

11<sup>e</sup> Conférence internationale

LYON 2023 — L'eau dans la ville | Urban water

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## Évaluation de l'efficacité de traitement in-situ des MES dans un système décentralisé de traitement des eaux pluviales à l'aide d'un suivi en continu

*Evaluation of in-situ TSS removal efficiency of a decentralized stormwater treatment system by means of continuous measurements*

Sandoval S., Spahni B., Favre F.





Sewer system

Flow rate  $Q$  [ $\text{m}^3/\text{s}$ ]



Total Suspended  
Solids  $TSS$  load [Kg]

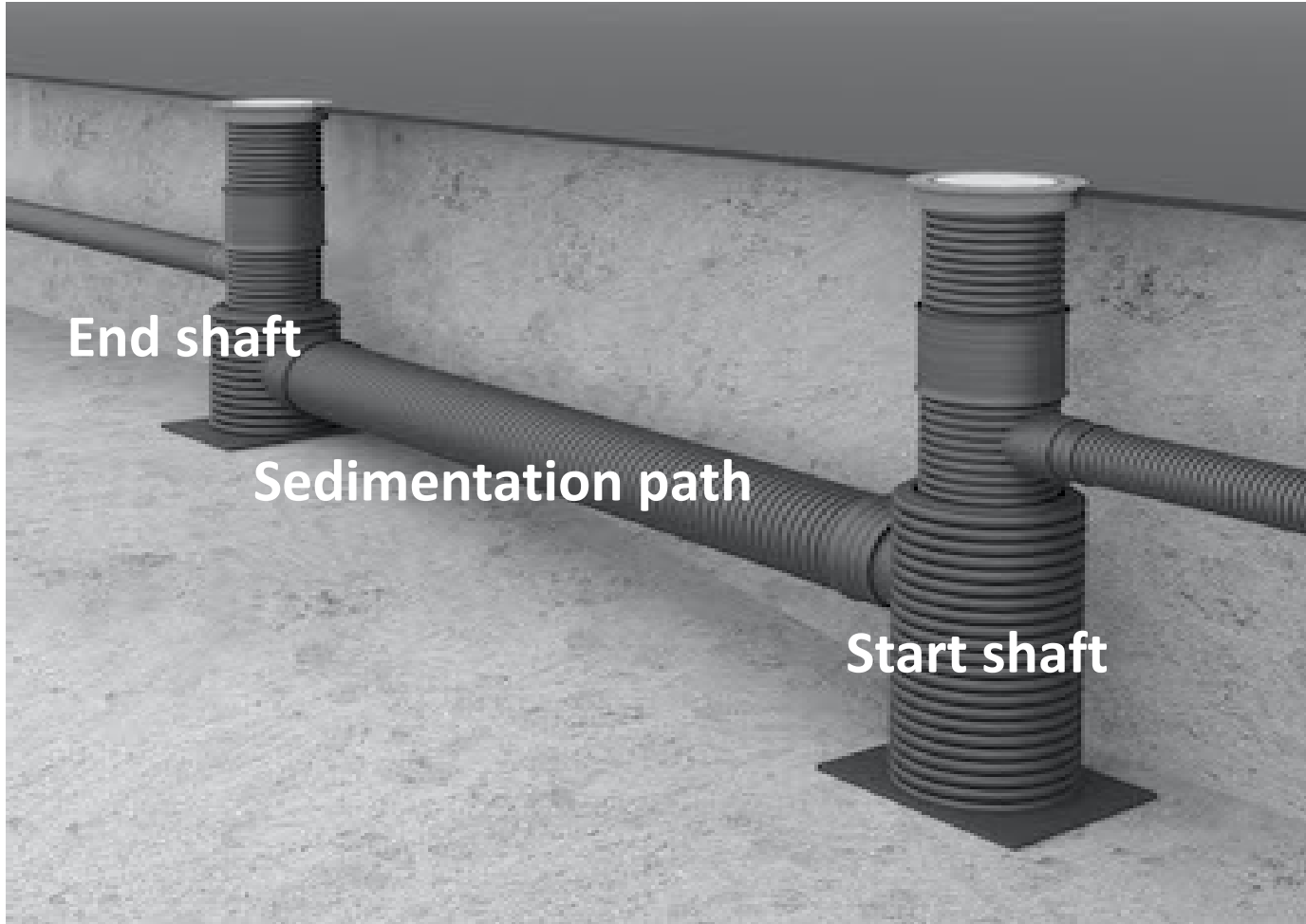
## Pollution source control ?

### To the outlet...

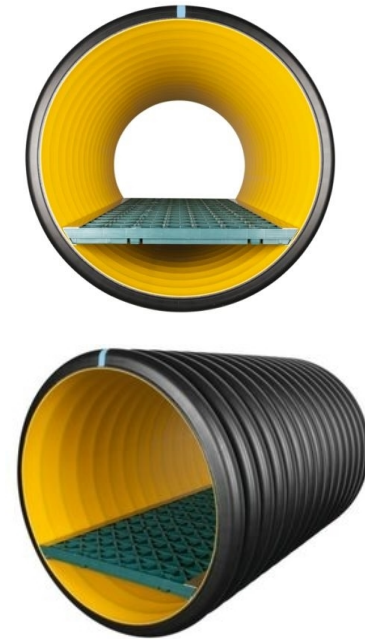
Retention basins, WWTP,  
urban rivers (CSO)....



## Sedimentation pipe (SEDIPIPE)

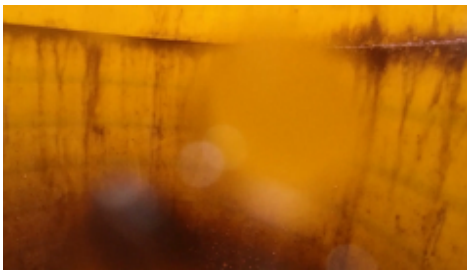
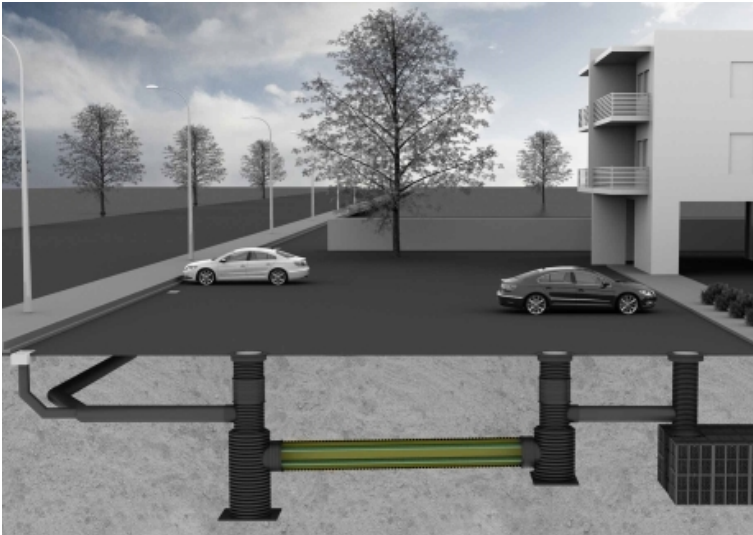


## Sedimentation path

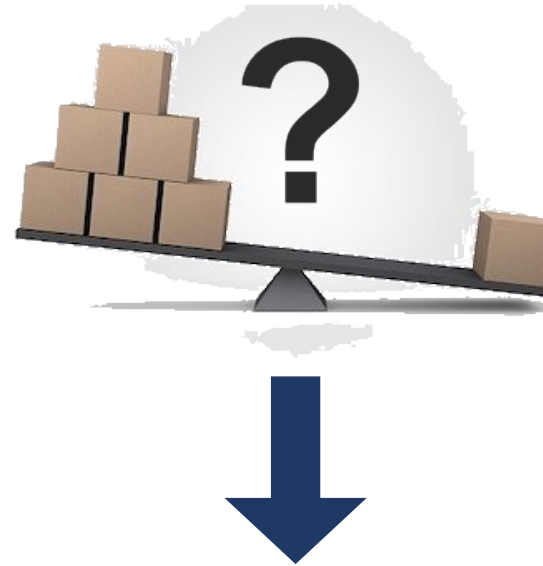


## Lower Separator

## System installed *in-situ*



## Laboratory conditions



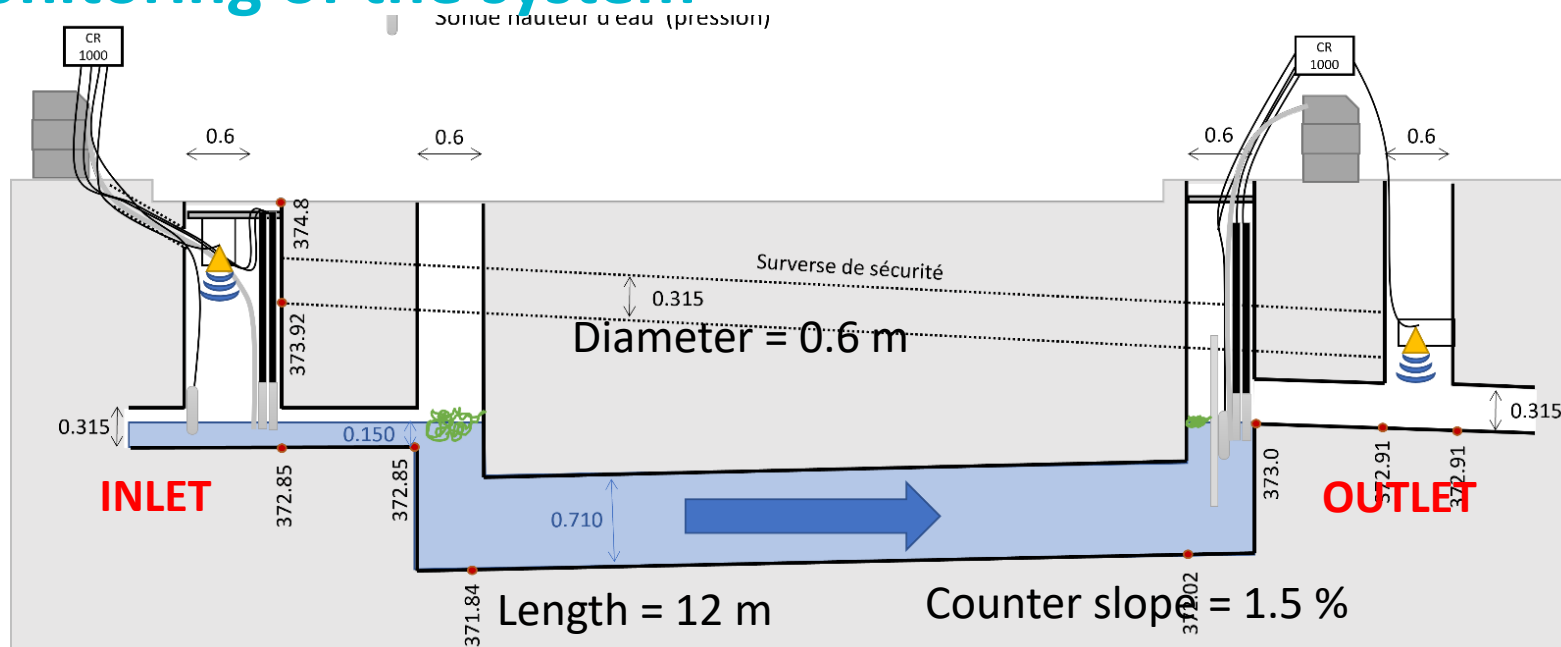
**Total Suspended Solids removal efficiency over a  
extended period (one year) ?**

## Study case: city of Lausanne, Switzerland



- Total impervious surface : **4000 m<sup>2</sup>** (including roofs and private areas)
- **Separate system**
- **18000** vehicles/day (heavy vehicles 3.5% to 4%)

## In situ monitoring of the system



### Online sensors :

- **Water depth** (radar sensors) → Flow Rate
- **Turbidimeters** → Total Suspended Solids
- **1 min** time step recorded data

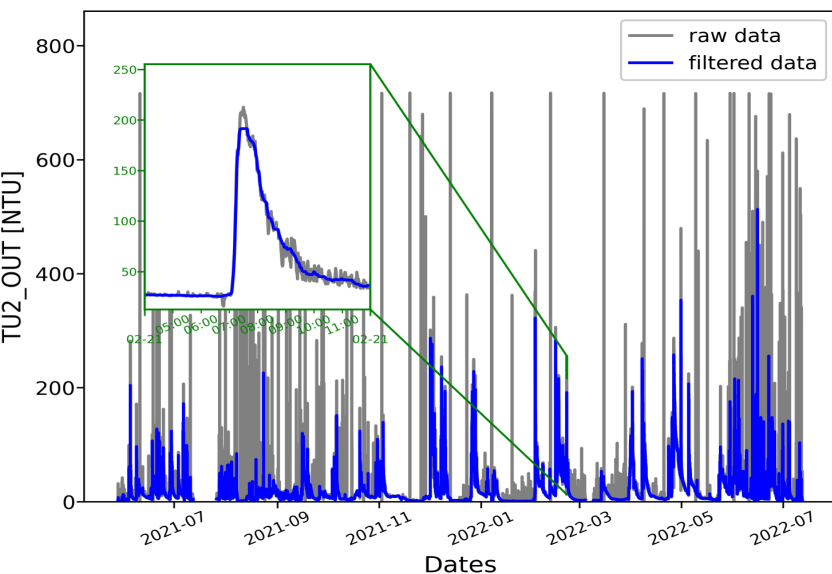
### Automated sampler :

- **24 bottles** peristaltic sampler
- **Volume-based** sampling strategy

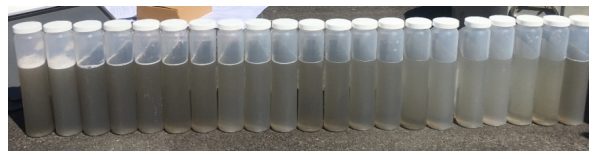
**one year** (June 2021 to August 2022) → 169 events

## Turbidity signals → Total Suspended Solids time series

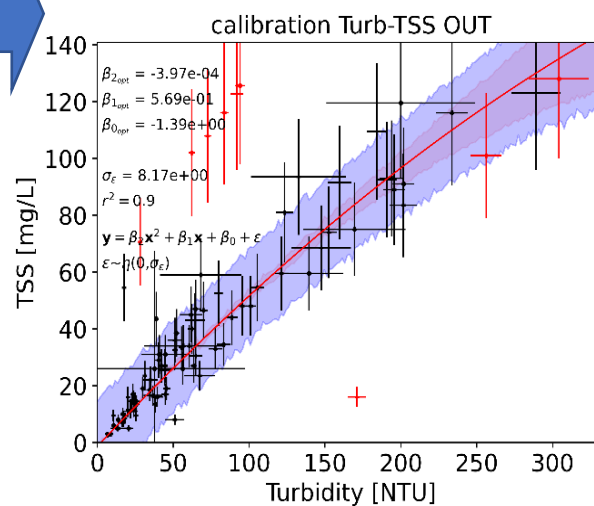
Filtering turbidity time series [NTU]



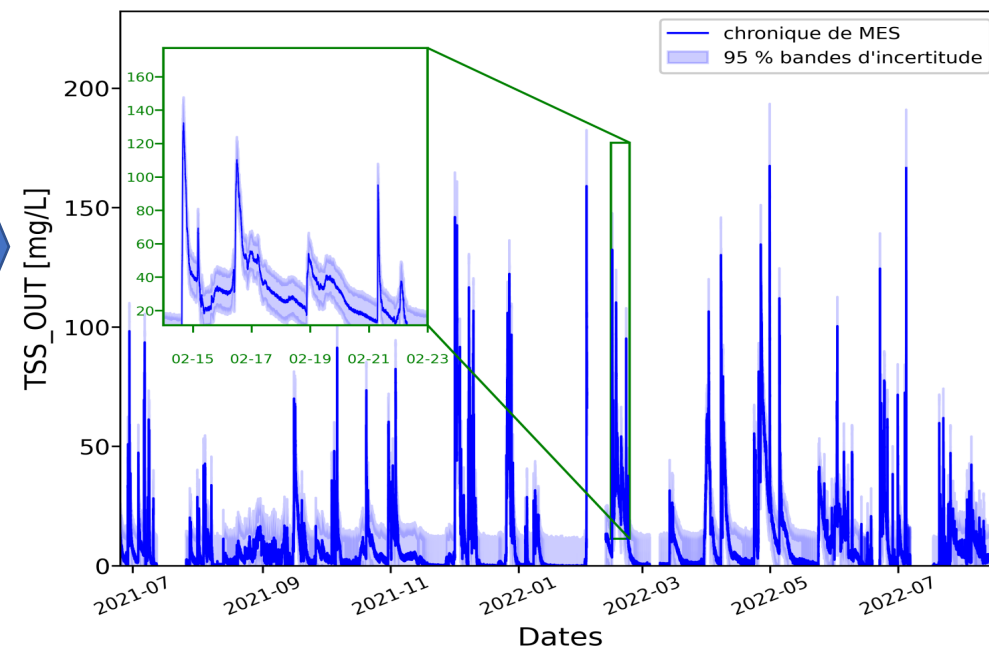
169 events



Calibration function :  
 $TSS = f(Turb)$

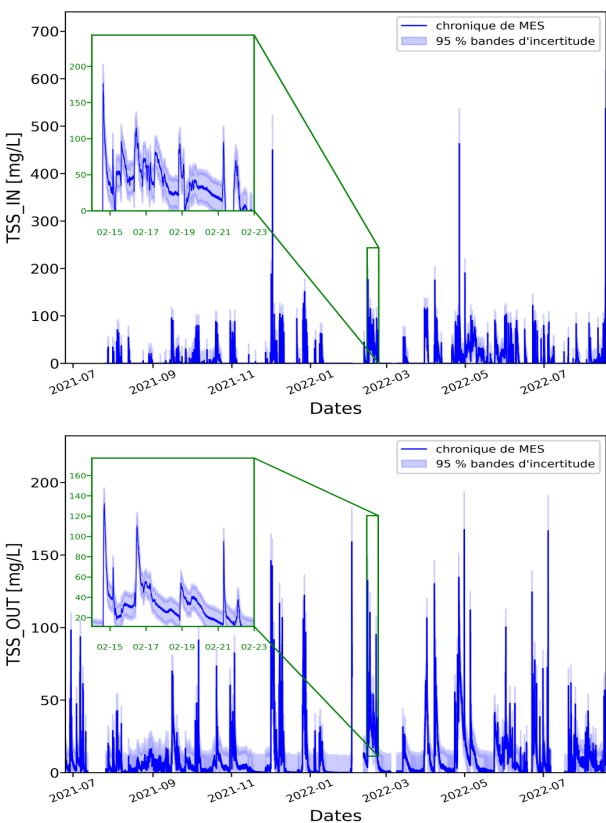


TSS concentration time series [mg/L]

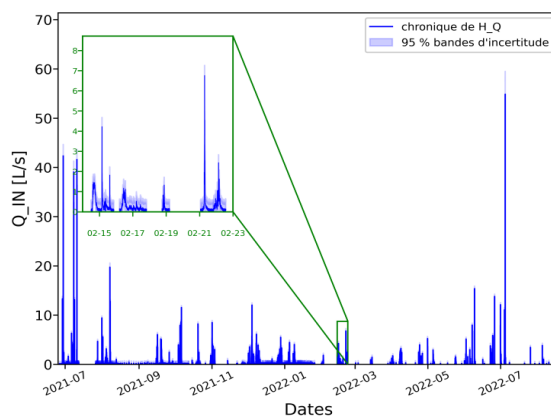


## Turbidity signals → Total Suspended Solids time series

TSS concentration time series [mg/L]

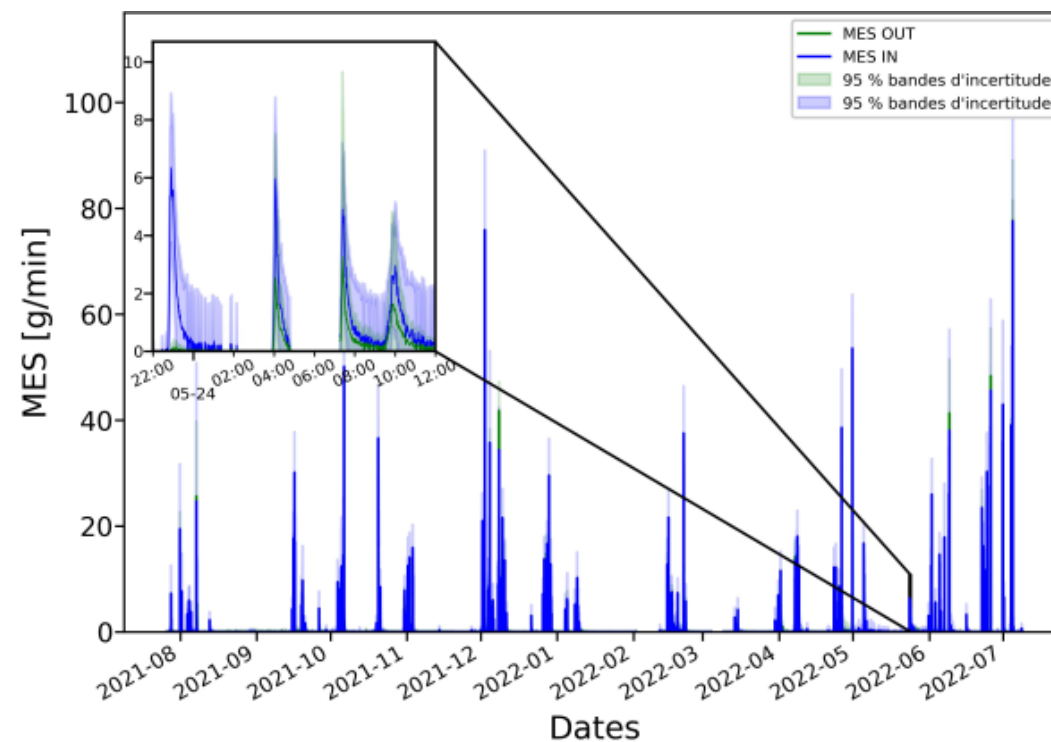


Flow rate [L/s]



TSS load = TSS conc . Q

TSS load [g/min]



$$\text{Global Removal Efficiency: } \eta_{\text{global}} = 1 - \frac{\sum TSS \text{ Load}_{\text{inlet}}(t) \cdot \Delta t}{\sum TSS \text{ Load}_{\text{outlet}}(t) \cdot \Delta t}$$



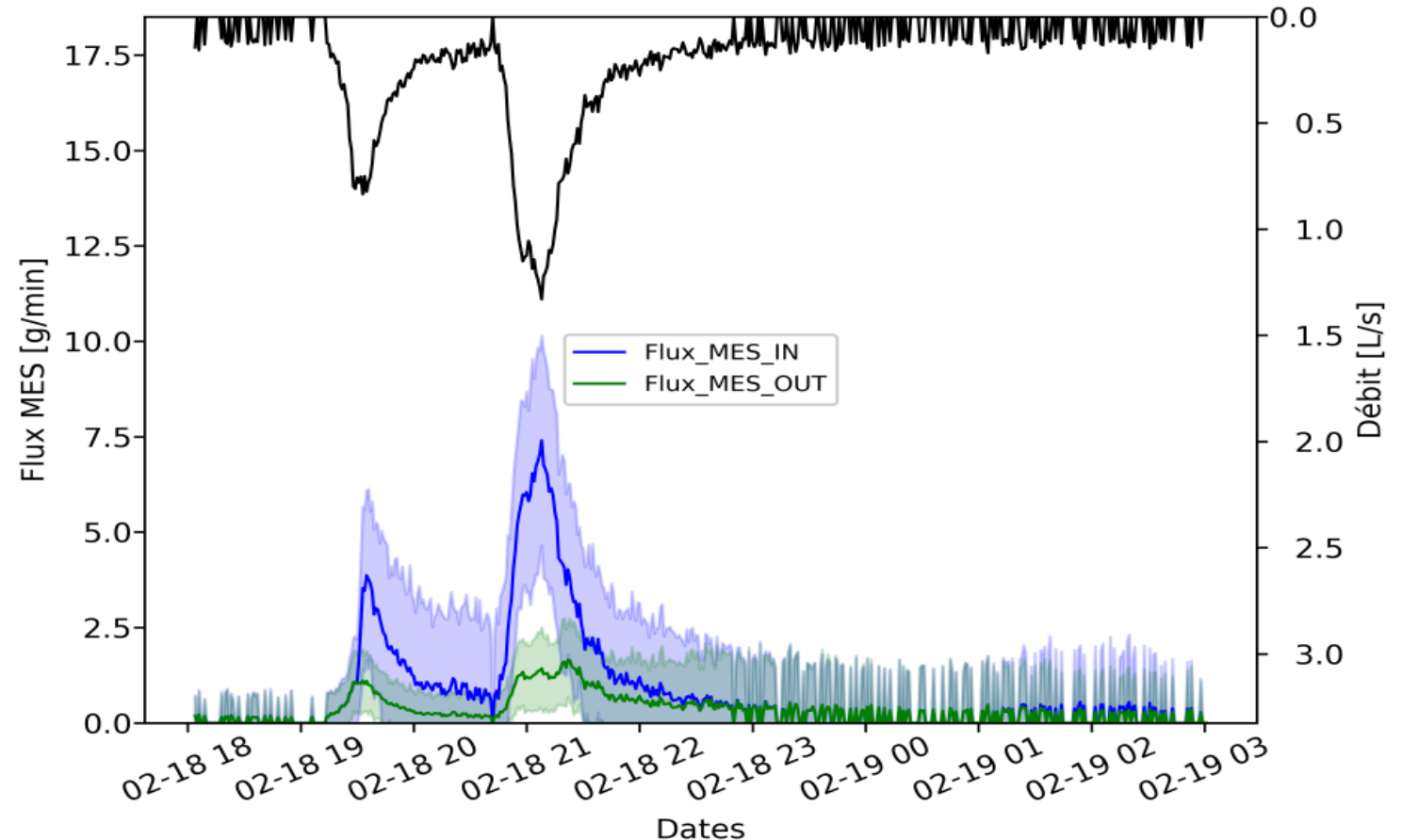
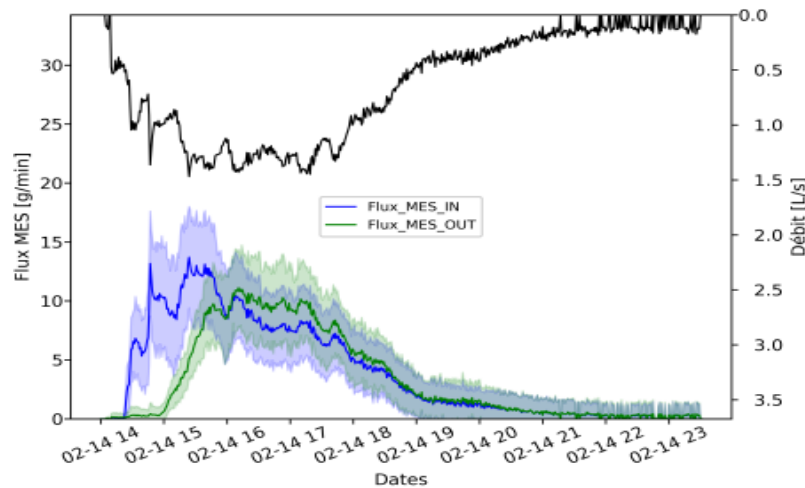
# MATERIALS AND METHODS

## Event-based analyses

TSS load<sub>inlet</sub> [g/min]

TSS load<sub>outlet</sub> [g/min]

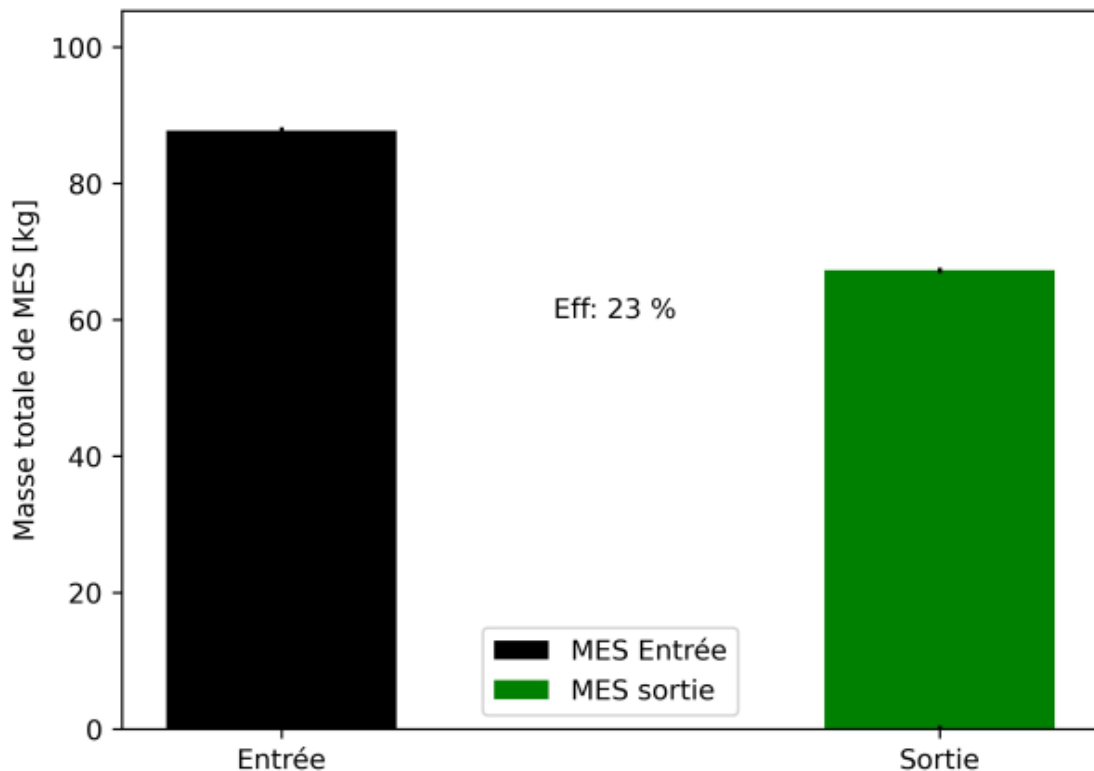
Flow Rate [L/s]



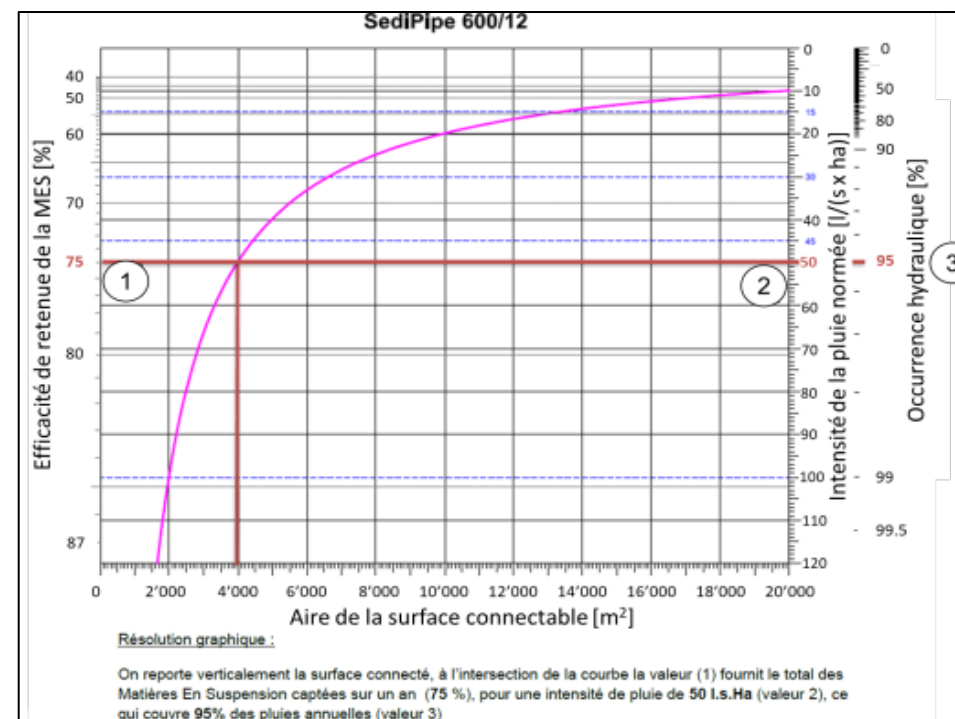
$$\text{Event-Based Removal Efficiency: } \eta_{ev} = 1 - \frac{\sum TSS \text{ Load}_{inlet}(Ev) \cdot \Delta t}{\sum TSS \text{ Load}_{outlet}(Ev) \cdot \Delta t}$$

## Global analyses

$\eta_{global}$  *in-situ* = 23 %

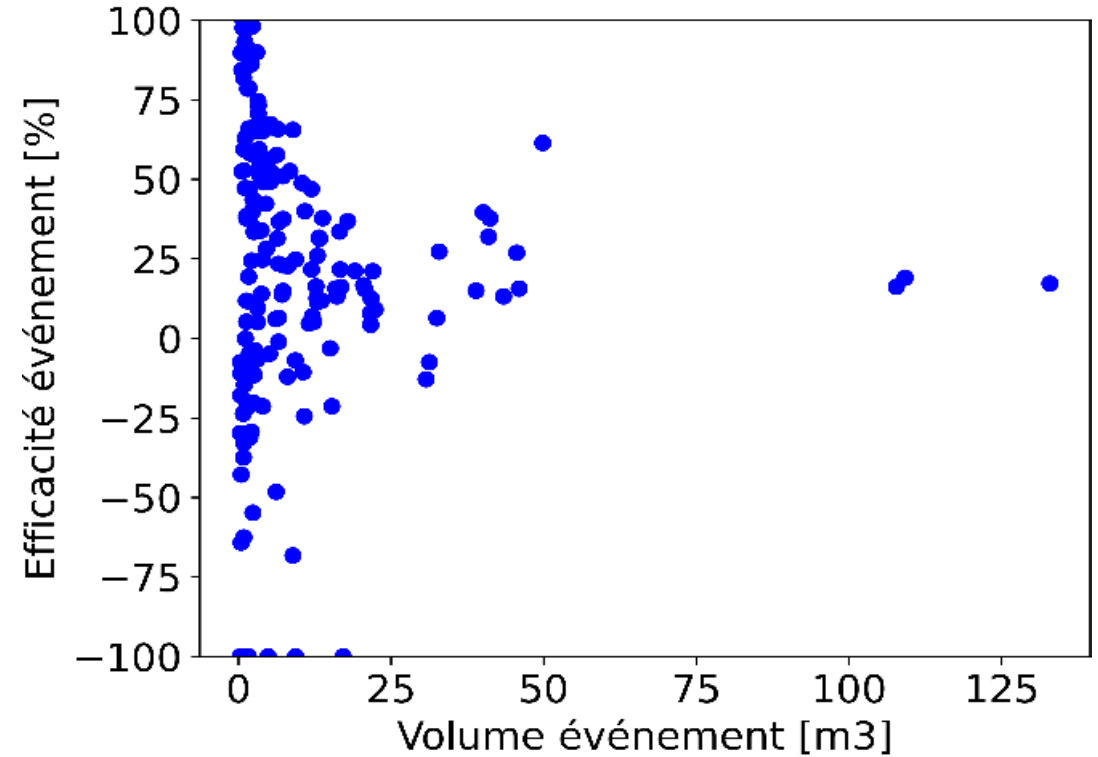
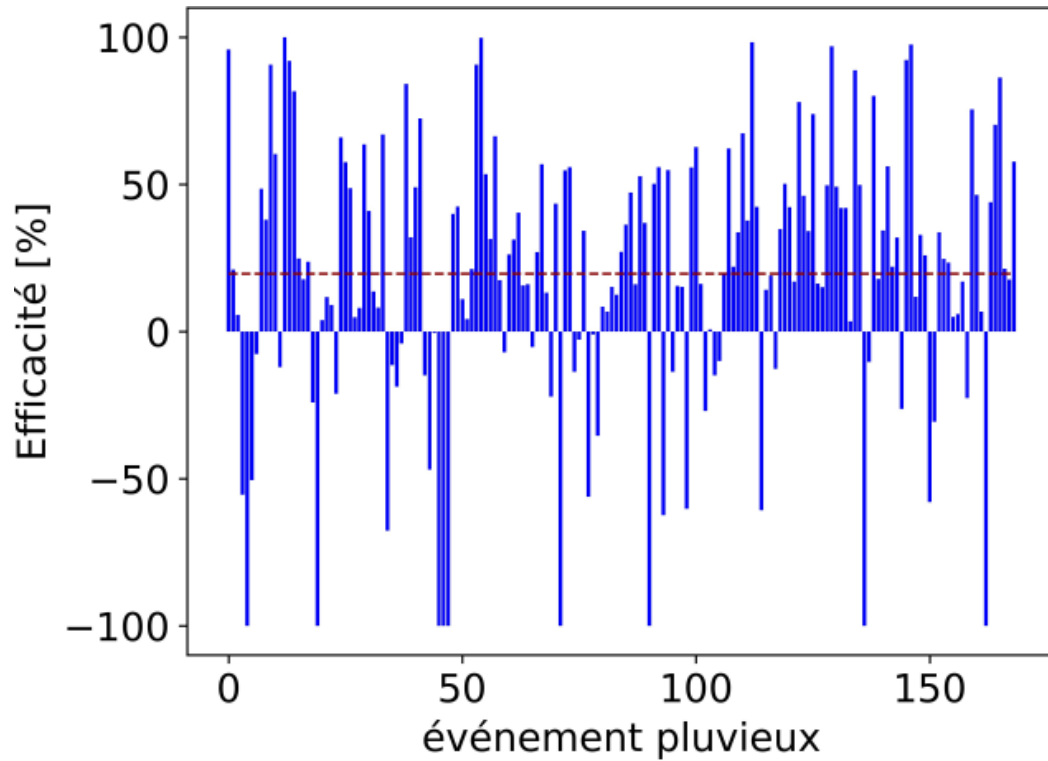


$\eta_{global}$  *laboratory* = 75 %



**Global removal efficiency** remarkably lower *in-situ* (23 %) → manufacturer's guide (75 %)

## Event-based analyses



**Event based removal efficiencies  $\eta_{ev}$**  -> no correlation with ADWP, rainfall intensity, duration or total volumes

**Higer variability for smaller events** -> Possible local resuspension

# CONCLUSIONS AND PERSPECTIVES

- **Significant differences** between **Removal Efficiency** estimated *in-situ*, compared to manufacturer's guide (lab. conditions)
- Higher variability of **event-based removal efficiencies** for smaller rainfall events, including **negative values** → suggesting local resuspension for smaller events
- No further link between the **event-based removal efficiencies** with **rainfall characteristics**
- Potential of **online monitoring** of TSS to verify the *in-situ* performance and **better understand** decentralized stormwater treatment systems.

**THANK YOU !**