

# Microplastic concentrations in freshwater during a flood event, a case study of the Seine river catchment

*Robin TREILLES<sup>1</sup>, Johnny GASPERI<sup>1</sup>, Romain TRAMOY<sup>1</sup>, Vincent ROCHER<sup>2</sup>, Bruno TASSIN<sup>1</sup>.*

*<sup>1</sup>The Urban Systems, Environment and Water Laboratory (LEESU)*

*<sup>2</sup>The Paris Public Sanitation Service (SIAAP)*



Micro 2018, November 19-23th 2018, Lanzarote



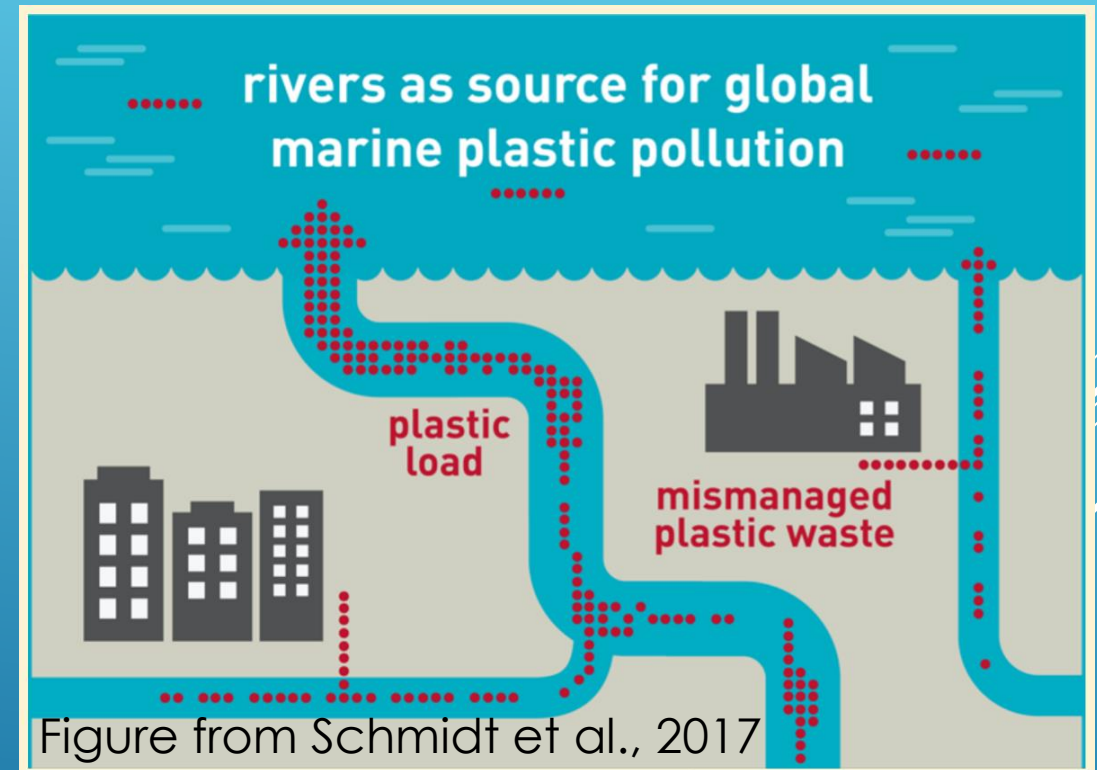
# More and more studies about freshwaters

According to Schmidt et al. 2017:  
"the global plastic debris inputs from rivers into the sea range between **0.41 and  $4 \times 10^6$  t/y**"

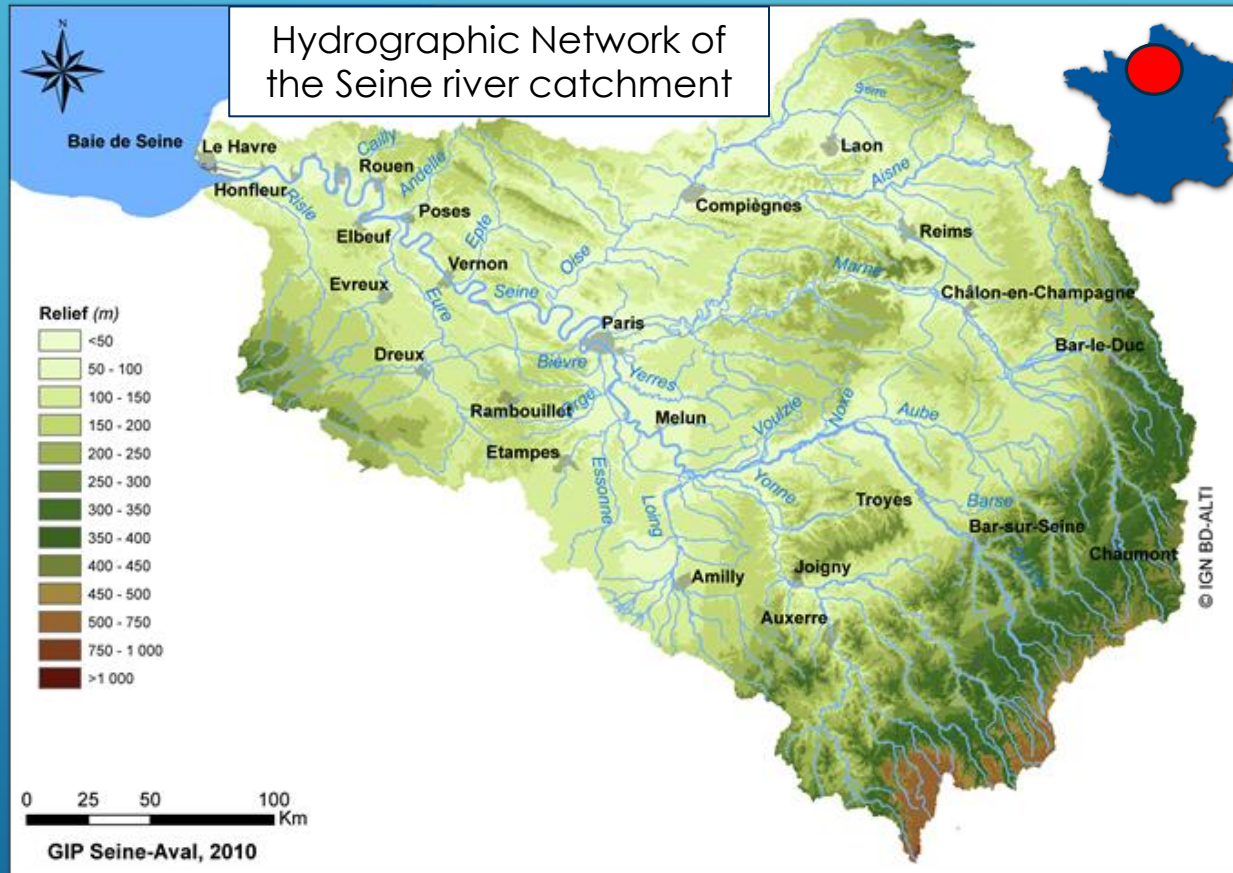
Calculations are done for a **steady state** and **usual flowrates values**.

A gap of knowledge **on flood events**:

- The **concentration** of microplastics?
- The **fibers and fragments distribution**?
- The **microplastic fluxes** during the flood?



# The Seine river catchment



The mean flow rate : 350 m<sup>3</sup>/s. The Seine river catchment represents:

- 75,000 km<sup>2</sup>
- 17.5 million of inhabitants
- 40 % of the national industrial activities

The Seine river and tributaries: an environment with a high anthropogenic pressure

# A flood event on the Seine basin



- On January 26th 2018, we observed:  $Q_{\max Paris} = 1710 \text{ m}^3/\text{s}$   
( $Q_{10} = 1650 \text{ m}^3/\text{s}$  and  $Q_{100} = 2400 \text{ m}^3/\text{s}$ )

# A flood event on the Seine basin

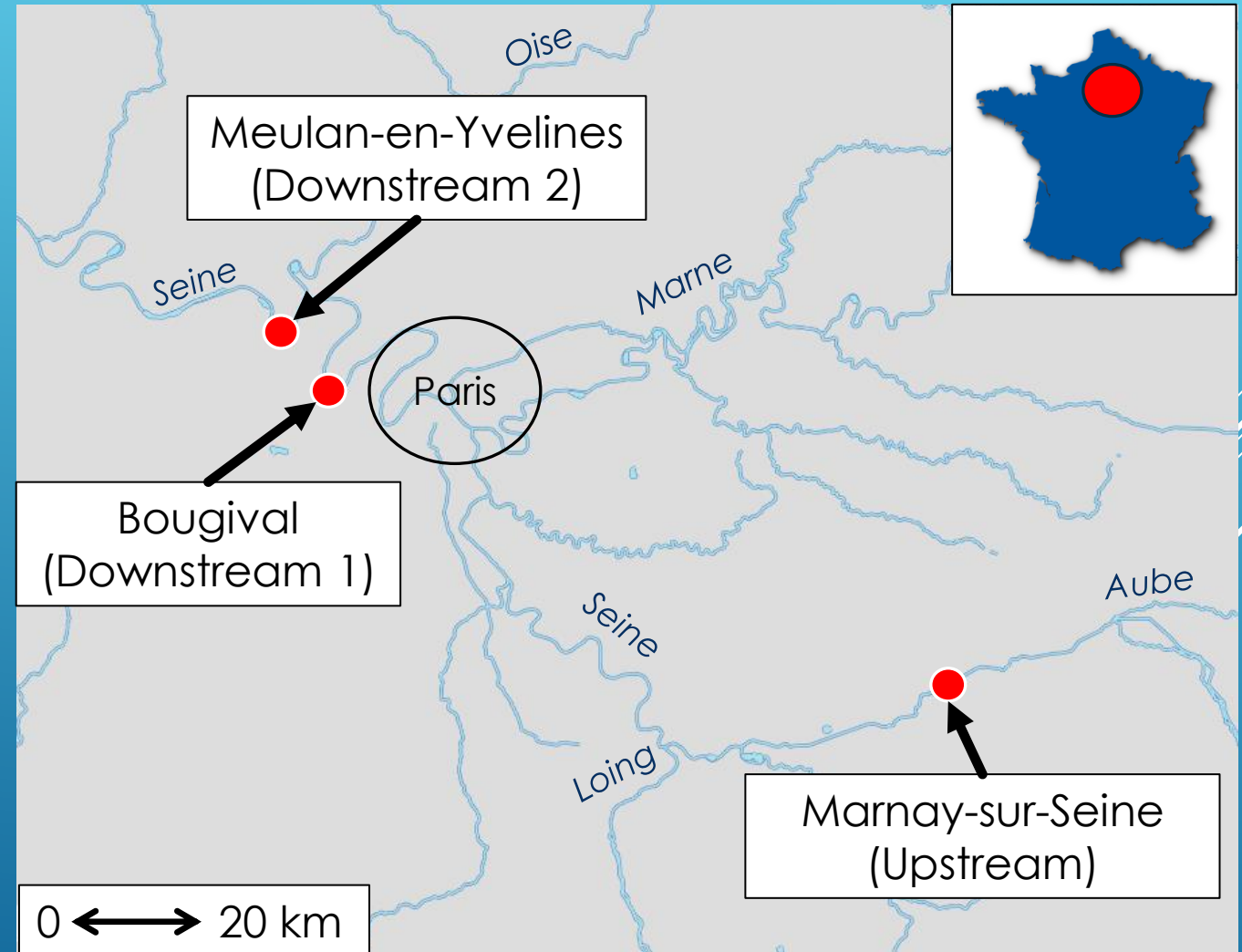


- On January 26th 2018, we observed:  $Q_{\max Paris} = 1710 \text{ m}^3/\text{s}$   
( $Q_{10} = 1650 \text{ m}^3/\text{s}$  and  $Q_{100} = 2400 \text{ m}^3/\text{s}$ )

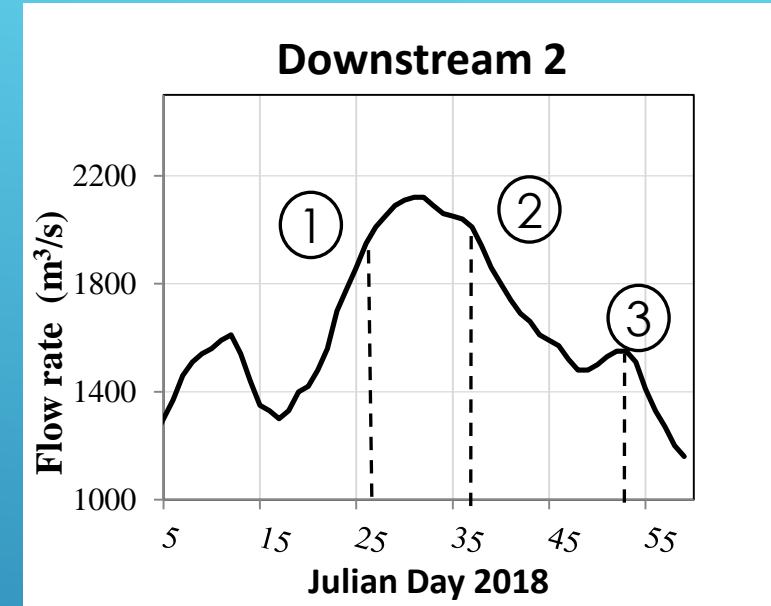
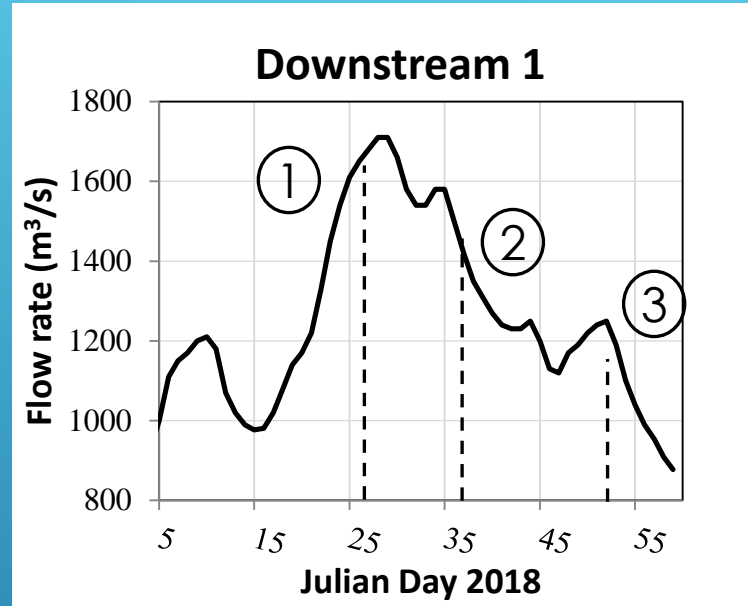
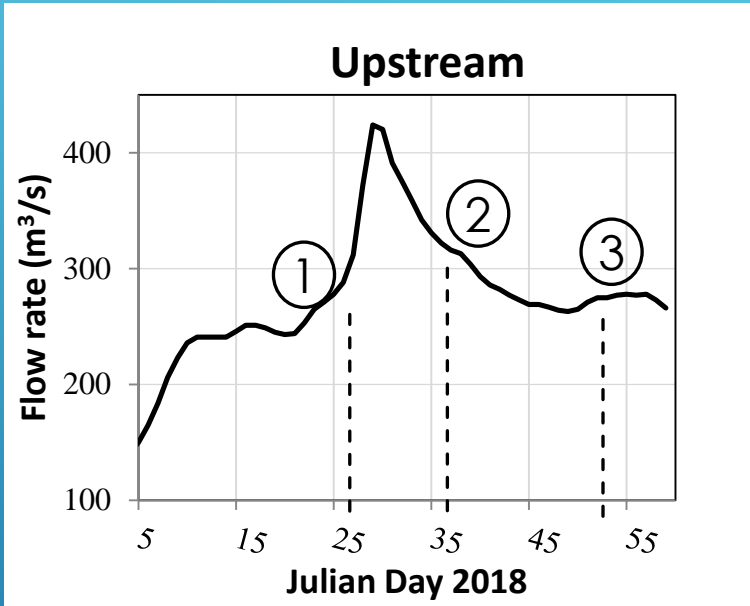
# Sampling sites

3 sampling sites:

- Upstream, considered as the reference point;
- Downstream 1 (125 km far from the reference point);
- Downstream 2 (145 km).

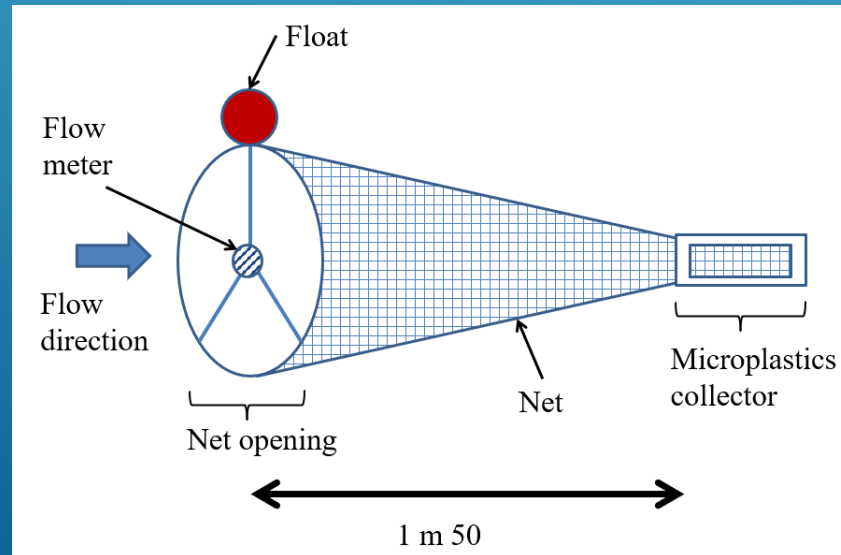


# Sampling sites



# Sampling Method

- We used two different nets:
- **300  $\mu\text{m}$  net**, dropped in the river for 5 minutes (volume collected: between 12 and 60  $\text{m}^3$ ).
- **80  $\mu\text{m}$  net**, used to filter 20 L of freshwater (not shown).





# Methods: NaI separation and H<sub>2</sub>O<sub>2</sub> digestion

- Microplastic extraction has been conducted in three main steps.

5 mm and 1 mm **sieving** and **visual sorting** with binocular microscope

1 mm < Microplastic < 5 mm

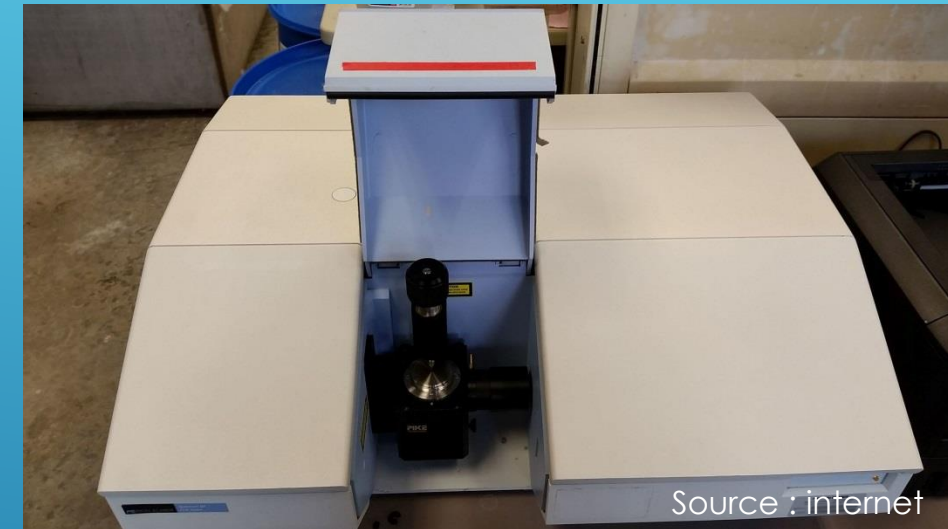
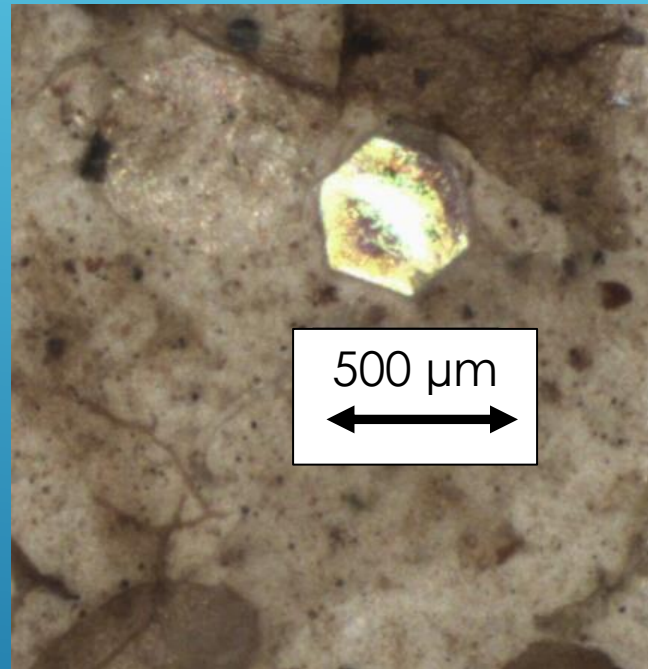
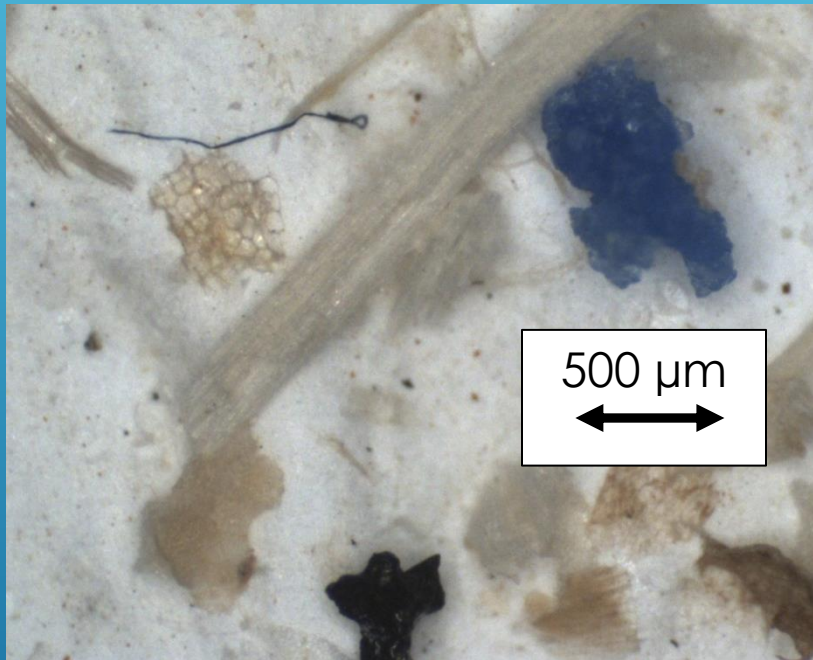
Microplastic < 1 mm

**NaI separation** (d = 1,6) with centrifugation and sonication

**H<sub>2</sub>O<sub>2</sub> 30% digestion** at 50°C during 48 hours

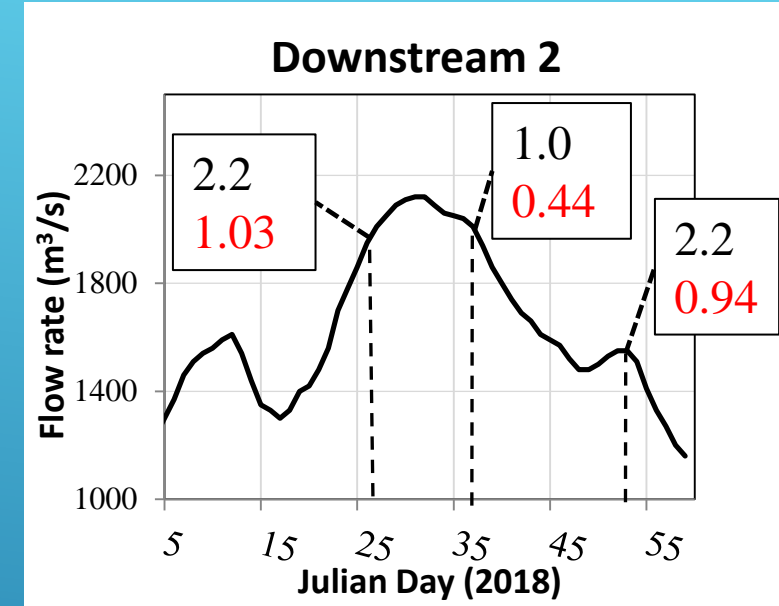
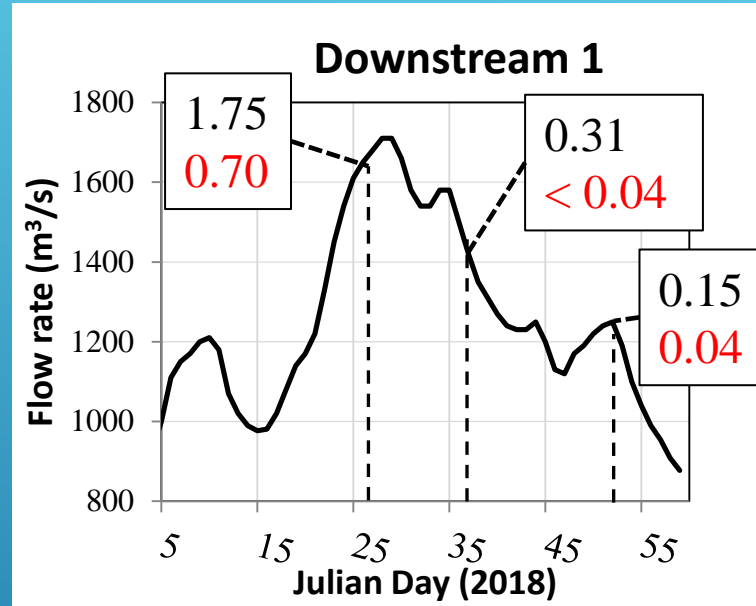
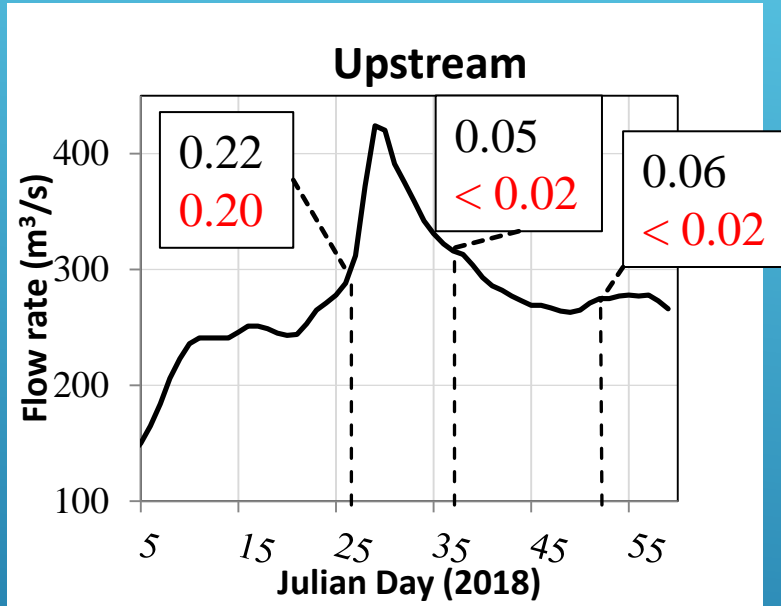


# Methods: Stereomicroscope counting and FTIR analysis



- 1-5 mm microplastics were analyzed with FTIR-ATR
- Smaller microplastic will be counted and analyzed with  $\mu$ FTIR

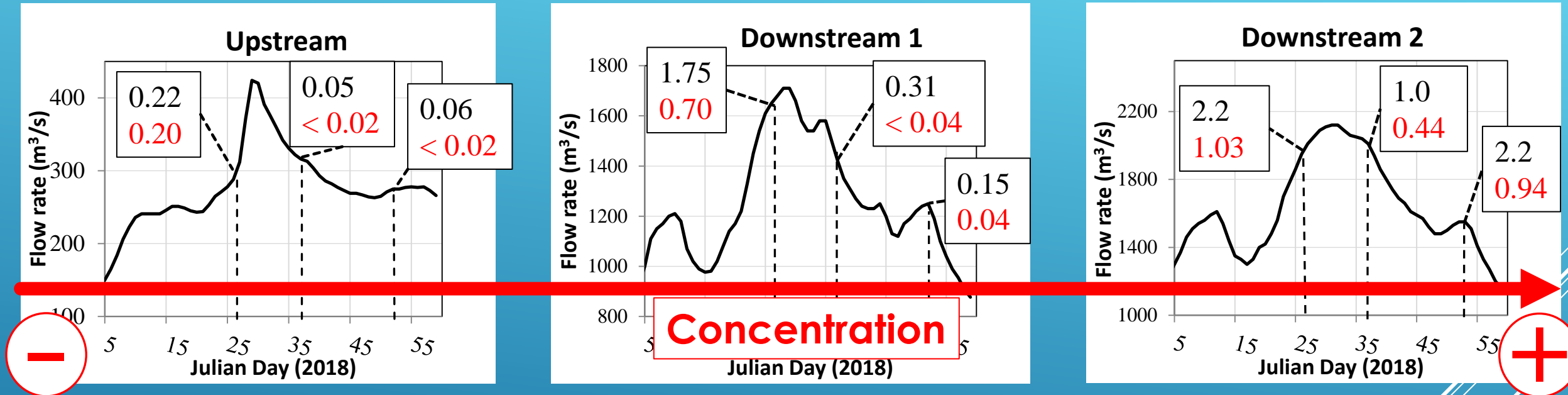
# Results: 1-5 mm Microplastics (300 µm net)



- Unit: Fragments/m<sup>3</sup>. In **black**: Number of isolated particules ;
- In **red**: number of microplastics observed with FTIR ATR.
- For all sites, highest values are found before the flood peak. Moreover:

$$C_{Upstream}^t < C_{Downstream 1}^t < C_{Downstream 2}^t$$

# Results: 1-5 mm Microplastics (300 μm net)



- Unit: Fragments/m<sup>3</sup>. In **black**: Number of isolated particules ;
- In **red**: number of microplastics observed with FTIR ATR.
- For all sites, highest values are found before the flood peak. Moreover:

$$C_{Upstream}^t < C_{Downstream 1}^t < C_{Downstream 2}^t$$

# Results: 1-5 mm Microplastics (300 µm net)

	% PE	% PS	% PA
<b>26/01/18</b> Upstream	0	100	0
<b>26/01/18</b> Downstream 1	0	100	0
<b>26/01/18</b> Downstream 2	10	80	10
<b>05/02/18</b> Upstream	0	0	0
<b>05/02/18</b> Downstream 1	0	0	0
<b>05/02/18</b> Downstream 2	40	47	13
<b>21/02/18</b> Upstream	0	0	0
<b>21/02/18</b> Downstream 1*	50	0	25
<b>21/02/18</b> Downstream 2	25	67	8

\* We observed 1 phenoxy resin in this sample

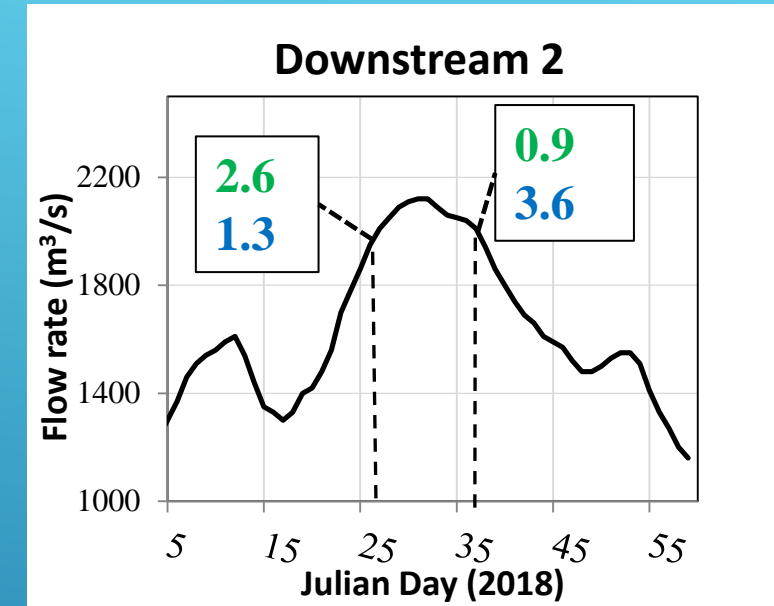
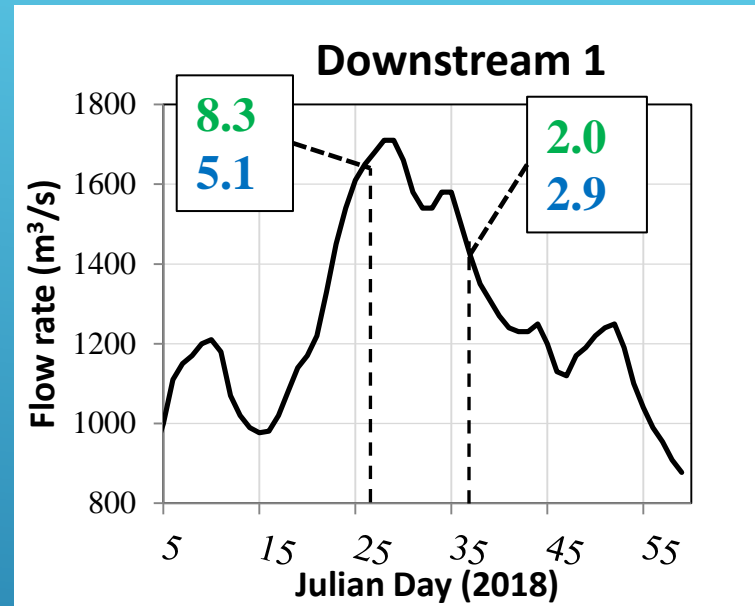
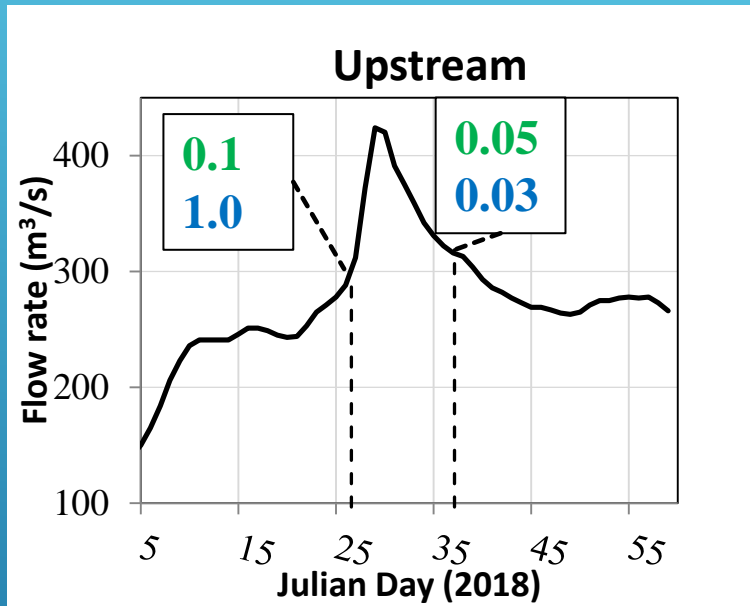
# Results: 1-5 mm Microplastics (300 µm net)

	% PE	% PS	% PA
<b>26/01/18</b> Upstream	0	100	0
<b>26/01/18</b> Downstream 1	0	100	0
<b>26/01/18</b> Downstream 2	10	80	10
<b>05/02/18</b> Upstream	0	0	0
<b>05/02/18</b> Downstream 1	0	0	0
<b>05/02/18</b> Downstream 2	40	47	13
<b>21/02/18</b> Upstream	0	0	0
<b>21/02/18</b> Downstream 1*	50	0	25
<b>21/02/18</b> Downstream 2	25	67	8

\* We observed 1 phenoxy resin in this sample



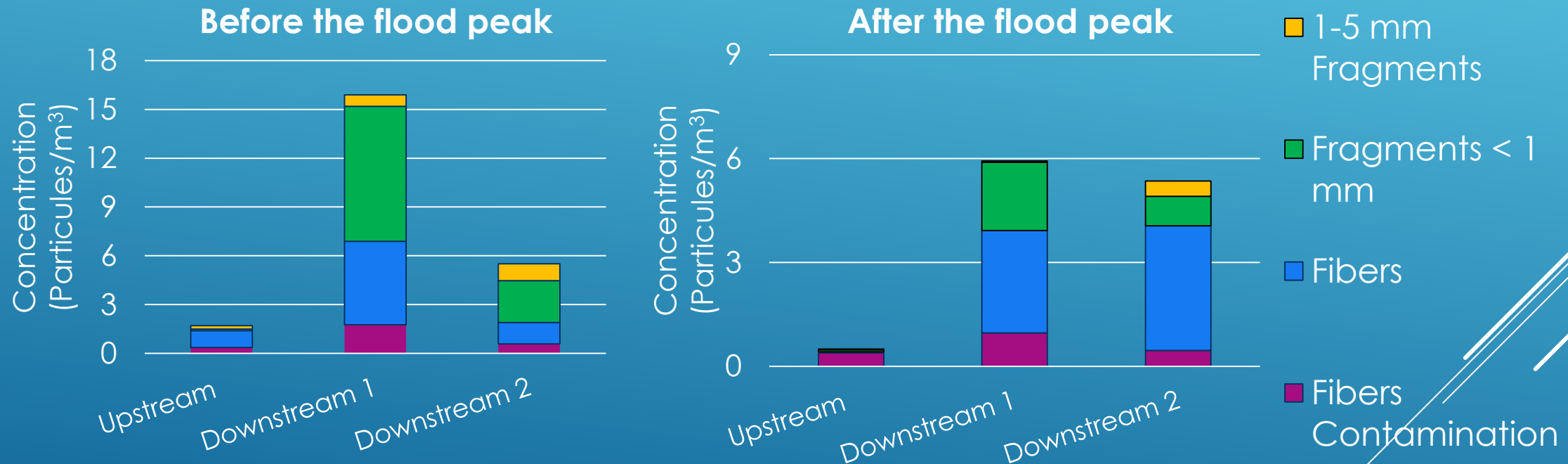
# Results: Microplastics < 1mm (300 μm net)



- Unit : ■ Fragments/m<sup>3</sup> and ■ Fibers/m<sup>3</sup>
- For fragments, concentration can be **15 times higher than low flow periods (0.54 fragments/m<sup>3</sup>)**.
- Mean fiber concentration observed by Dris et al., 2018 in Paris is **45 fibers/m<sup>3</sup>**.

# Results: Shape repartition

- Microplastics counted with stereomicroscope

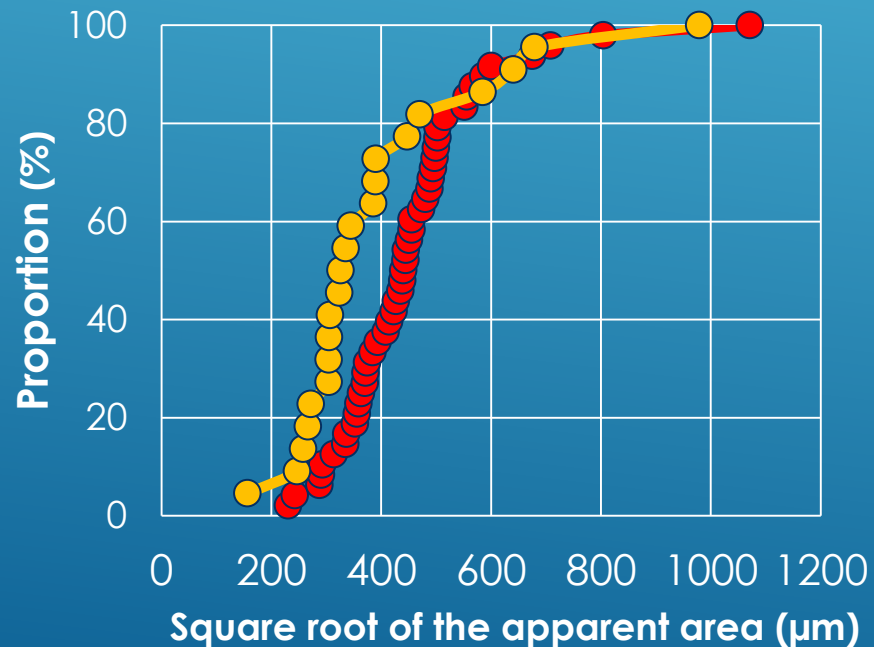




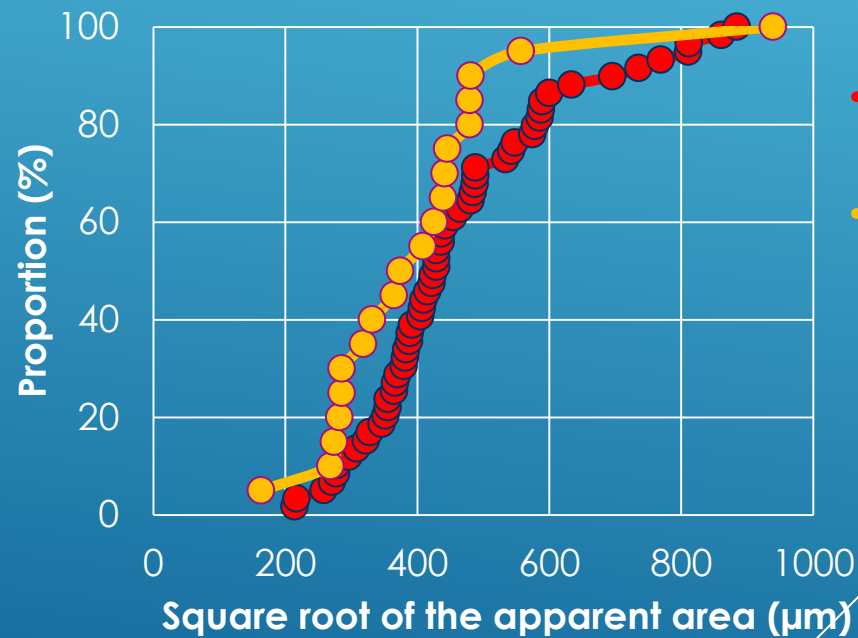
# Results: Size repartition for fragments



Fragments Downstream 1



Fragments Downstream 2

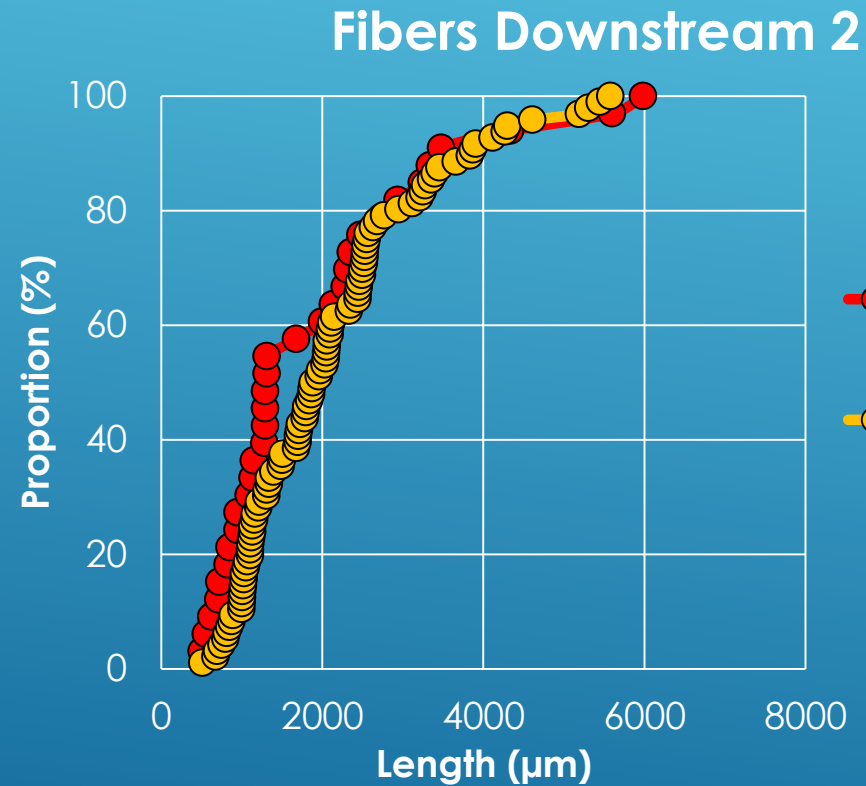
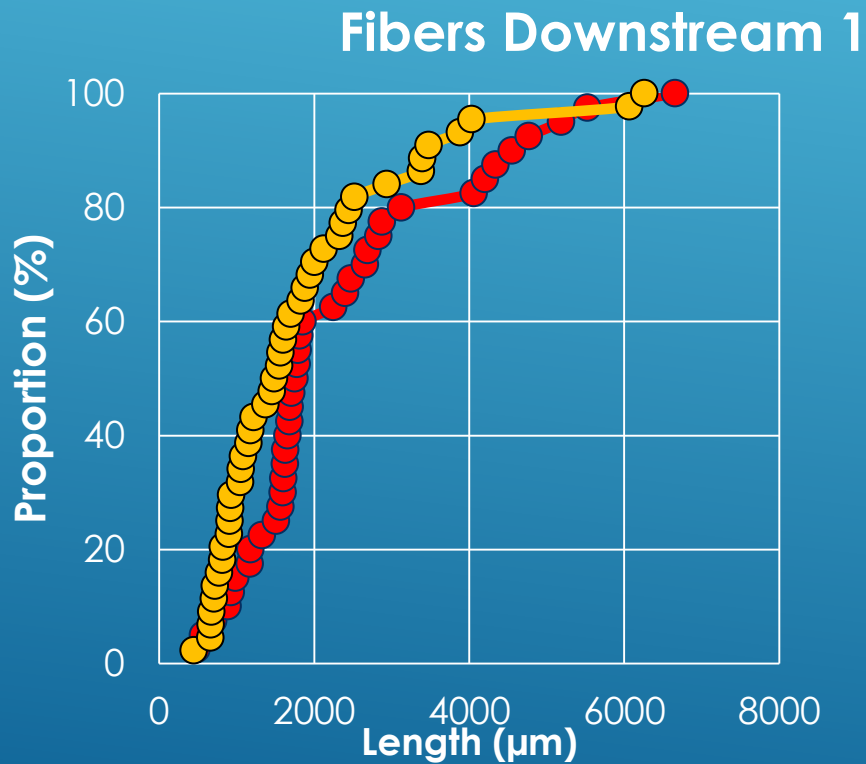


Min : 156 µm  
Max : 1070 µm

- Before the flood peak
- After the flood peak

# Results: Size repartition for fibers

- Fibers size repartition, observed with stereomicroscope



Min : 448  $\mu\text{m}$   
Max : 6658  $\mu\text{m}$

● Before the flood peak  
● After the flood peak

# Conclusion

- **Flood events are hardly considered.**
- During this flood, **fragment concentrations** can be **15 times higher than low flow periods (0.54 fragments/m<sup>3</sup>)**.
- **For microplastics < 1 mm**, polymer type will be determined **with  $\mu$ FTIR**. We also have to **analyse the smaller fraction (< 50  $\mu$ m)**.
- **What is the concentration of fibers with the 80  $\mu$ m net?**
- **Another campaign in July 2018**, for the same sites in dry weather has been done to compare those results.

Thank you for your attention!



Any questions???

robin.treilles@enpc.fr