Observation strategy for quantifying particulate contaminant fluxes along the Rhône river: the Rhône sediment observatory (OSR)

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OBSERVATION STRATEGY FOR QUANTIFYING PARTICULATE CONTAMINANT FLUXES ALONG THE RHÔNE RIVER: THE RHÔNE SEDIMENT OBSERVATORY (OSR)

Stratégie d'observation pour la quantification des flux de contaminants particulaires dans le Rhône : l'Observatoire des Sédiments du Rhône (OSR)

C. Le Bescond[1]; F. Thollet[1]; J. Le Coz[1]; M. Launay[1]; H. Angot[1]; M. Coquery[1]; S. Gairoard[2]; O. Radakovitch[2]; C. Antonelli[3]; F. Eyrolle-Boyer[3]; P. Raimbault[4]; I. Pairaud[5] – Contact: chloe.le-bescond@irstea.fr
[1]**Irstea**, Lyon-Villeurbanne, France; [2]**Cerege**, Aix-en-Provence, France; [3]**IRSN**, Saint Paul Lez Durance, France; [4]**MIO**, Marseille, France; [5]**Ifremer**, La Seyne-sur-Mer, France

• INTRODUCTION

Most of the suspended particulate matter (SPM) and associated contaminants delivered to the Mediterranean Sea is carried by the Rhône river. However, accurate estimations of particulate contaminant fluxes along the Rhône river and its tributaries are complex due to:

- Difficulties to assess river fluxes because of temporal and hydrological variabilities;
- Incomplete available data on SPM and particulate contaminant concentrations.

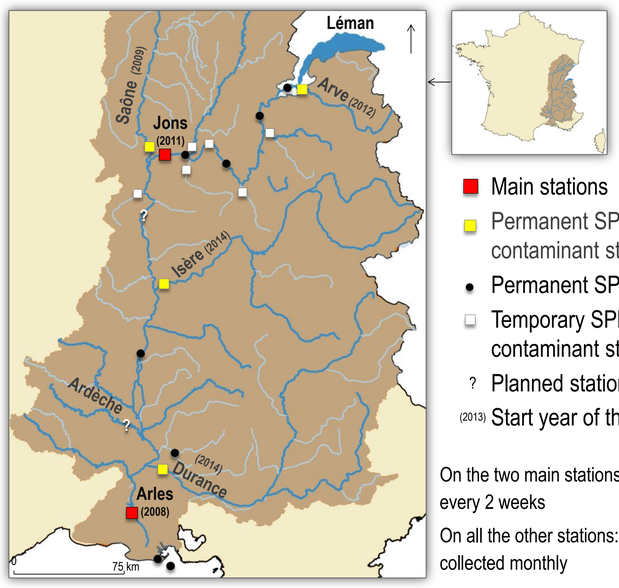
A long-term goal of the Rhône Sediment Observatory (2009-2017) is to **produce dense datasets** in order to **quantify** both **SPM and associated contaminants fluxes** (trace metals, polychlorobiphenyls) in a **robust way**, from hydrological events to annual scales.

• A STRATEGY FOR EVALUATING CONTAMINANT FLUXES

Through a distributed network of permanent and temporary stations in the Rhône river and its main tributaries, the observation strategy developed in the OSR program consists in **monitoring the 3 parameters** required in the calculation of the particulate contaminant flux $\Phi_{contaminant}$ (µg/s):

$$\Phi_{contaminant} = \int_T Q \ . \ C_{SPM} \ . \ C_{contaminant} \ . \ dt$$

- **Q**: the **water discharge** (m^3/s):
  - Continuously measured at **hydrometric stations** with a stage-discharge rating curve checked by stream gauging;
  - The systematic errors are negligible, within 2%-6%.

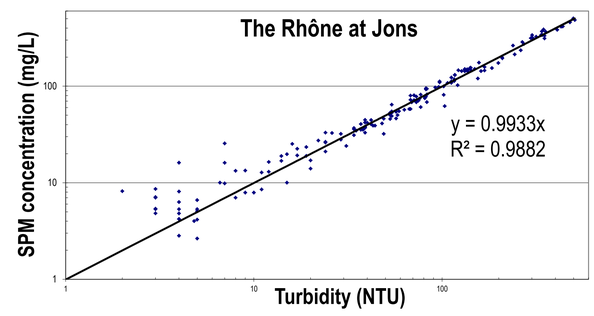


The French Rhône river observatory network

- **C_{SPM}**: the continuous **SPM concentration** time-serie (g/L) established from:
  - A **turbidity** dataset, recorded continuously every ten minutes;
  - A **calibration curve**, to convert turbidity into SPM concentration.

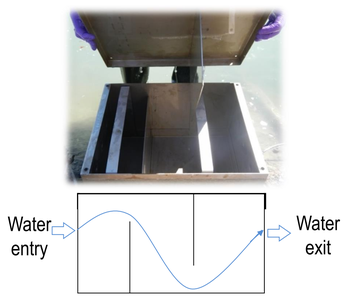
Collection of time-stamped water samples with an automatic sampler coupled to the turbidity sensor

Determination of SPM concentration by filtration (porosity filter 0.7 µm)



Construction of the calibration curve, checked by random water samplings, for each sensor and for different periods of time [3].

- **$C_{contaminant}$**: the **contaminant concentrations** (µg/kg) in SPM collected with different techniques:
  - A continuous-flow **centrifuge**, used as the reference;
  - An integrative **particle trap** in the rivers [2], allows to complete the network in a cheap and handy way.



A particle trap in river

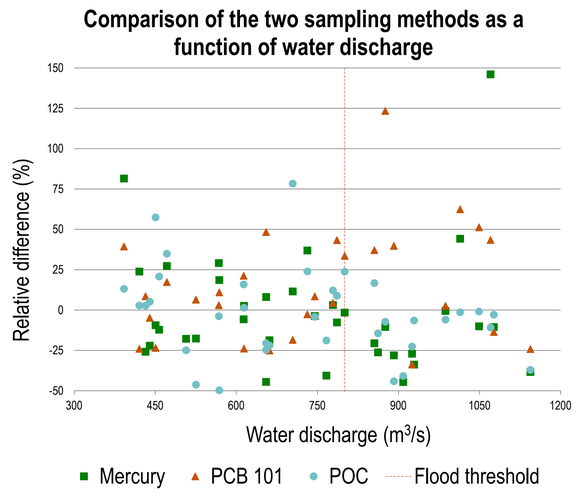
The continuous-flow centrifuge at Jons

The performed analyses on SPM are: PCBs, mercury, metallic trace elements, particulate organic carbon (POC) and grain-size distribution.

• RESULTS

Complementarity of the SPM sampling methods

We compared particulate contaminants and POC concentrations in SPM sampled together with a centrifuge (n=43) or a particle trap (n=40) from August 2012 to April 2014.

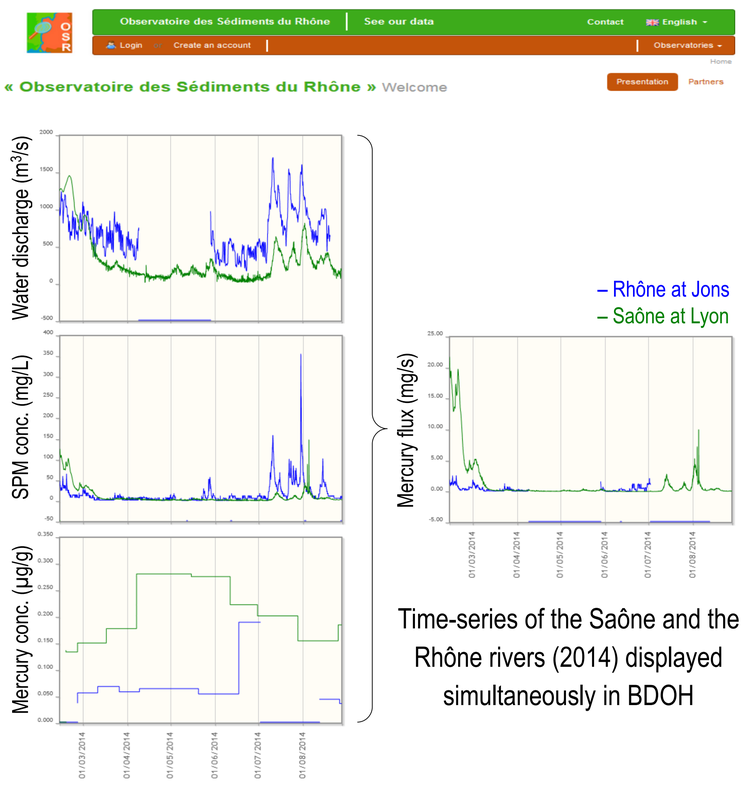


- Concentrations of mercury (Hg), PCB 101 and POC are **comparable for the two sampling techniques**, even during floods, as the analytical uncertainties are 15% for Hg, 30% for PCB 101 and 10% for POC.

→ However, the sedimentation process in particle traps remains unknown and will be **studied** in an experimental flume **under controlled conditions**.

Data storage

Particulate contaminant fluxes are calculated using continuous time-series in a dedicated online database: https://bdoh.irstea.fr



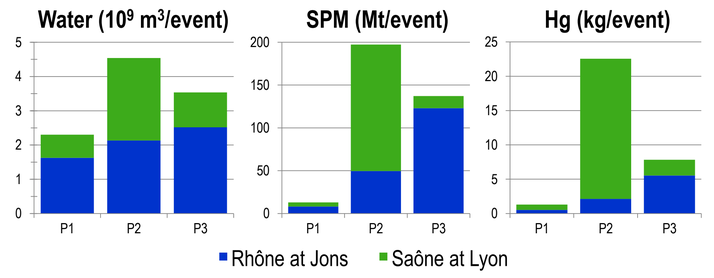
Time-series of the Saône and the Rhône rivers (2014) displayed simultaneously in BDOH

→ The datasets had permitted to develop **a 1-D hydraulic-SPM numerical model** of the Rhône to understand and predict the propagation and fate of particulate fluxes.

Example of fluxes assessments

We calculated fluxes assessment on the Saône at Lyon and the Rhône at Jons, on 3 periods with various hydrological conditions.

	Hydrological condition	Period	Duration (days)	Q mean (m^3/s)	[SPM] mean (mg/L)	[Hg] mean (µg/g)
P1	Low water	08/03/14	31	**588**	**4.6**	**0.063**
		08/04/14		**243**	**6.1**	**0.175**
P2	Flood event	11/02/14	28	**850**	**20.3**	**0.048**
	on the Saône	11/03/14		**959**	**52.0**	**0.143**
P3	Flood event	20/07/14	31	**939**	**40.9**	**0.045**
	on the Rhône	20/08/14		**380**	**11.1**	**0.168**



- Contaminant fluxes are mainly governed by **SPM fluxes**, and to a lesser extent by **contamination levels**.
- Although the water discharge is lower on the Saône, the **contribution** of both rivers regarding **particulate contaminant fluxes** is **similar**.

→ **Each main tributary needs to be monitored** to quantify its SPM and associated contaminants inputs to the Rhône river.

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