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Microplastics and microfibers in urban runoff from a suburban catchment of Greater Paris

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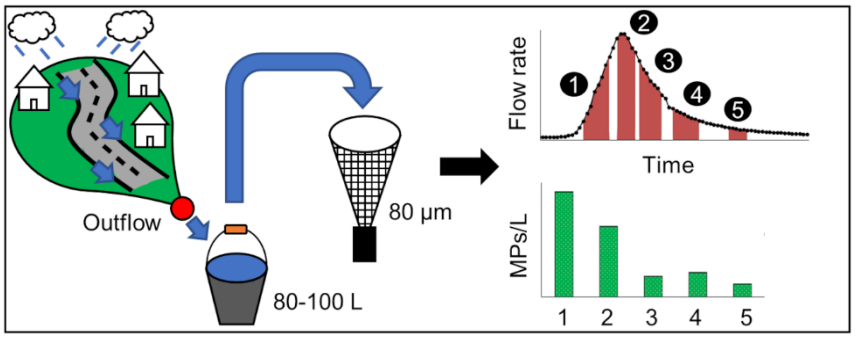
Graphical abstract



Abstract

Microplastics (MPs) and microfibers (MFs) in stormwater have been poorly investigated. Data on their concentration variation during rain events over space and time are still sparse. For the first time, the variability of microlitter concentrations in stormwater has been studied. MF

and MP concentrations were investigated in stormwater runoff at the outlet of the suburban catchment at Sucy-en-Brie (a suburb of Paris, France), during four rain events with different precipitation levels (2.6–8.6 mm/h). For each rain event, 3–5 samples of 80–100 L of stormwater were collected and filtered through a net with an 80 µm mesh. Samples were digested using sodium dodecyl sulphate and 30% H_2O_2 followed by NaI density separation. The MFs were then counted using a stereomicroscope. MPs were identified using Fourier transform infrared spectroscopy coupled with microscopy (µFTIR). Median MF and MP concentrations were 1.9 and 29 items/L, with an interquartile range of 2.3 and 36 items/L, respectively (N=18). A different pattern was observed between MFs and MPs. While no relationship or trends were observed for MFs, the highest MP concentrations were observed before the flow rate peak of the rain events. This could indicate a difference in the behaviour between MFs and MPs. We estimated the median MP mass concentration to be 56 µg/L with an interquartile range of 194 µg/L, whereas the mass concentration of macroplastics was estimated to be 31 µg/L with an interquartile range of 22 µg/L at the same sampling site, in a previous study. For this sampling site, MPs and macroplastics have the same order of magnitude. This study may have strong implications on microplastic study in urban waters.

Capsule (no more than two lines)

Microfiber (MF) and microplastic (MP) median concentrations in stormwater were 1.9 and 29 items/L. The MP and macroplastics were in the same range of mass concentration.

KEYWORDS: Microplastic, Microfiber, Stormwater runoff, Urban effluent

1. Introduction

Microplastic (MP) pollution in urban hydrosystems is an emerging concern. MPs, mostly in the form of microfibers (MFs), have been reported in all types of urban water: (i) the atmosphere and rainwater (Dris, 2016), (ii) in drinking water (Pivokonsky et al., 2018), (iii) wastewater entering wastewater treatment plants, in effluent (Talvitie et al., 2015), sludge (Mintenig et al., 2017) and, (iv) more recently, in stormwater (Dris et al., 2018). However, this last type is the

47 least documented. Stormwater peak flows may reach high values depending on
48 hydrometeorological conditions; therefore, as Hitchcock (2020) recently suggested,
49 stormwater can play a significant role in the MP budget at the urban scale. A mini review of
50 studies on stormwater is presented in Table 1. In those studies, MP concentrations ranged
51 between 0.5 to 1,050 MPs/L.

52 Table 1: Microplastic concentrations in stormwater in urban drainage systems

References	Study site	Size detection limit	MPs.L^{-1} (min–max)	Sampling volumes (L)
Dris et al., 2018	France	80 µm	24-60 fibers.L^{-1} and <2-16 fragments.L^{-1}	0.2-1.5
Eisentraut et al., 2018	Germany	10 µm	Mass estimations of polymers and SBR*	3
Liu et al.2019	Denmark	10 µm	0.49–22.9	201-454
Olesen et al., 2019a	Denmark	10 µm	270 (on average)	10
Piñon-Colin et al., 2020	Mexico	200 µm	88–275	3
Järlskog et al., 2020	Sweden	20 µm	1–100	2.7-9
Mak et al., 2020	Hong-Kong	54 µm	0.5–10	8
Bondelind et al., 2020	Sweden	20 µm	29.3–1050	Mathematical modeling

53 **SBR: styrene butadiene rubber*

54 To the best of our knowledge, Dris et al. (2018) was the first to report the presence of MPs in
55 stormwater using visual identification. In their results, the fibers corresponded to the most
56 significant shape found in these samples; the MP fragments were less numerous. Eisentraut
57 et al. (2018) used thermal extraction desorption gas chromatography mass spectrometry to
58 identify the nature of the particles, particularly those from tire wear, in stormwater samples
59 using chemical markers to identify styrene butadiene rubber (SBR), which corresponds to one
60 of the main tire components. Several studies produced new data regarding the accumulation
61 of MP fragments, fibers, and SBR particles in stormwater retention ponds and demonstrated
62 that there were significant differences in the concentrations thereof between sampling sites
63 (Liu et al., 2019; Olesen et al., 2019); for example, sediments in stormwater retention ponds
64 act as MP sinks (Olesen et al., 2019).Piñon-Colin et al. (2020) provided the first data on MPs
65 in stormwater from a semi-arid region, and found concentrations similar to those from previous
66 studies. Other recent studies focusing on tire and bitumen wear particles showed a significant

concentration of these particles in stormwater (Järlskog et al., 2020). Some recent studies also modelled the dispersion of traffic-related MPs from stormwater to a receiving river (Bondelind et al., 2020) and showed that a significant part of the tire-related particles settled in the river. As this mini-review shows, research on MFs and MPs in stormwater and urban areas is still sparse. Storm events represent key moments for MP transport and contamination (Hitchcock, 2020). However, although storm events are characterised by variability, there is almost no data on the range and variability of MP concentrations during such events.

In this paper, we provide the concentrations of MFs and MPs for four rain events at the scale of a suburban catchment in Greater Paris. We also examine the concentrations of MFs and MPs during rain events as a function of rainfall intensity and flow rate. Previous works have shown that the presence of non-synthetic fibers, such as the artificial and cellulose-based viscose and natural fibers such as cotton, is significant in urban environments (Zhao et al., 2016). Thus, all MFs with anthropogenic origins were counted. In this paper, we use the term "microlitter" for all fibers and fragments investigated. Finally, this work also compares the MP inputs in stormwater with those recently estimated at a corresponding sampling site (Treilles et al., 2021).

2. Materials and methods

2.1. Sampling site

Samples were collected at the outlet of the Sucy-en-Brie catchment, which is located in a suburban area south-east of the Greater Paris region (Figure 1). It has a surface area of 228 ha of which 62 ha is impervious (Gasperi et al., 2017). The population of the catchment is ~5,700 (density of 25 cap.ha^{-1}). The area is mostly residential, with individual households that correspond to a moderately dense urban area in France (Gasperi et al., 2017). However, there are limited commercial and professional activities conducted in the area. Sewer systems in the catchment are separated; wastewater and stormwater are collected separately. The stormwater treatment device was located at the catchment outlet. Stormwater volumes and precipitation levels were measured with flowmeters (DRUCK-PTX1830 and DRUCK-

PTX5032) and provided by Val-de-Marne Environmental and Sanitation Services Directorate (DSEA 94). Samples of MPs were taken from stormwater collected, upstream from the stormwater treatment device, during rain events.

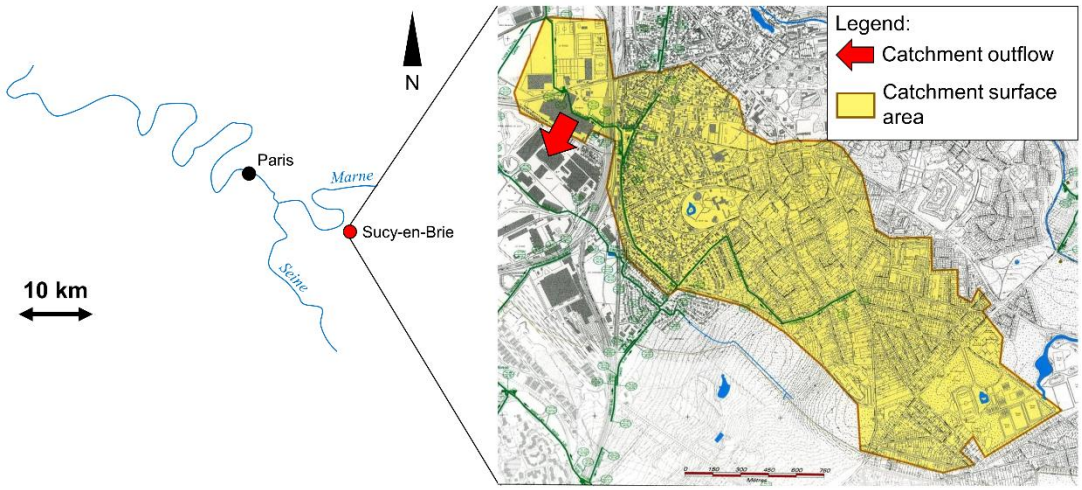


Figure 1. Location and delimitation of the Sucy-en-Brie catchment

2.2. Sampling method

Four rain events that occurred from June 2018 to May 2019 where the precipitation level was between 2.6 and 8.6 mm/h were studied. In comparison, the mean daily rainfall in Paris from March 2018 to March 2019 was 1.7 (data from Météo France). Rain events are defined as rainfall with a depth higher than 0.2 mm during 4 h. The sampling procedure was as follows: for a given rain event, 3–5 consecutive samples of stormwater were collected repeatedly at the same place (at the catchment outlet), using a metal bucket and filtered through an 80 µm net. The sampling depth is approximately 30 cm. According to Table 1, stormwater samples are generally below 10 L. Small sampling volumes may increase the variability of the results and decrease their representativity. For this reason, we decided to collect a minimum of 80 L and up to 100 L of stormwater for each sample. Because an automatic sampling device was complex to set up, manual sampling was preferred. The net was rinsed with stormwater as part of sample recovery. The samples were then stored in glass containers in a cold room (4 °C). The sampling of a rain event was based on weather forecasts. For these reasons, it was not always possible to cover all the rain events that occurred during the study period. The

June 2018 and May 2019 campaigns corresponded to summer, which is characterised by relatively rare and more intense storm events, whereas the December 2018 and March 2019 campaigns correspond to winter, which is characterised by frequent rain events with low levels of precipitation. For more details, please see the hyetographs of all rain events reported in Sucy-en-Brie during one week (Figure S1) and one year (Figure S2).

The hydrographs for each rain event sampled are presented in supplementary data (Figure S3) and the sampling times are presented in the colour band. The first rain event (June 2018) was the most intense, with a maximal flow rate of ~2.5 m^3/s. Other rain events have the same approximate maximal flow rate (~0.6 m^3/s), but their durations differ. According to our definition of a rain event, March 2019 is an unusual case as it had two peaks. The shortest rain event was in May 2019 (Figure S3).

2.3. Preventing contamination

The following precautions were taken to mitigate the risk of contamination:

- The solutions used were preliminarily filtered on glass fiber filters (GF/D Whatman, Sigma Aldrich, 2.7 µm). In this paper, the water and 50% ethanol used for rinsing the filters is always referred to as filtered solutions.
- All glass vessels and filters were heated at 500 °C for 2 h before use. When needed, the vessels were rinsed with water and 50% ethanol. Plastic materials were not used and only 100% cotton laboratory coats were worn.
- The samples were stored in glass bottles covered with aluminium foil. All beakers used during the extraction protocols were also covered with aluminium foil.
- Sieving was carried out under a laminar flow hood.
- Procedural blanks (N = 6) were prepared to evaluate the contamination of the samples during the different steps used to extract the MPs. These underwent the same processing steps as the actual samples. Each blank had an initial volume of 1 L of

water that was previously filtered through a GF/D filter (2.7 µm, Ø 90 mm). They were then resuspended and analysed as samples (see the section “Analytical procedure”).

2.4. Analytical procedure

Stormwater samples were first sieved using both 5 mm and 1 mm sieves. The MP samples were then separated into two distinct fractions: those 1–5 mm and <1 mm in size. Despite sieving, long fibers (> 5 mm) were observed in the treated samples. These fibers were included in the results. The 1–5 mm fraction was carefully observed on a 1 mm sieve under a binocular magnifier. Particles suspected to be MPs based on their physical characteristics (colour, shape, or texture) were removed and set aside in glass petri dishes to be characterised using an infrared spectrometer with attenuated total reflectance (ATR; Thermo ScientificTM iD7).

The <1 mm fraction underwent different treatment steps, as follows: (i) pre-treatment via sodium dodecyl sulphate (SDS) digestion (3.5 g/L, 50 mL) at 40 °C, while being stirred with a magnetic stirrer at 300 rotations per minute (rpm) for 24 h to denature any proteins; (ii) digestion in 50 mL of 30 wt% H_2O_2 at 40 °C for 48 h, while being stirred with a magnetic stirrer at 300 rpm, to oxidize organic matter (OM); (iii) filtration on a metallic filter (Ø 90 mm, 10 µm); and (iv) resuspension and densimetric separation in a NaI solution ($\rho \geq 1.6$ g.cm^{-3}) in a separating funnel. The supernatant was then recovered for microlitter analysis by filtering it on the metallic filters previously used. Digestion was conducted at temperatures ≤ 40 °C to prevent thermal degradation of the MPs (Treilles et al., 2020). MFs were counted manually under a stereomicroscope (Leica MZ12) coupled with image analysis software (Histolab) while MPs were counted using µFTIR imaging.

Several criteria based on the colour and shape of the MFs were considered and then used in the identification of MFs (Dris et al., 2015). The size detection limit of this method was 100 µm.

Once the MFs were counted, each metallic filter was plunged into a crystallizer with 20 mL of filtered water and the particles were remobilized using an ultrasonic bath for 30 s. The filtered

water was then poured into a 100 mL glass bottle. This resuspension step was repeated thrice. The metallic filter was then rinsed for a final time with 40 mL of filtered water.

The glass bottle was then covered and strongly agitated for 1 min to homogenise its contents. Depending on the clogging, a certain volume (2.5–20 mL or 2.5–20 %) was filtered onto a Whatman® anodisc inorganic filter membrane (porosity: 0.2 µm, Ø 25 mm with a filtration surface of Ø 14 mm).

The last sample from May 2019 was counted and analysed differently from other samples as an important quantity of suspended materials were collected therein. After treatment, a sub-sample of 10% of its initial mass was filtered on a metallic filter and subjected to the same analytical steps as the other samples.

Anodisc filters were analysed via µFTIR with a Thermo Scientific Nicolet™ iN10 infrared microscope in transmission mode. The detector used was a Thermo Scientific® MCT/A cooled imaging detector (with a spectral range of 4000–1200 cm^{-1} and automatic baseline correction to prevent interference with the anodisc filter).

Once the spectral background was defined, µFTIR analyses were processed as follows:

- Using the mapping analyzing mode with one scan, all particles of three 6x6 mm infrared maps were analyzed, which correspond to 70% of the filtration surface.
- Maps acquired were corrected using an atmospheric suppression.
- Maps were analysed using the MP analysis software siMPle, which was developed at Aalborg University, Denmark, and the Alfred Wegener Institute, Germany (Liu et al., 2019).

The size detection limit of this method was 25 µm. Each spectrum was checked, after the analysis was complete, to prevent errors. Particular attention was paid to PE spectra, as other studies (Witzig et al., 2020) have noted false positive particle detection. The analysis software siMPle allows the assessment of the number, mass, and volume of MPs; this is explained in Kirstein et al.. (2021). MP concentrations were extrapolated to the initial sampling volumes. As the number of samples was small, non-parametric statistics were used in the analysis of the results.

It is worth noting that MF concentrations correspond to the anthropogenic microfibers with no distinction of nature (synthetic, artificial and natural-cellulosic), as this fibers were only counted. MP concentrations correspond to all synthetic particles found in our samples after µFTIR analyses. Thus, MF concentrations and MP concentrations are independent as the methods used to collect these data are different.

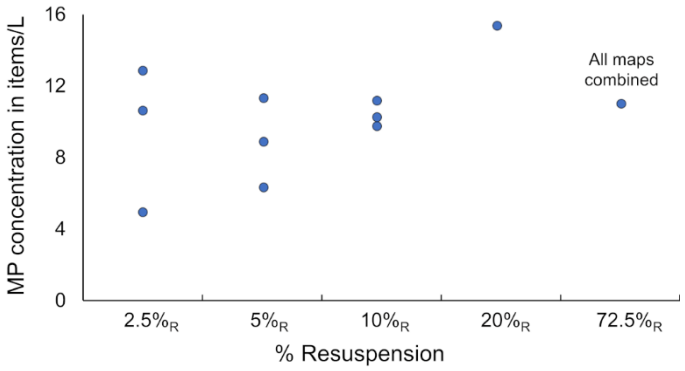
3. Results

3.1. Variability of analyses using Fourier transform infrared spectroscopy coupled with microscopy (µFTIR)

The variability of the analytical methods used for analysing MPs has not generally been investigated in previous studies. Therefore, we decided to assess the variability of the µFTIR method used in this study. To do this, the same sample was resuspended several times at the various resuspension percentages given below (in $\%_R$):

- in triplicate at 2.5$\%_R$;
- in triplicate at 5$\%_R$;
- in triplicate at 10$\%_R$;
- Once at 20$\%_R$.

The results, which are shown in Figure 2, enabled the assessment of the variability using the resuspension percentage. The variation between the first and third quartiles for 2.5$\%_R$, 5$\%_R$, and 10$\%_R$ were 121%, 81%, and 15%, respectively. The variability decreased when the resuspension percentage increased. A variation of 48% was observed between the median concentration with 10 $\%_R$ and the reported concentration with 20$\%_R$. More details are given in the supplementary data (Figure S4 and Figure S5).



215

216 Figure 2: Microplastic (MP) concentrations estimated in items/L in different resuspension
217 percentages ($\%_R$) for the same stormwater sample

218 ### 3.2. Anthropogenic microfibers in stormwater

219 Anthropogenic MF concentrations estimated via counting are shown in Figure 3. The sampling
220 volumes and number of MFs in each sample are given in Table S1. The analytical blanks
221 contained 26 fiber MFs with an interquartile range of 5 MFs (N = 6). The contamination is
222 shown in Figure 3.

223

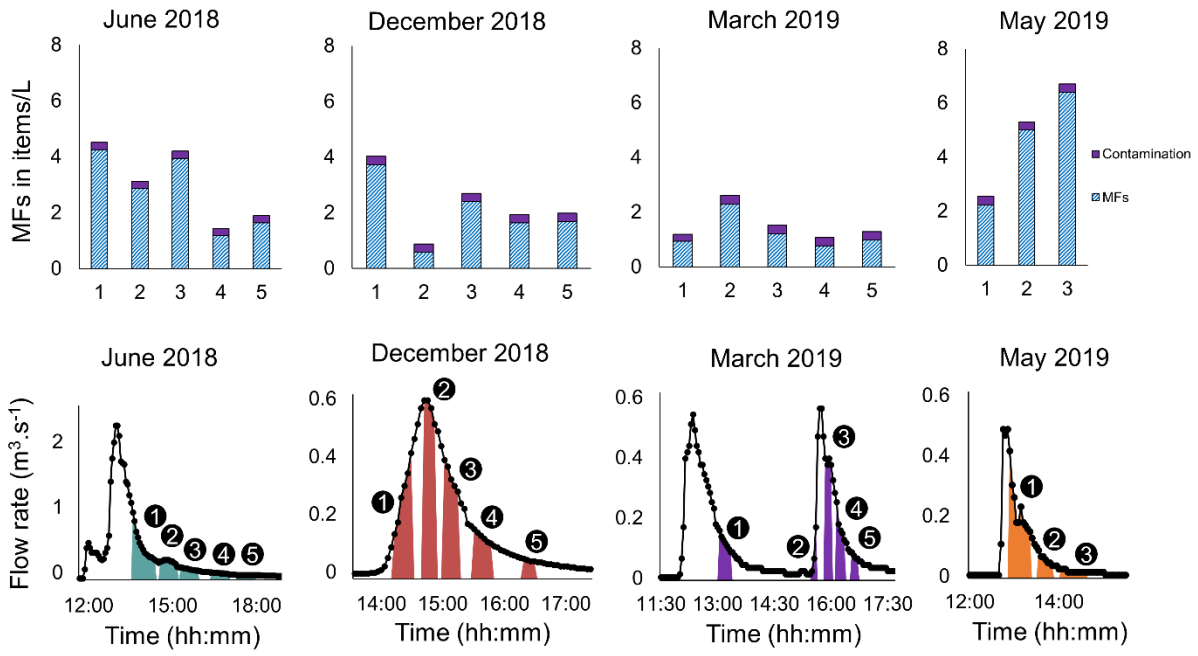


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Figure 3. Hydrographs for each rain event studied showing microfiber (MF) concentrations in items/L

When all samples were combined, the mean MF concentration was 2.5 ± 1.3 MFs/L (mean ± standard deviation) with a median value of 1.9 MFs/L and an interquartile range of 2.3 MFs/L (N = 18). The highest concentration was observed during the last campaign (May 2019). The size distribution of particles in each sample and the mean length of all MFs found in samples from each rain event are shown in Figure 4.

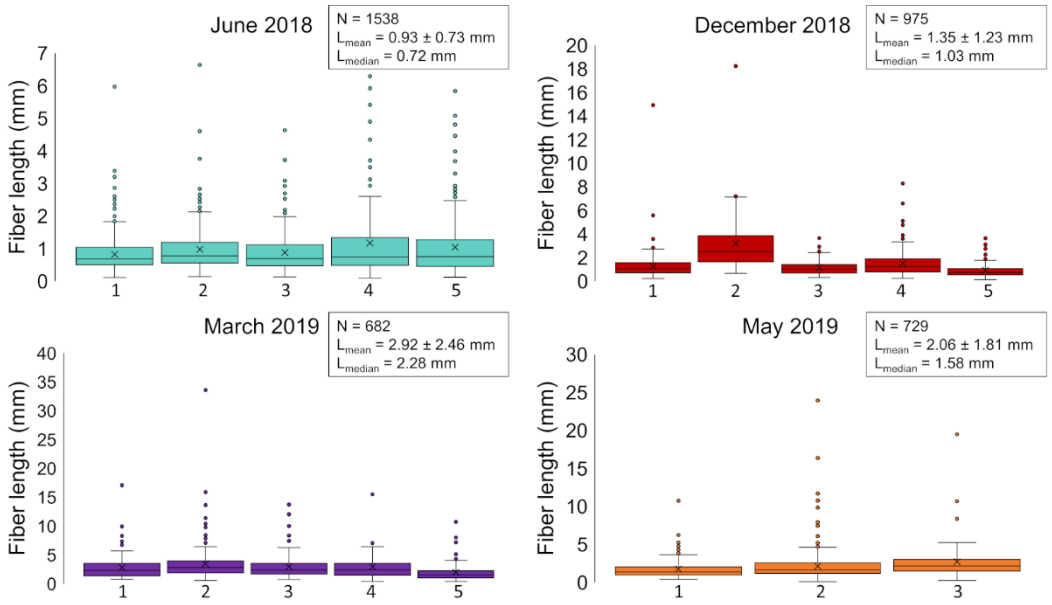


Figure 4. Size distribution of particles in each sample and each rain event; N = total number of fibers found in each sampling campaign; L_{mean} = mean length of all fibers ± standard deviation, L_{median} = median length of all fibers

For all campaigns, the mean fiber length ranged between 0.93–2.92 mm; the median values were always lower than these, ranging between 0.72–2.28 as a reflection of the significant presence of fibers > 5 mm and the large number of fibers present that were <1 mm. Among all the fibers counted, the maximum size found was 33.6 mm while the minimum size was 94 µm.

3.3. Microplastics in stormwater

The analytical blanks show a variable contamination of 13 MPs with an interquartile range of 28 MPs (N = 6); this was negligible for almost all samples, with the exception of the last campaign (May 2019) (Figure 5).

Figure 5 presents the concentration of MP in items/L and the hydrographs of each rain event. The concentrations ranged from 3–129 items/L (min–max) with a median of 29 items/L and an interquartile range of 36 items/L (N = 18).

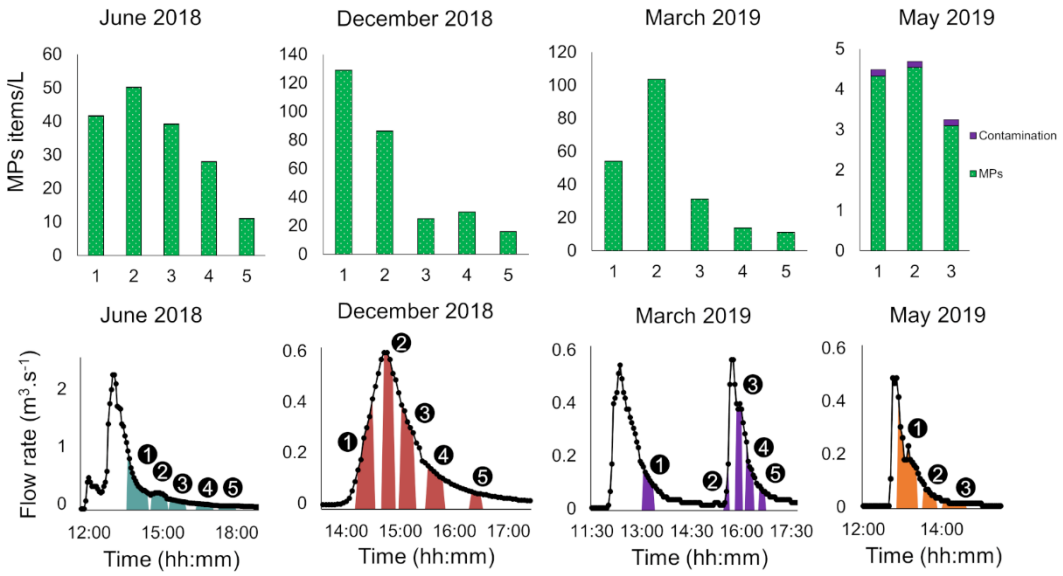
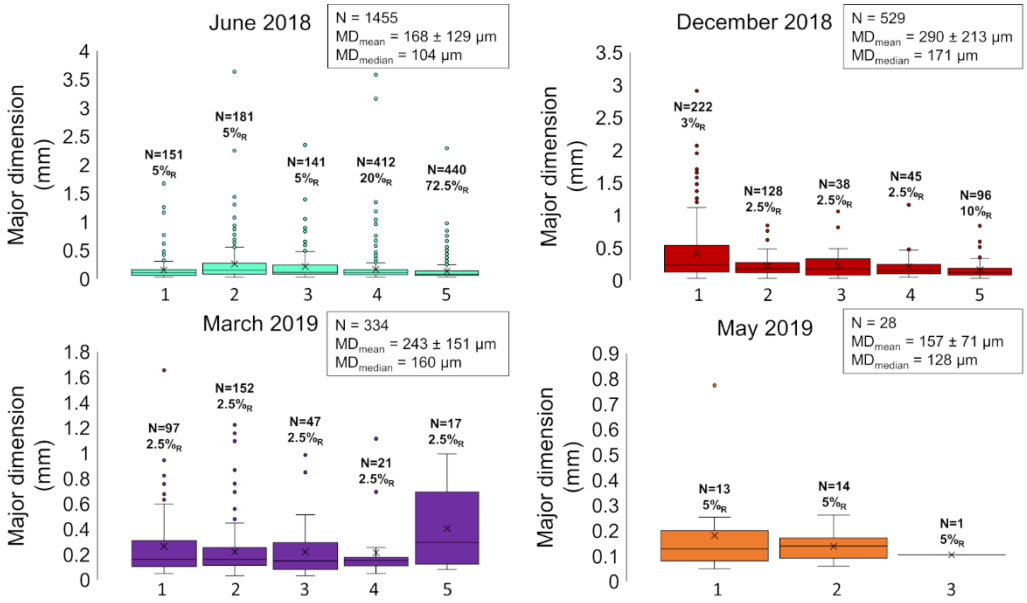


Figure 5. Hydrographs for each rain event studied showing the concentration of microplastics (MPs) in items/L

The major dimension (length) of all MPs identified for each sample using µFTIR are presented in Figure 6. In these boxplots, the mean values of the major dimensions are higher than median values due to the sizes of the largest MPs observed. The mean particle sizes found in December 2018 and March 2019 campaigns were larger than those found in the other two campaigns.



256

257 Figure 6. Boxplots of the major MP dimensions found in each sample and during each
258 sampling campaign. MDmean = mean major dimension ± standard deviation;
259 MDmedian = median major dimension for a campaign; $\%_R$: resuspension percentage; N:
260 Number of MPs found for a given resuspension volume.

261 Figure 7 shows the proportion of each polymer type, with polyethylene (PE), polypropylene
262 (PP), and polystyrene (PS) corresponding to the predominant polymers. Only a few MPs were
263 found in May 2019, which explains the distribution observed during this campaign.

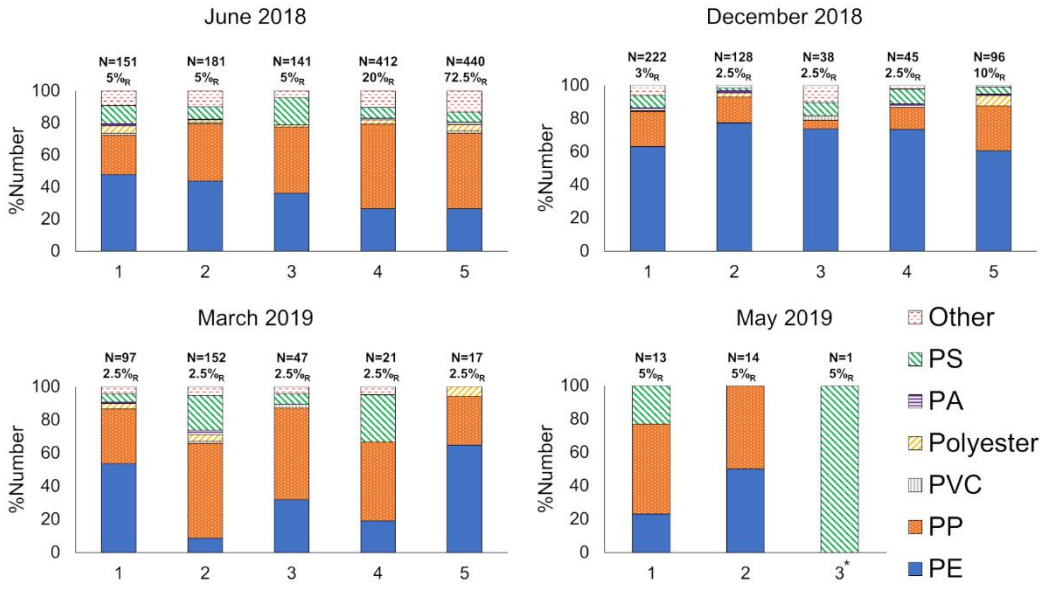


Figure 7. Percentage of polymers in each sample. N: Number of microplastics (MP) particles found for a given resuspension volume; $\%_R$: resuspension percentage. PE: polyethylene; PP: polypropylene; PVC: polyvinyl chloride; PA: polyamide; PS: polystyrene. Only 10% of the initial mass was used in the sample marked *.

4. Discussion

4.1. Anthropogenic microfibers in stormwater

No correlation was found between the MF concentration and mean flow rate for each sampling period (Figure S6); the results do not even present a particular pattern depending on the latter. MF concentrations ranged between 0.6–6.4 MFs/L (min-max values) among the different samples and rain events (Figure 3). These concentrations were lower than those reported by Dris et al. 2018, who found a concentration of 24–60 fibers/L in runoff; however, Dris et al. (2018) used raw water samples that were expected to have a higher MP concentration than pre-filtered samples.

The median length of the particles found was > 0.72 mm for all campaigns (Figure 4). Our results suggest a significant presence of relatively long fibers in stormwater. Sutton et al. (2016) showed that 53% of the fibers sampled in urban waters from San Francisco Bay were sized 0.355–0.999 mm; this corresponds approximately to our results according to the median

values we obtained. Given this size distribution, the fibers we analysed do not appear to have originated from atmospheric deposition, given that they are predominantly small in size at < 600 µm (Allen et al., 2019; Cai et al., 2017; Dris et al., 2017). The fibers found could have come primarily from the wear and tear of textile products.

4.2. Microplastics in stormwater

We observed MP concentrations that ranged between 3–129 items/L (min–max values) with a median of 29 items/L and an interquartile range of 36 items/L; these are the same order of magnitude as previous studies (Järlskog et al., 2020; Olesen et al., 2019; Piñon-Colin et al., 2020). A comparison between the concentrations and hydrographs in Figure 5 reveals the global trends for these results. The highest concentrations were observed in December 2018 and March 2019. During these two campaigns, the concentration peaks could be linked to the increase in flow rate. The MP concentrations just before the flow rate reached its peak were six times higher than the concentration reported at the end of the rain event (Figure 5). MP behaviour could be comparable to that of suspended material during flood events (Tockner et al., 1999). However, the MP concentrations decreased after the peak in the flow rate. More data should be collected to confirm these trends. The rain event in May 2019 was the shortest and had the lowest MP concentrations. We infer that MP remobilization occurs during rain events that are sufficiently intense (>2.5 mm/h and longer than 2h). For example, if MPs becoming remobilized once the flow rate reaches a certain threshold could explain the low concentrations found during this sampling campaign. However, this variation was not present for the MFs. MFs and MPs may thus have different accumulation dynamics in environmental matrices.

A total of 2,346 particles overall were identified as MPs. The mean major dimension for MPs found in stormwater was 207 µm with a standard deviation of 273 µm; this shows a high variability. The median value was 115 µm, with 80% of the particles being less than 255 µm long. This repartition shows the importance of utilising sampling devices with mesh sizes less than 300 µm. Despite pre-filtration with an 80 µm mesh net, 20% of the particles were smaller

than 75 µm, which can be explained by clogging. A smaller mesh size may help to study smaller particles. However, clogging is more frequent with smaller mesh sizes. For this reason, several mesh sizes may be tested for both microplastic and microfiber samples. Large particles (>1 mm) were also observed in these samples. The largest MPs were found in the sample from December 2018, among the four studied rain events, whereas those from June 2018 and May 2019 contained the smallest MPs (Figure 6). However, these present no clear trends in terms of the impact of stormwater flow rate on size of MP found.

In all samples, PE, PP, and PS generally made up more than 85% of the polymers found. These polymers are the most common and lightest synthetic polymers. Other polymers are observed occasionally.

The mass discharge of MPs in stormwater was estimated at 56 µg/L with an interquartile range of 194 µg/L (N = 18). The interquartile range of this discharge reflects the high variability in this estimation. These estimates are approximate and provide information on the order of magnitude of the MP concentrations. However, when compared with the data in the literature, the mass concentrations found were significant. In stormwater retention ponds in Denmark, Liu et al., (2019) found a median mass concentration of 0.231 µg/L; our estimates are two orders of magnitude higher than this study. That can possibly be explained by two factors. The first is the quality of the stormwater, since the sampling site is in the vicinity of a densely populated suburban catchment, a poor stormwater quality is expected and the second is the difference in the dynamics of stormwater retention ponds (in which sedimentation can occur) and stormwater runoff (which may transport more MPs).

Macroplastic concentration was measured at 31 µg/L with an interquartile range of 22 µg/L (N = 15) at the same sampling site in a previous study (Treilles et al., 2021). Macroplastics are defined as plastic waste larger than 5 mm. For this sampling site, MPs mass concentrations are of the same order of magnitude than macroplastics. This is unexpected but can be explained by three parameters: (i) the small size of the MPs, which facilitates their transport; (ii) the abundance of MPs in urban environments; and (iii) waste management

systems being made to reduce visible plastic and macrowaste such as macroplastics. In terms of MPs, there is no method that screens these particles in stormwater, which could thus contain a high concentration –in terms of numbers and mass–of MPs.

In the future, influence of different key factors may be considered to improve the comprehension of the MF and MP transport in stormwater such as: wind trends, the seasonality, the population behaviour and the degradation dynamic of macroplastics.

5. Conclusion

This study provides new data regarding microlitter pollution in stormwater in a suburban area. The concentration of MFs in the stormwater ranged from 0.6–6.4 MFs/L, whereas that of MPs ranged from 3–129 items/L. In all sampling campaigns, the median MF sizes were always > 0.72 mm and characterised by the presence of long fibers (those > 5 mm). These fibers are most likely caused by the degradation of larger objects. The concentration of MPs varied with the stormwater flow rate; higher concentrations corresponded to samples collected immediately before the latter peaked. Furthermore, the behaviour of MPs may be similar to the dynamics of suspended materials during rain events. In terms of their sizes, MPs in stormwater had a median major dimension of 115 µm and 80% of all the MPs found were smaller than 255 µm. For almost all samples, more than 85% of all the polymers found were PE, PP, and PS. When compared with a previous study, the median concentrations of MP were surprisingly of the same order of magnitude than those of macroplastics: the values were 56 µg/L with an interquartile range 194 µg/L for MPs and 31 µg/L with an interquartile range of 22 µg/L for macroplastics. However, this may have been because MPs may be easily transported in urban areas. Additional studies should be performed on microlitter in stormwater in other urban catchments for comparison with these results as this could help form an estimate of the MP mass fluxes in the environment.

6. Acknowledgements

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Supplementary data

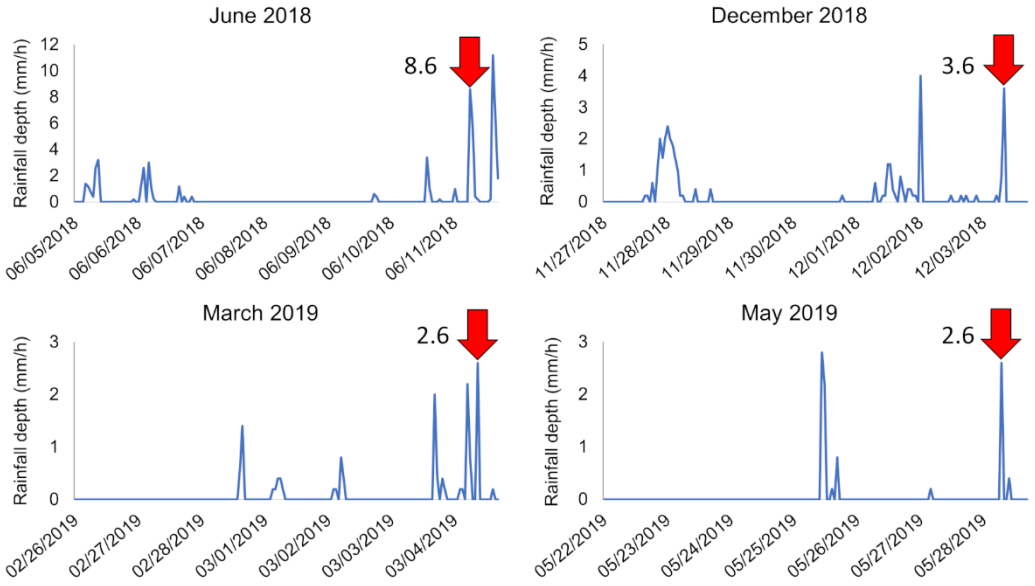


Figure S1: Weekly hyetographs of all rain events for each sampling campaign; the sampling dates are represented by the red arrows (data from DSEA 94 collected in Sucy-en-Brie)

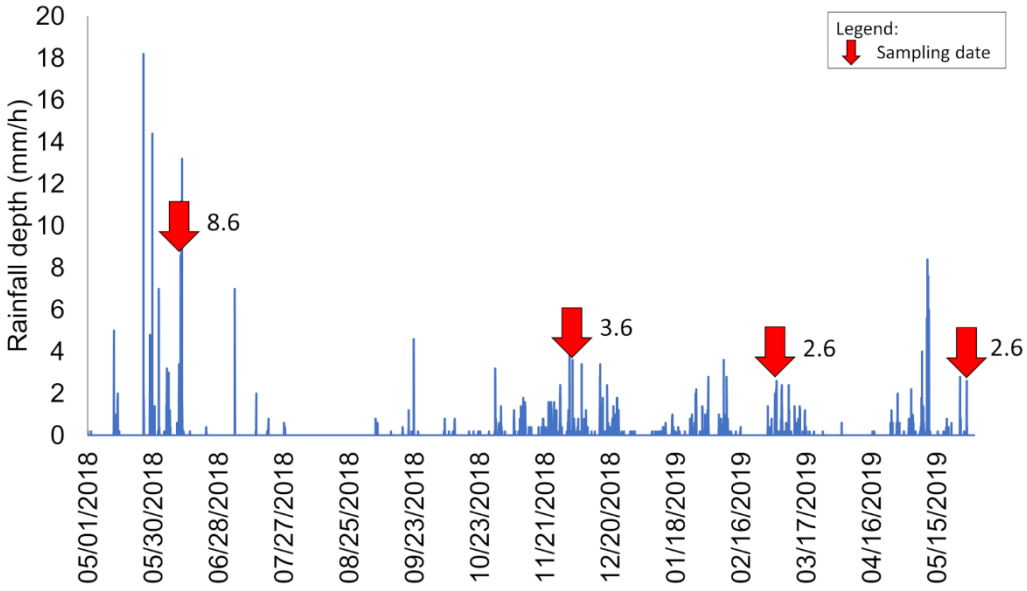
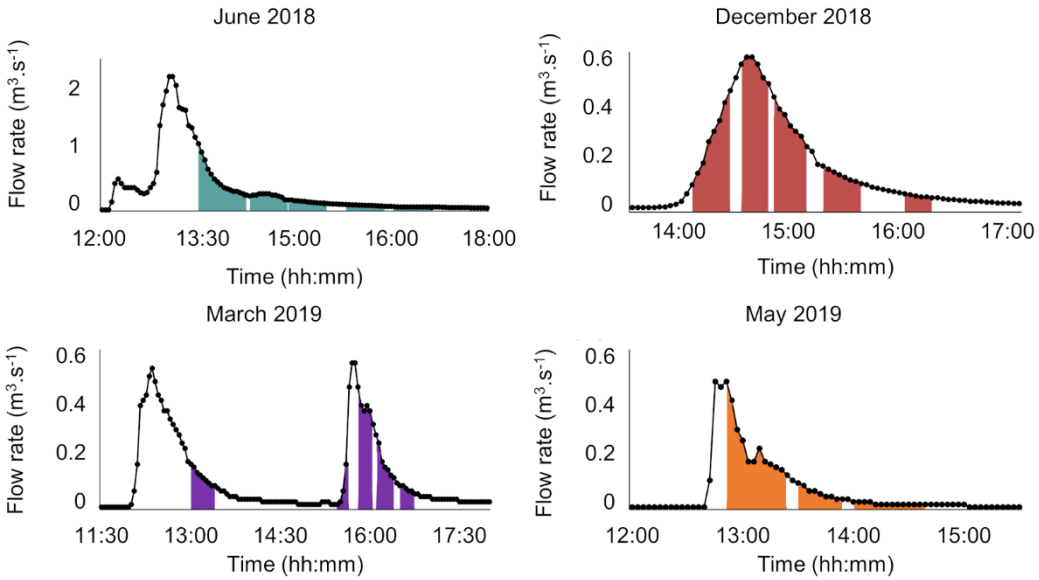


Figure S2: Hyetograph of all rain events from March 2018 to May 2019; sampled rain events are marked with the red arrows



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460 Figure S3: Hydrograph of each rain event sampled. Sampling periods are represented in the

461 colour bands. Note that the y-axis differs for the first event (June 2018)

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	Map 1	Map 2	Map 3	All maps combined	Concentrations (items/L)
Filter 1 – 2.5 $\%_R$	N = 9	N = 4	N = 6	N = 19	10.5
Filter 2 – 2.5 $\%_R$	N = 8	N = 7	N = 8	N = 23	12.7
Filter 3 – 2.5 $\%_R$	N = 0	N = 2	N = 7	N = 9	4.9
Filter 1 – 5 $\%_R$	N = 10	N = 7	N = 5	N = 22	6.1
Filter 2 – 5 $\%_R$	N = 6	N = 14	N = 11	N = 31	8.6
Filter 3 – 5 $\%_R$	N = 15	N = 17	N = 8	N = 40	11

464

465 Figure S4: Number and types of microplastics and estimated concentrations found in the
466 sample June 2018_5 with various resuspension percentages (triplicates of 2.5%$_R$ and 5%$_R$);
467 PE: polyethylene; PP: polypropylene; PVC: polyvinyl chloride; PA: polyamide; PS: polystyrene

	Map 1	Map 2	Map 3	All maps combined	Concentrations (items/L)
Filter 1 – 10 $\%_R$	N = 28	N = 13	N = 31	N = 72	9.9
Filter 2 – 10 $\%_R$	N = 29	N = 9	N = 30	N = 68	9.4
Filter 3 – 10 $\%_R$	N = 25	N = 19	N = 34	N = 78	10.8
Filter 1 – 20 $\%_R$	N = 110	N = 61	N = 37	N = 208	14.7
All filters combined 72.5 $\%_R$				N = 570	11.1

Figure S5: Number and types of microplastics and estimated concentrations found in the sample June 2018_5 with various resuspension percentages (triplicates of 10%$_R$, one sample at 20%$_R$ and all resuspensions combined); PE: polyethylene; PP: polypropylene; PVC: polyvinyl chloride; PA: polyamide; PS: polystyrene.

Table S1: Sampling volumes and number of fibers counted for each sample

	Volume (L)	Number of fibers counted
June 2018-1	103.5	467
June 2018-2	103.05	322
June 2018-3	102.6	431
June 2018-4	104.9	150
June 2018-5	101.2	192
December 2018-1	82.1	331
December 2018-2	84.8	75
December 2018-3	87.1	235
December 2018-4	87.1	169
December 2018-5	86.2	171
March 2019-1	102.6	122
March 2019-2	83.9	219
March 2019-3	86.2	131
March 2019-4	86.7	93
March 2019-5	87.6	113
May 2019-1	83	211
May 2019-2	85.3	452
May 2019-3-10%	88	59

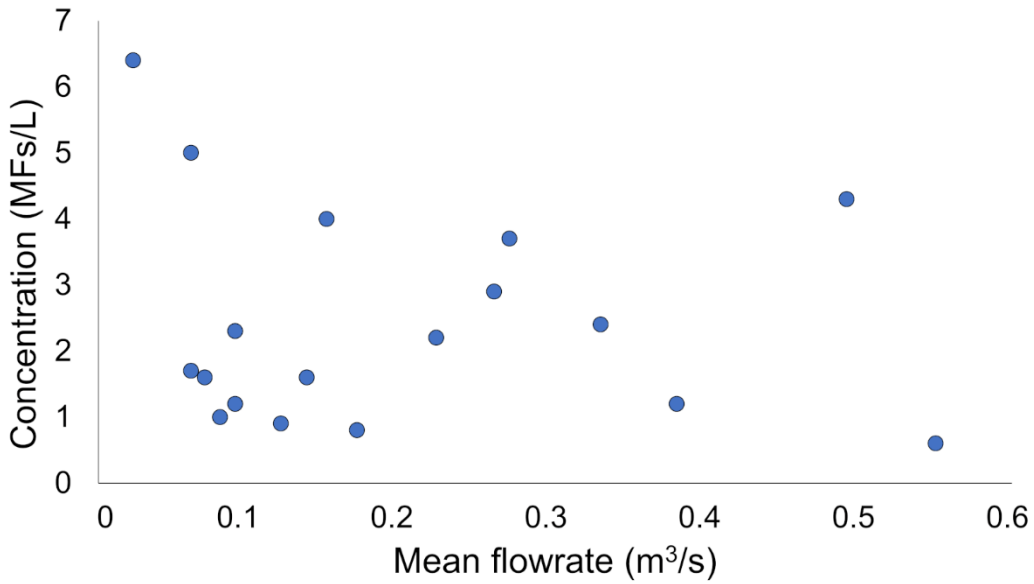

Figure S6: Concentration of microfibers (MFs) in items/L versus the mean flow rate (m^3/s) of each sampling period.