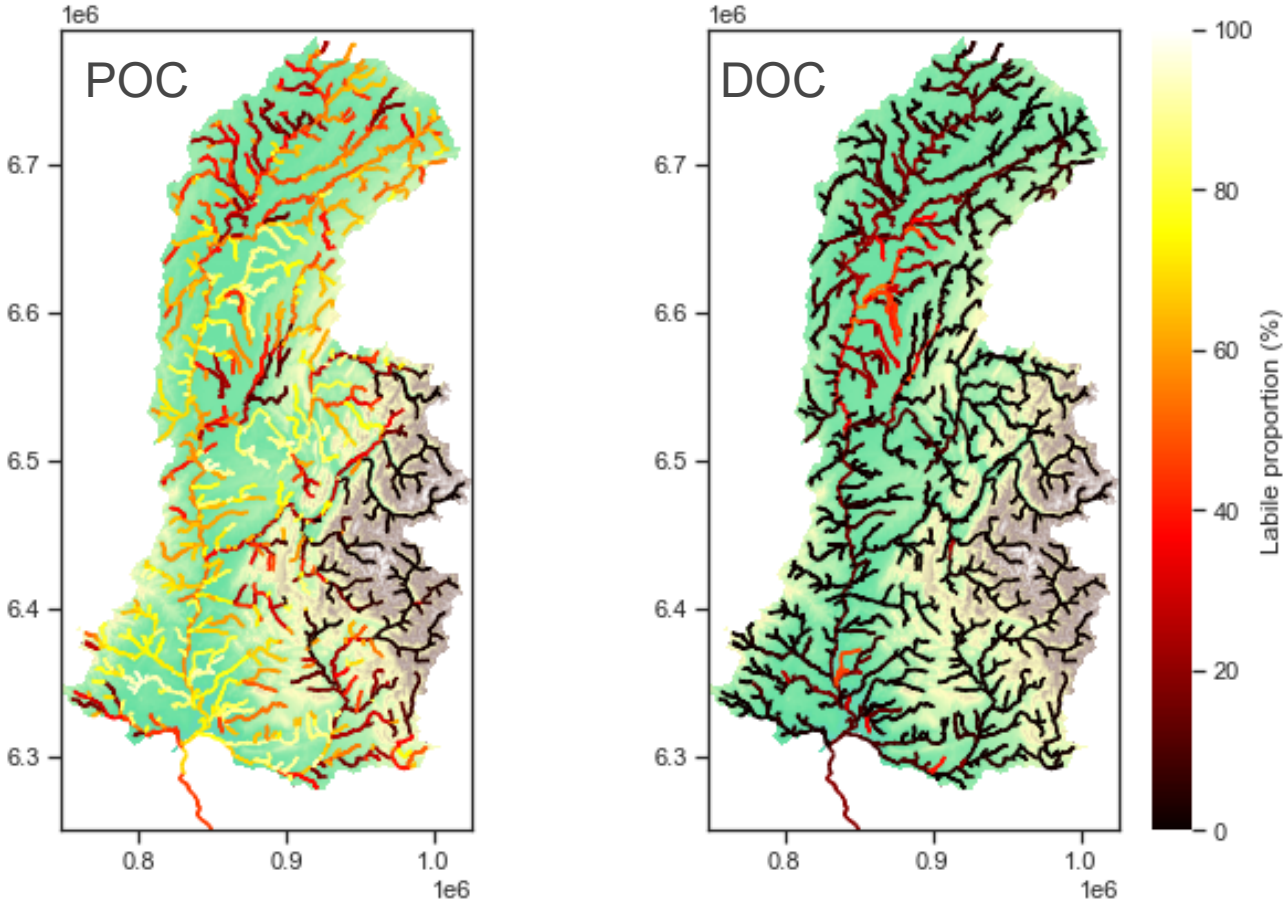


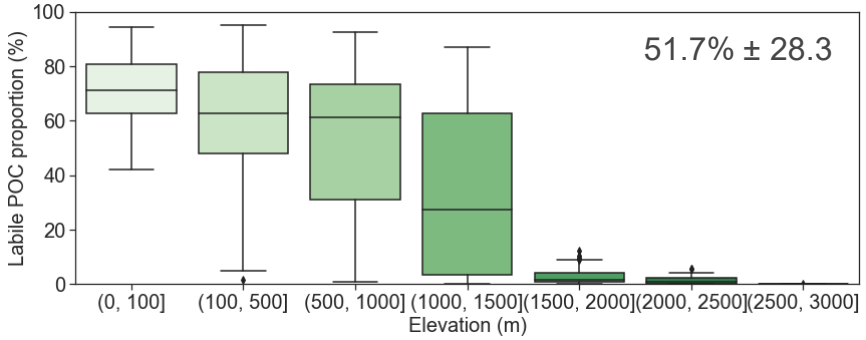
OC dynamics at catchment scale

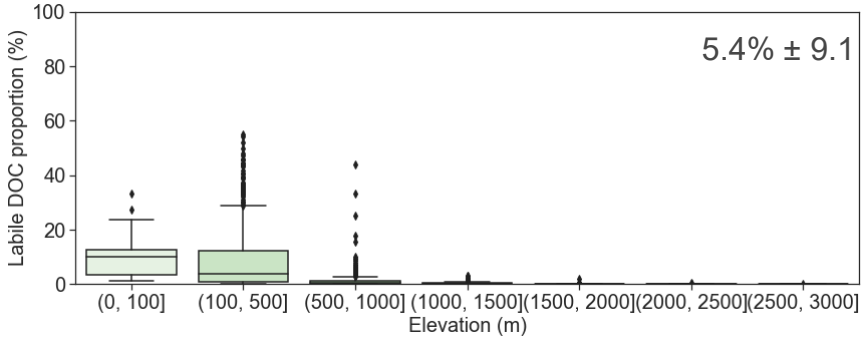




Average proportion of labile OC for each stream







DOC lability in rivers: 19% ± 16

Sondegaard and Middelboe, 1995

- Assess of sediment and OC dynamics in a large catchment with multiple anthropogenic activities affecting water and sediment processes

- Lower fluxes of sediment and POC than previous studies (not considering punctual flushing events performed by dams managers)

Discussion:

- Low number of data for OC

- SWAT-Carbon parameters for OC : basin-scaled not representing heterogeneity of large scale studies

By using subbasin-scaled parameters, we may be able to highlight hot spots of DOC and POC fluxes based on decent observed data to validate the modelled ones

Thank you for your attention

Adopt a flamingo

CRBE
CENTRE DE RECHERCHE SUR LA BIODIVERSITÉ ET L'ENVIRONNEMENT

cnrs

Tour du Valat
Institut de recherche pour la conservation des zones humides méditerranéennes

Rejoignez-nous

www.tourduvalat.org