I.S.RIVERS LYON 2018

Sampling of suspended particulate matter using particle traps in the Rhône River: relevance and representativeness for the monitoring of contaminants

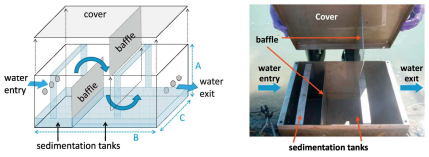
1 Introduction & Objectives

As hydrophobic and lipophilic substances tend to preferentially accumulate in suspended particulate matter (SPM) rather than in the dissolved phase, SPM sampling is recommended as an alternative method to water sampling for the monitoring of these contaminants in rivers. Particle trap (PT) provides a low-cost, practicable and usable technical solution for monitoring of contaminant concentrations and fluxes in surface waters. Whereas the representativeness of SPM samples collected by continuous flow centrifugation (CFC) was investigated and validated as early as 25 years ago, the representativeness of the particles collected with PTs is still questionable and not fully understood.

Since 2009, within the Rhône Sediment Observatory (OSR) program, PTs designed according to the German PT described by Schulze *et al.* (2007) have been implemented and routinely used for the monitoring of particulate contaminants throughout the Rhône River (from Lake Geneva to the Mediterranean Sea). The objective of this study was to determine the physico-chemical representativeness of SPM samples collected by this type of PT in a large river under various hydrological conditions.

2 Material & Methods

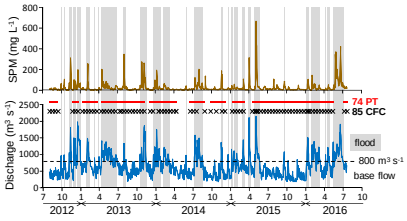
The German particle trap used in the OSR Program



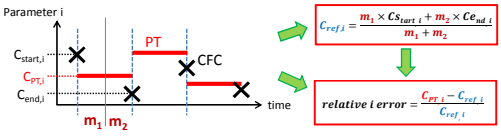
➢ The PTs used in this study and in the OSR monitoring network were built identical to PTs described in Schulze et al. (2007; *J Soils Sediments* 7:361-367):

- high quality (type 316 L) stainless steel box
- 3 holes on the front and back faces allowing water circulation inside
- 2 baffles induce a decrease of the current velocity within the PT
- decantation of SPM into two sedimentation tanks.

How to compare characteristics of SPM collected by punctual and time-integrated sampling methods ?



➢ Comparison of physico-chemical characteristics of SPM collected in the Rhône River at Jons station (upstream of the Lyon urban area) in contrasted hydrological conditions by PT andCFC.



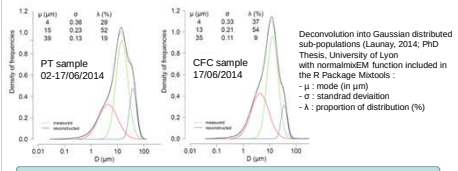
➢ Each deployment of PT was systematically bordered with two SPM samplings by CFC carried out during the PT installation and recovery days.

➢ For each parameter, concentrations measured in the PT were compared to reference concentrations calculated on the basis of the two bordering CFC samples.

➢ The studied parameters were: gain size distribution, particulate organic carbon (POC), total mercury (Hg) and PCB indicators (PCB 138 showed in the poster).

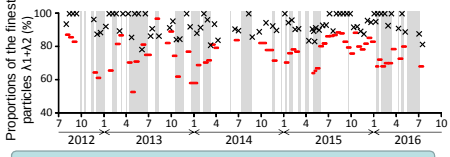
3 Results & Discussion

Grain size distribution

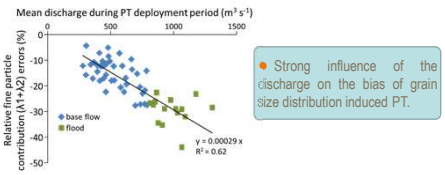


Deconvolution into Gaussian distributed sub-populations (Launay, 2014; PhD Thesis, University of Lyon with normalmixEM function included in the R Package Mixtools :
- µ : mode (in µm)
- σ : standrad deviation
- λ : proportion of distribution (%)

- Deconvolution of grain size distributions into Gaussian sub-populations.
- At Jons station, SPM consisted of a mixture of three classes of particles.

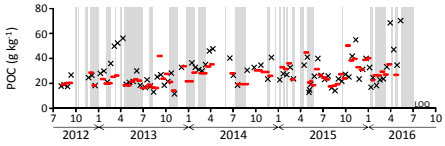


- Lower proportions of the fine particles lower for PT samples than for CFC samples.
- Unclear whether PT induced loss of finest or gain of coarsest particles.

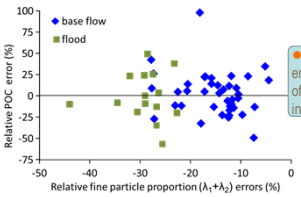


- Strong influence of the discharge on the bias of grain size distribution induced PT.

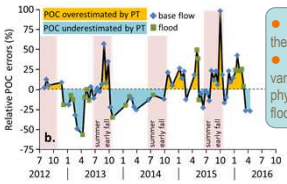
Particulate organic carbon



- Mean particulate organic carbon (POC) concentrations measured in PT and CFC samples not significantly different.

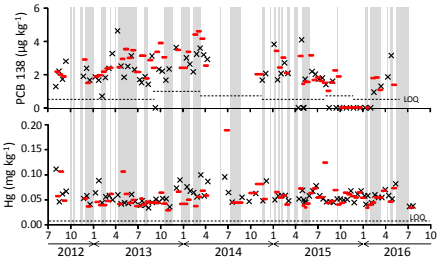


- Variations of POC errors not related to bias of grain size distribution induced by PT.

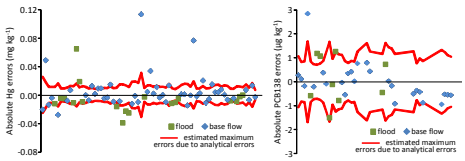


- Evolution of POC inside the PT ?
- Integration by PT of varying POC quality: phytoplankton blooms (+) or flood events (-).

Contaminants: mercury and PCB



- Mean Hg and PCB138 concentrations measured in PT and CFC samples not significantly different.



- For most samples, analytical uncertainties mainly explain the differences of Hg and PCB138 concentrations measured in PT and CFC samples.
- The highest relative Hg errors are related to the highest Hg concentrations measured in PT samples: transitory contribution of a Hg-enriched tributary during the PT deployment period.

4 Conclusions

- The relevance and representativeness of SPM collected in rivers with PT were studied with consideration of i) the integrative effect of PT compared to CFC, the latter being assimilated to punctual sampling, and ii) the analytical uncertainties.
- Despite the grain size distribution bias towards coarser particles and/or potential organic matter production/degradation, PTs can be considered as a reliable tool for SPM sampling within the aim of Hg and PCBs concentration/flux monitoring.
- This study highlighted the main advantage of SPM sampling by PTs: samples are time integrative and are thus representative of SPM and associated contaminants transported in the river during periods of time with varying hydrological conditions.

For more information: Masson el al., 2018, *Sci Total Environ* 637-638:538-549
matthieu.masson@irstea.fr

Matthieu Masson, Hélène Angot*, Chloé Le Bescond, Marina Launay, Aymeric Dabrin, Cécile Miège, Jérôme Le Coz, Marina Coquery
Irstea, UR RiverLy, Centre de Lyon-Villeurbanne, 5 rue de la Doua CS 20244, 69625 Villeurbanne, France
* Now at Institute for Data, Systems and Society, Massachusetts Institute of Technology, Cambridge, MA, USA

This study was conducted within the Rhône Sediment Observatory (OSR), a multi-partner research program funded through the Plan Rhône by the European Regional Development Fund (ERDF), Agence de l'Eau RMC, CNR, EDF and three regional councils (Auvergne-Rhône-Alpes, PACA and Occitanie). We gratefully acknowledge the following Irstea colleagues for SPM sampling, field campaigns, sample treatment, chemical analysis and data analysis: Myriam Arhror, Marie Courtel, Guillaume Dramais, Ghislaine Grisot, Mickaël Lagouy, Josselin Panay, Benjamin Renard, Loïc Richard and Fabien Thollet.