I.S.RIVERS LYON 2018

Consequences of a dam flushing operation on concentration and fluxes of suspended sediment and associated contaminants in the Upper Rhône River

Conséquences des opérations de chasses de barrages sur la concentration et les flux de matières en suspension et des contaminants associés dans le Haut Rhône

Context

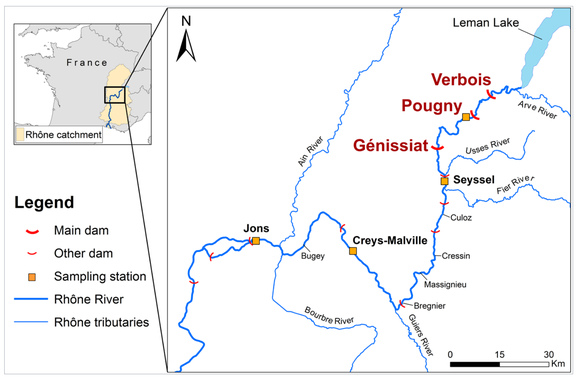
- **Rhône Sediment Observatory (OSR)**:
Investigate the dynamics of sediments along the river network and quantify suspended particulate matter (SPM) and associated contaminant fluxes.

- **Rhône River**:
21 dams from Lake Leman to the Mediterranean Sea. **Dam flushing operations are regularly organized to remove sediments stored in reservoirs.**

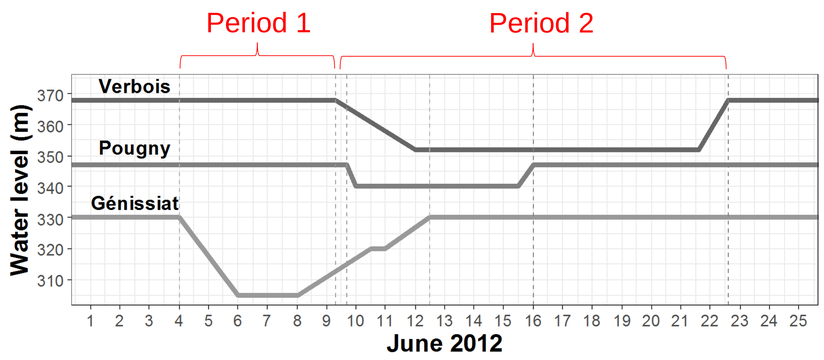
Objectives

- Evaluate the impacts of dam flushing operations on concentrations and fluxes of suspended particulate matter and associated contaminants.
- Investigate the origins of spatial variations of concentrations observed during dam flushing events, as well as temporal evolution.

Flushing operations in June 2012



Flushing process



Monitoring operations

Parameters measured:

- Discharge
- SPM content
- Particle size
- POC

Contaminants characterized:

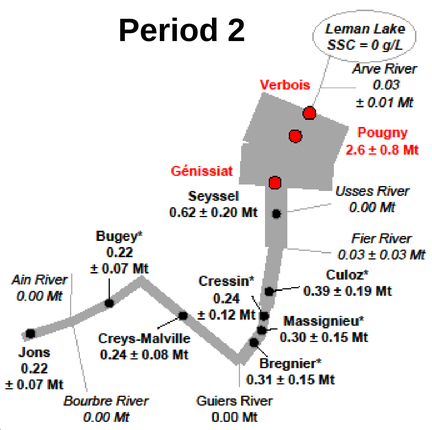
- Heavy metals
- Trace elements
- Organic compounds
- Radionuclides

Continuous-Flow Centrifugation

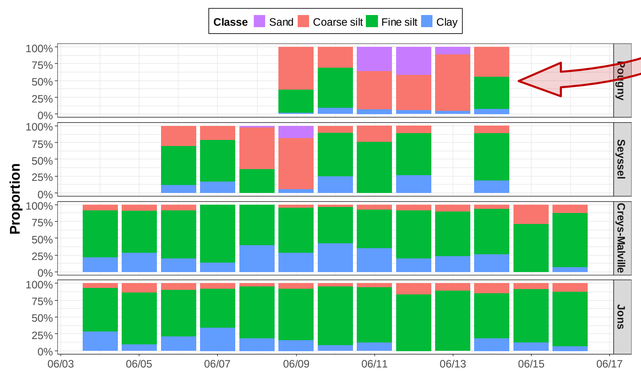
Massive SPM release mitigated by Génissiat Dam operation

SPM budget:

Period 2

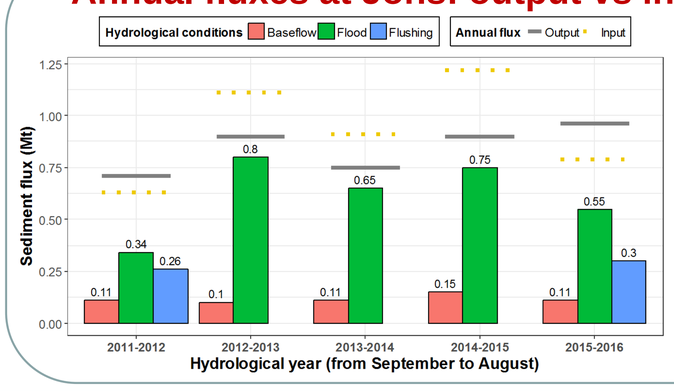


- Presence of other dams affect sediment flux:
  - ➢ **Sediment transport is delayed**
- Most of the sediments were rapidly deposited:
  - ➢ **Effect of the particle size**



Sand particles were only observed upstream

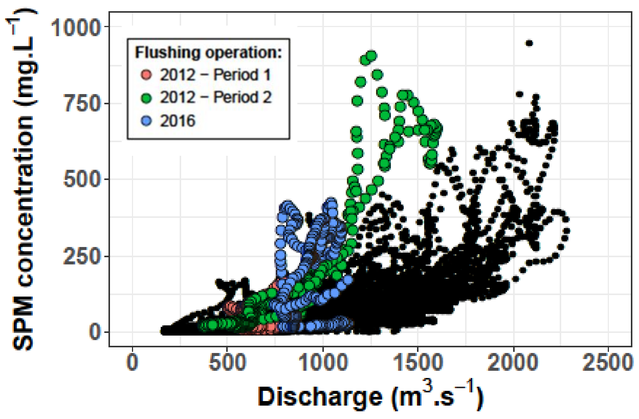
Annual fluxes at Jons: output vs input (tributaries)



- Flushing triggered 37% of the annual sediment flux in 5% of 2011-2012
- Year without flush = annual output flux overestimated:
  - ➢ **Storage of transported sediment**
- Year with flush = annual output flux underestimated:
  - ➢ **Resuspension of stored sediment**
- Unbalanced equilibrium over 5 years (-0,44 Mt):
  - ➢ **Part of sediment remain stored despite flushing events**

Sediment dynamics was different from other hydrological events

Jons station



- Flushing operations were also conducted in 2016 (different process with 1 period – only Q and [SPM] measured
- For similar discharge, the SPM concentration is higher during flushing operations than flood events:
  - ➢ **Different origins/sources of the particles**

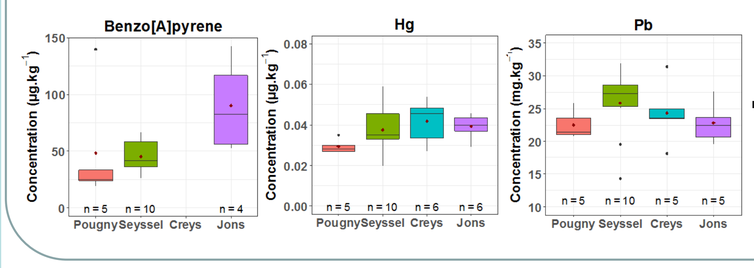
Particle size distribution: average during 2011-2016 period

	Mass proportion (%)		
	Clay (<4µm)	Fine silt (4 – 15µm)	Coarse silt (15 – 63µm)
Baseflow	23 ± 12	68 ± 11	12 ± 12
Flood	29 ± 12	64 ± 10	9 ± 6
Flushing (2012)	17 ± 8	76 ± 9	10 ± 4

- Coarser particles than other hydrological conditions:
  - ➢ **Various origins/sources of the particles**

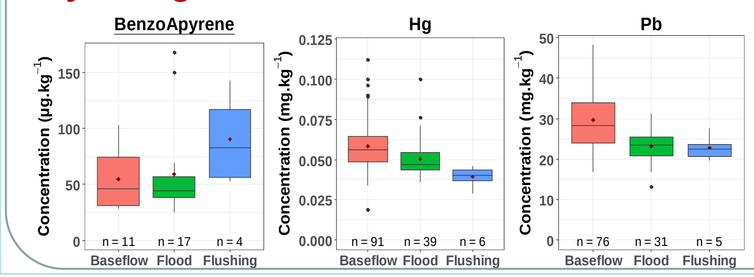
Contaminant concentrations were related to particle size (upstream) and SPM origins (downstream)

Spatial variation during the 2012 flushing operations:



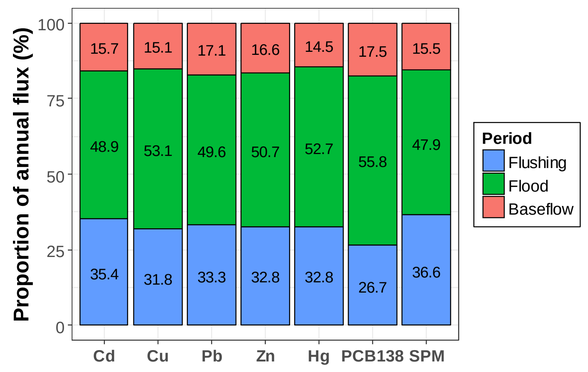
- Increases of contaminant concentrations from Pougny to Seyssel are mostly related to the increase of the proportion of coarse particles:
  - ➢ **Dilution of the contaminant concentration**
- Variation from Seyssel to Jons is mostly related to the origin of the particles:
  - ➢ **Resuspension of old sediment stored** *(contaminated in Benzo[a]pyrene and depleted in Pb)*

Contaminant variation at Jons during 2011-2016 according to hydrological conditions:



- Contamination levels vary with hydrological conditions:
  - ➢ **Particles that transited during flushing events were different than flood and baseflow**

Proportion of annual contaminant fluxes in 2011-2012 at Jons



- Proportions are similar to SPM proportion:
  - ➢ **Whatever the contaminant concentration is, contaminant fluxes are more controlled by SPM concentration**

Hugo Lepage[1], Marina Launay[2], Jérôme le Coz[2], Hélène Angot[2], Cécile Miege[2], Julie Gattacceca[3], Olivier Radakovitch[1,3], Marina Coquery[2]

This study was supported by the Rhône Sediment Observatory (OSR), a multi-partner research program partly funded by the Plan Rhône, and by the European Regional Development Fund (ERDF) allocated by the European Union.
More information about OSR Project http://www.graie.org/osr/ - Data used are available here: **DOI** 10.17180/OBS.OSR