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Transfer and fluxes of microplastics in the watercourses of an agricultural sub-catchment (Avenelles)

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Context

Knowledge about dynamics, sources and transfer of microplastics (MP) toward the watercourses are insufficient. Particularly, the impact of agricultural activities on river pollution is poorly understood.

This study aims at providing insight on :

- Spatio-temporal dynamics at different scales
- Determining the role of flood events
- Estimate fluxes during dry and wet season

Methods

Sub-catchment (45 km², Fig. 1) mainly agricultural, with a large proportion of the surface area drained. Two types of sample have been collected: the outlet (river) and an agricultural drain at the head of the catchement.

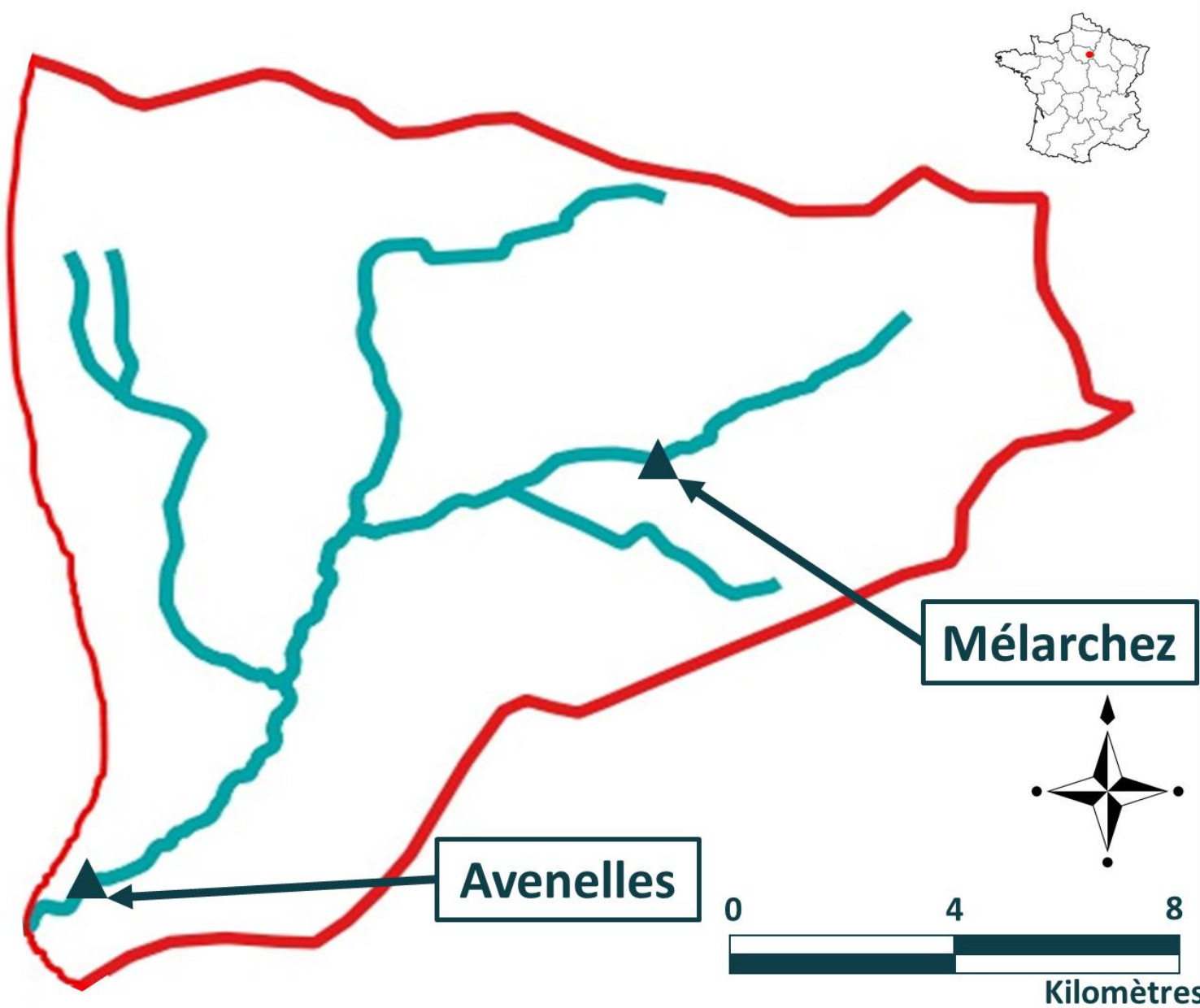
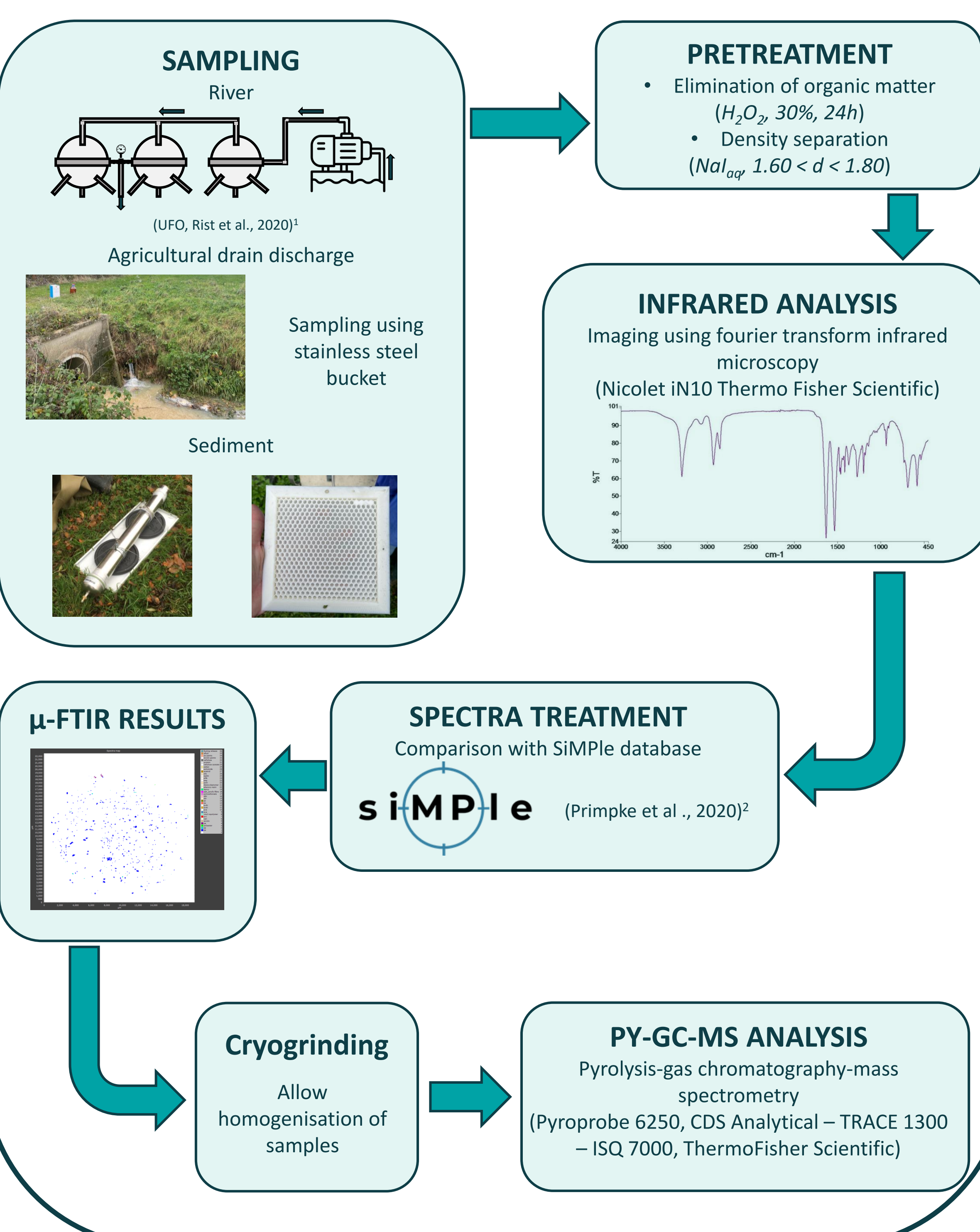


Figure 1 : Sub-catchment map of Avenelles

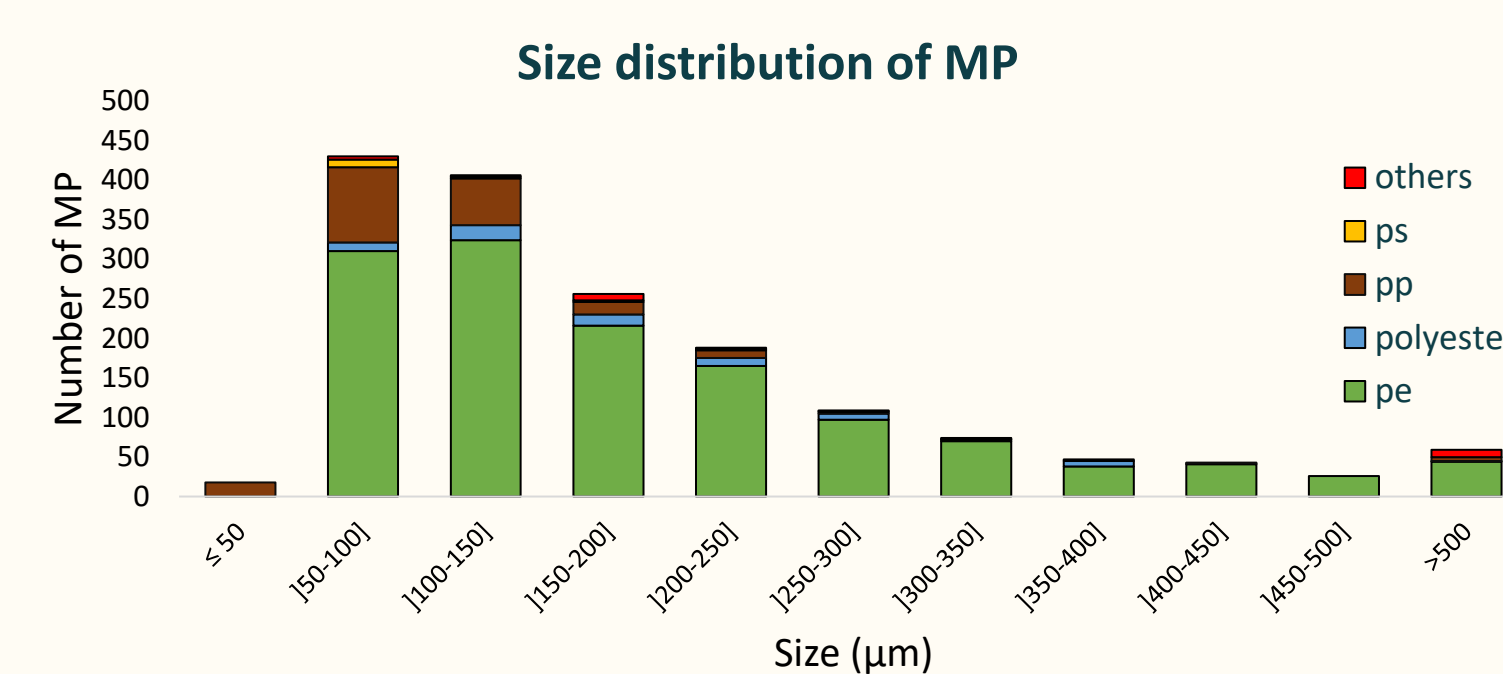


Results and discussion

River – dry weather

(median values, n=11)

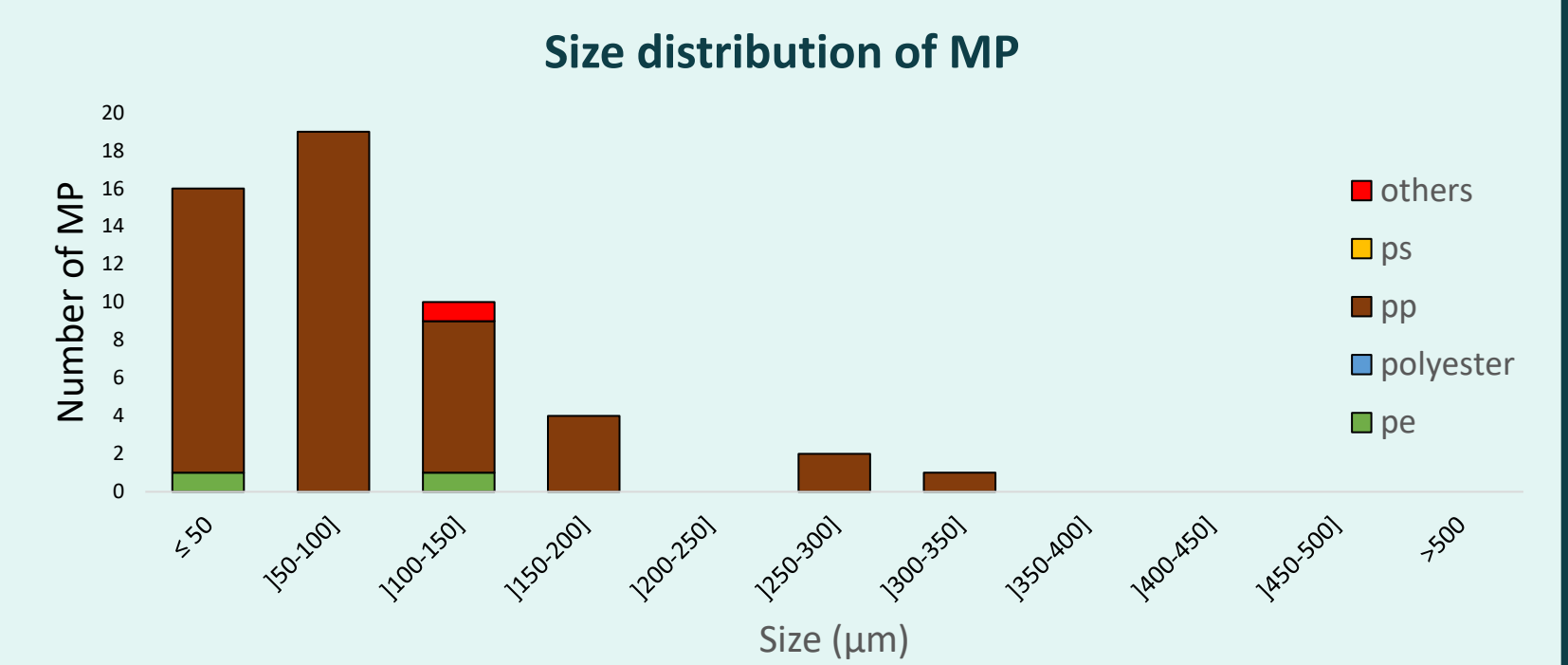
- Concentration = 0.66 MPs L⁻¹
= 0.40 μg L⁻¹
- Mass flux = 0.13 g h⁻¹



Agricultural drain

(n=1)

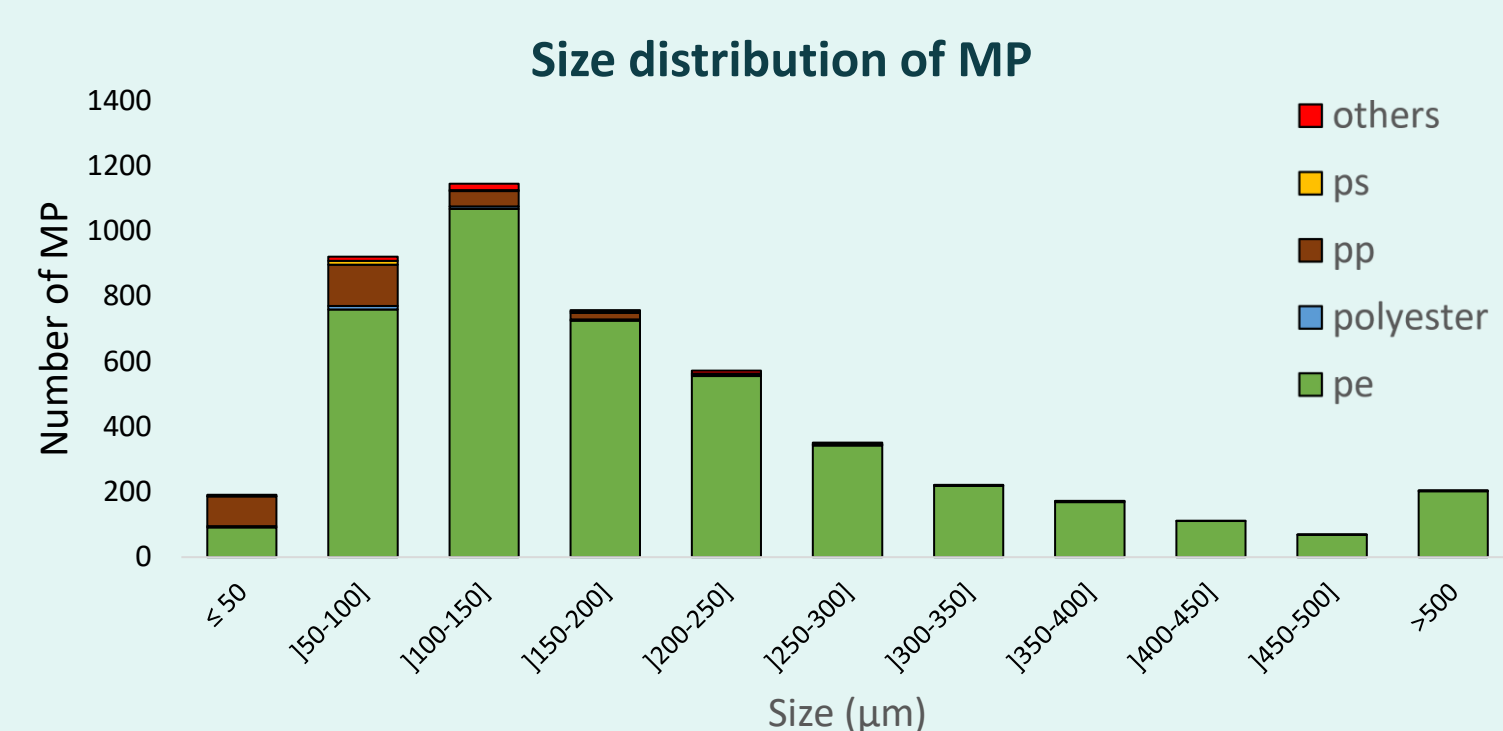
- Concentration = 1.04 MP L⁻¹
= 0.14 μg L⁻¹
- Mass flux = 0.0006 g h⁻¹



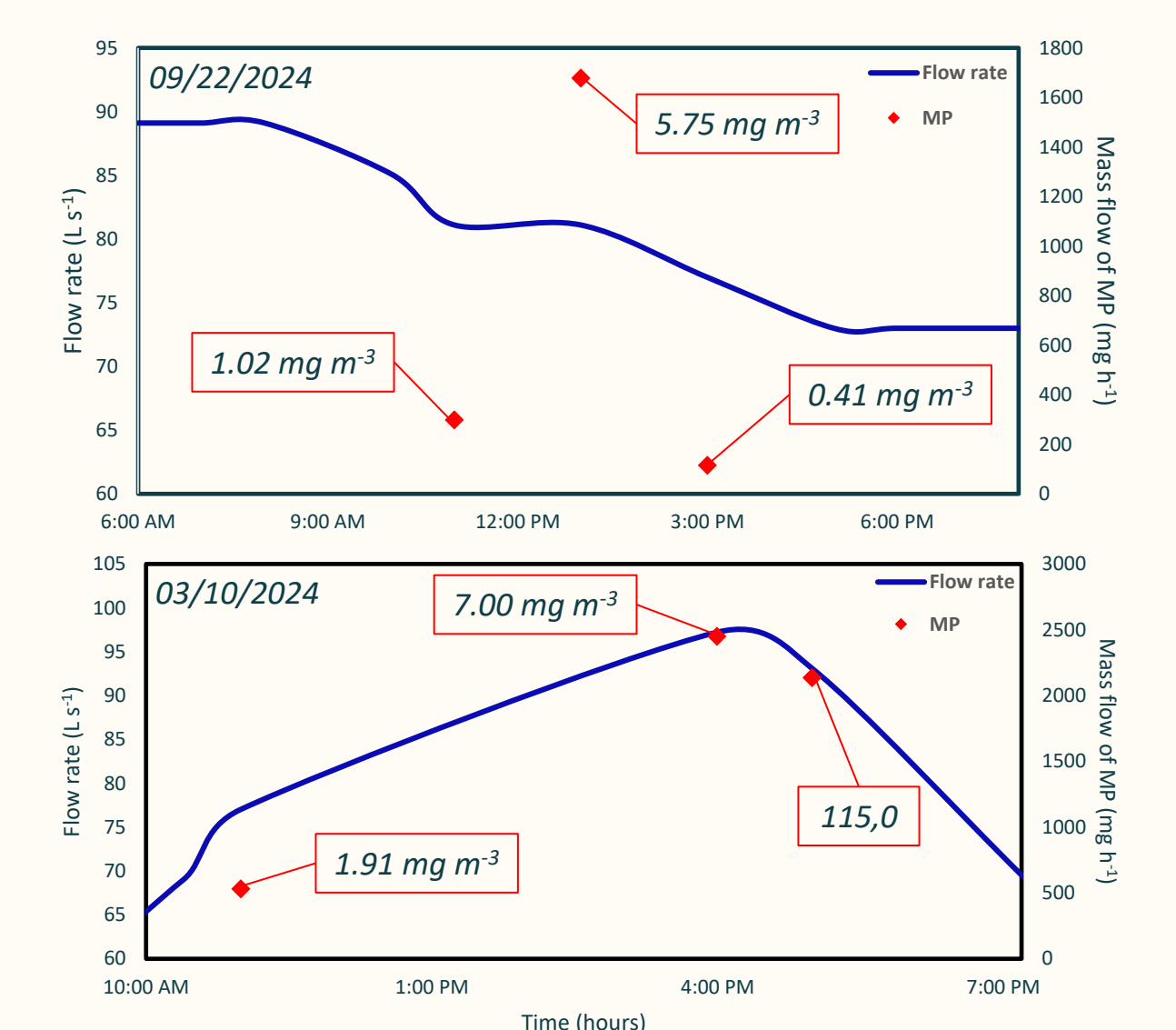
River – wet weather

(median values, n=14)

- Concentration = 4.14 MPs L⁻¹
= 6.06 μg L⁻¹
- Mass flux = 7.33 g h⁻¹



MP flux dynamics



- In contrast to the studies carried out on the Seine (Treilles et al., 2022)³, polyethylene (PE) was observed to be more prevalent than polypropylene (PP).
- The polymer type repartition shows similar results for both periods. However, the estimated flows are 15 to 50 times greater during wet weather periods. Size distribution during wet weather shows a majority of MP between 100 and 150 μm. In dry weather, the majority are between 50 and 100 μm.
- First drain analysis results show a different typology, with a predominance of PP.
- The MP mass flux variation is linked to flow rate only for some events.

Conclusions

- Agricultural drains do not appear to be the main source of microplastics in the river. They still represent a non-negligible contribution, with the majority being PP.
- The fact that MP fluxes are not always related to water flow rates highlights that there is a potential source that is independent from the hydrodynamics of the sub-catchment.
- Significant differences in size distribution between dry and wet weather suggest that the main source of MP is different between these seasons.
- Potential sources (WWTP discharges, road runoff, erosion, etc.) of MPs will be identified as a next step of this research.