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Prospective study on plastic waste in the soil of urban and rural areas of Hauts de France

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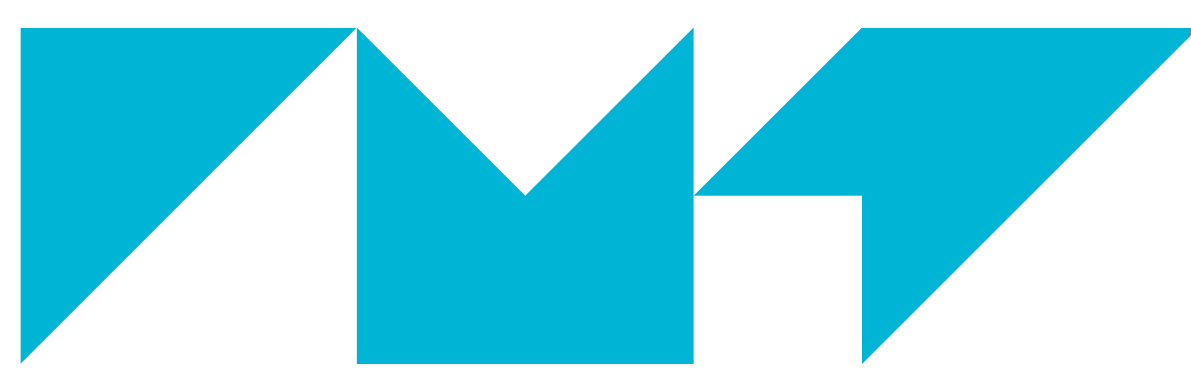
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MICRO 2024
PLASTIC POLLUTION
FROM MACRO TO NANO
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INTERNATIONAL CONFERENCE

Prospective study on plastic waste in the soil of urban and rural areas of Hauts de France

Project



Dymitria

DYnamics of deposition and transfer of MicroplasTics in RIvers in a region subject to heavy urban and agricultural Anthropization

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Key words

Microplastics
Soil
Anthropization

Partners



Funders



Figure 1. Urban waste in Douai (France).

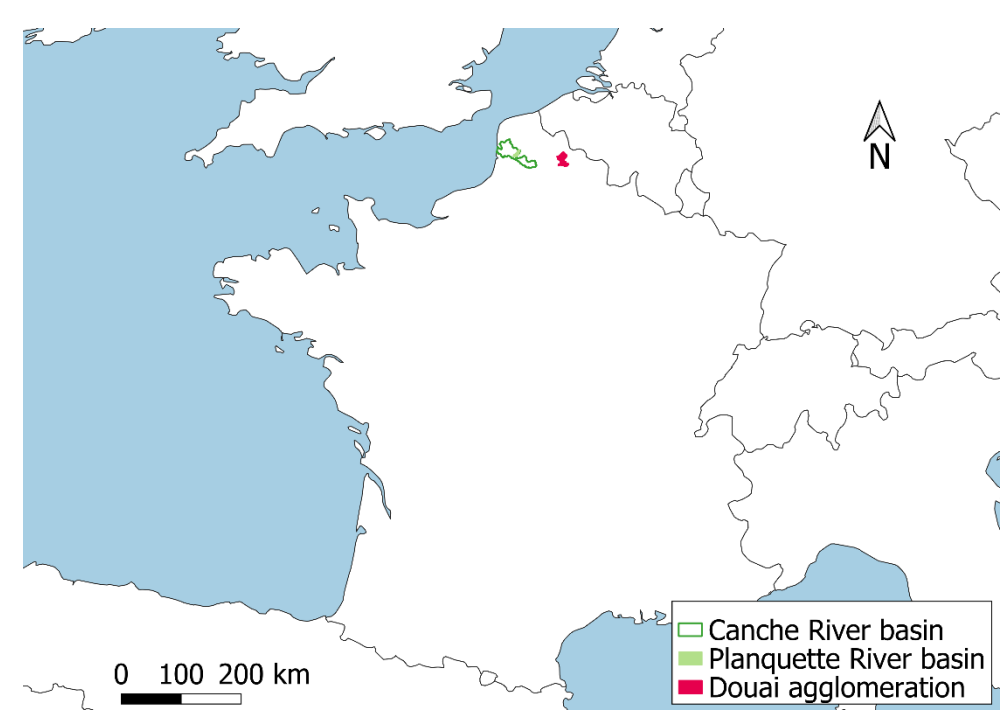


Figure 2. General map of France with the location of the watershed studied (red rectangle).

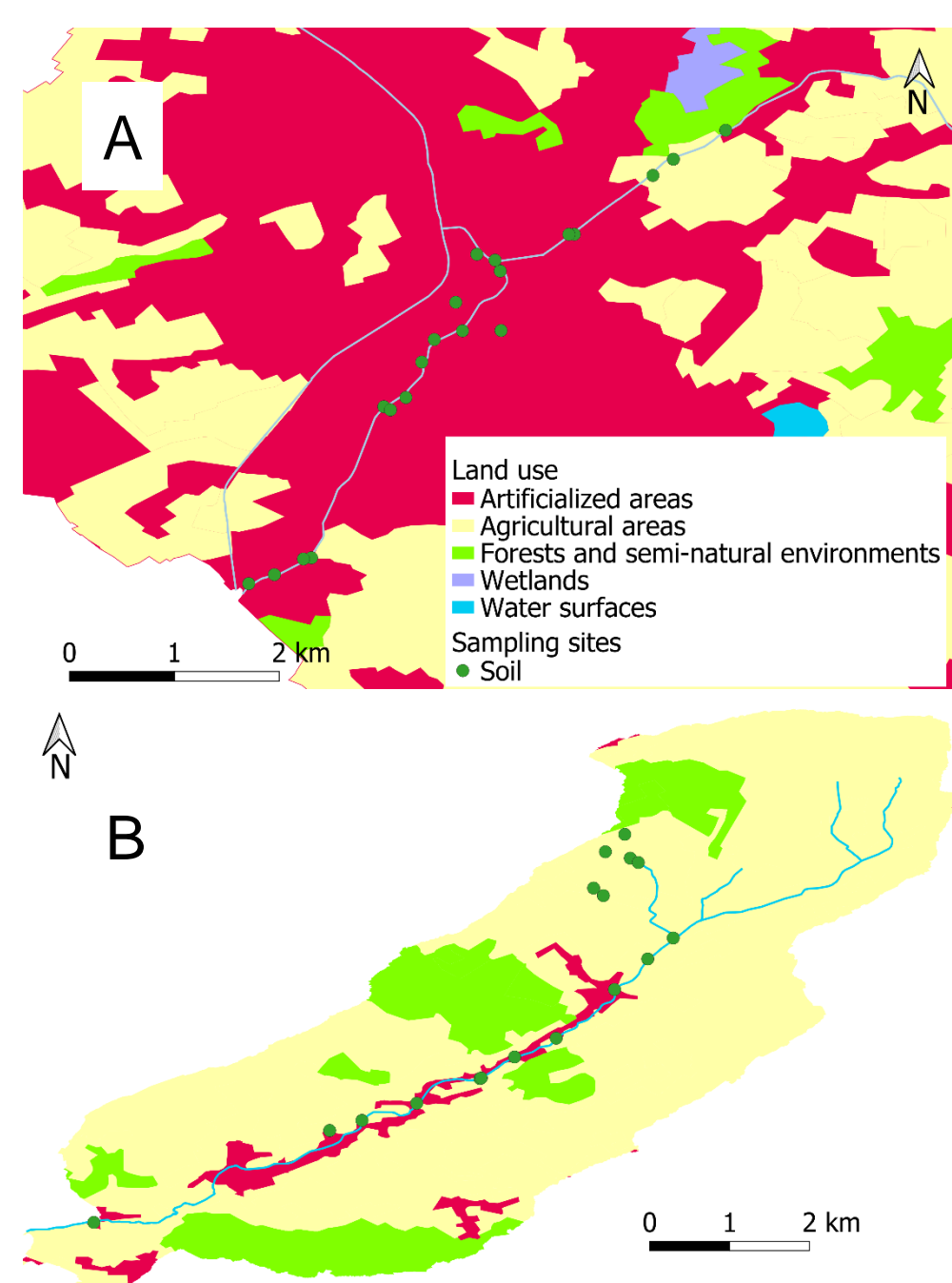


Figure 3. Sampling sites (circles) along the Scarpe River in the conurbation of Douai (A) and the Planquette River basin (B).



Figure 5. Picture of LMP.

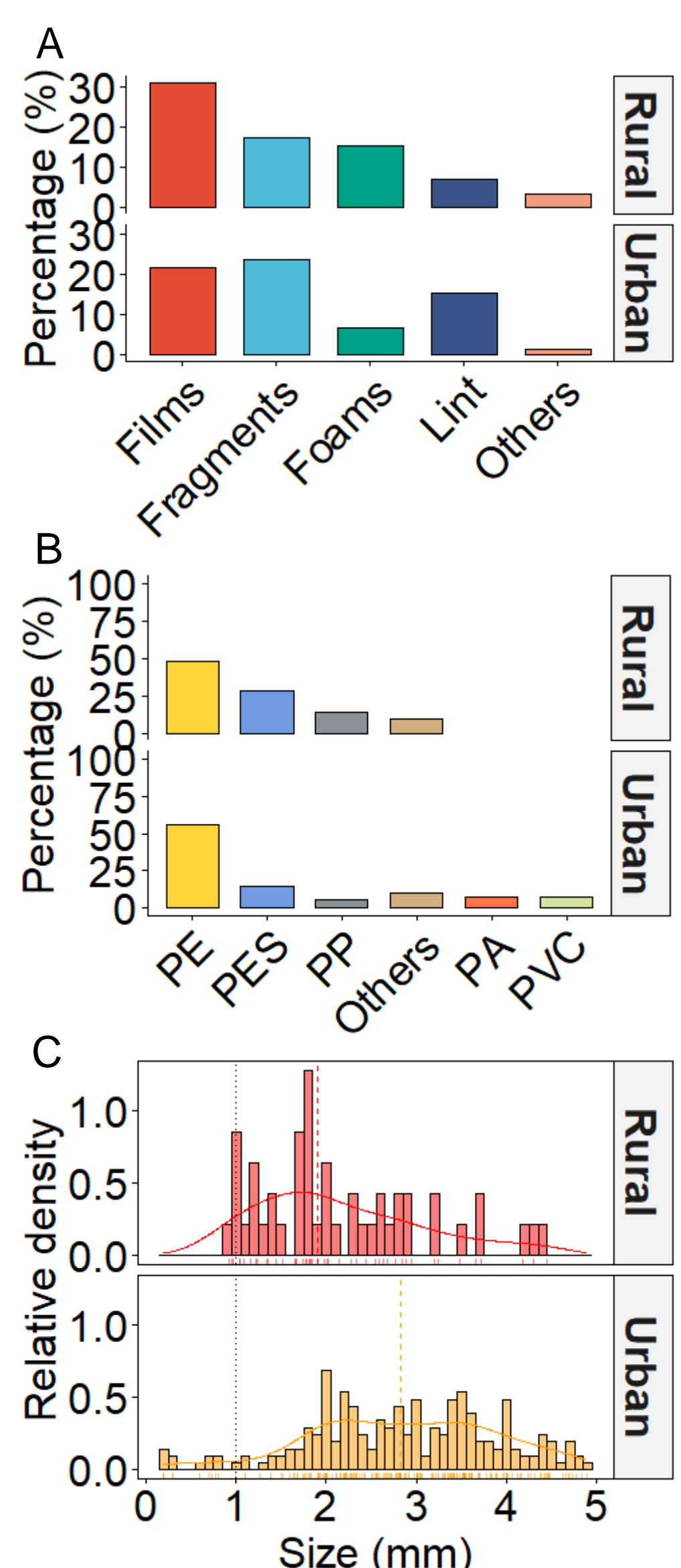


Figure 7. Shape (A), polymer (B) and size (C) of LMP found in the conurbation of Douai and the Planquette River basin.

Introduction

Plastic waste and its fragments (microplastics; MP <5 mm) represent a global, persistent and omnipresent threat to ecosystems (Fig. 1). Their sources, their transfers, their storage and then their fate are still poorly understood, particularly in soils.

Material and methods

Study area and sampling

37 sites with various land uses (farmland, pathway, roadside, park, etc.) were selected in the northern France (Fig. 2), 20 along the Scarpe canal in the Douai conurbation (urban area; Fig 3A) and 17 along the Planquette River (rural area; Fig 3B). At each site, 10 soil samples were collected every 2 m along an 18 m line using a hand auger, cut to keep the 0-5 cm depth (Fig 4A) and pooled to create one composite sample.

Sample processing and analysis

Samples were wet sieved at 5 and 1 mm (Fig. 4B) to collect large microplastics (LMP; 1-5 mm; Fig. 5), mesoplastics (MeP; 5-25 mm) and macroplastics (MaP; >25 mm). Particles extracted under dissecting stereomicroscope (Fig. 4C) were analyzed by attenuated total reflectance Fourier transform infrared spectroscopy (Fig. 4D).

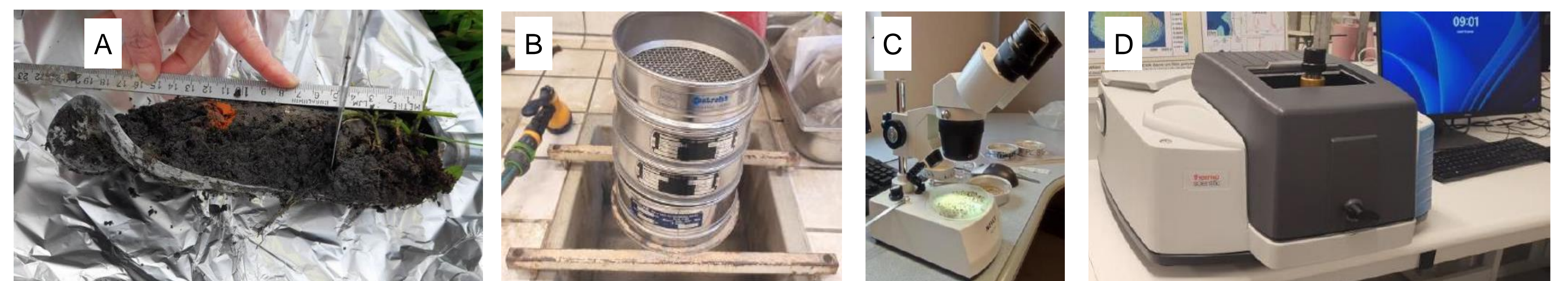


Figure 4. Sampling, processing and analysis. A) Hand auger. B) Wet sieving. C) stereomicroscope. D) FTIR spectrometer.

Results

Concentrations

Preliminary results indicate that 35 of the 37 sites are contaminated with LMP, with concentrations up to more than 80 LMP/kg or 4000 LMP/m². Urban sites have concentrations on average 5 times greater than rural sites (Fig. 6A).

Shape, polymers and size

For both basin, more than half of the LMP observed are polyethylene films and fragments (Fig. 7A and B). However size distribution were more uniform in the urban than in the rural area (Fig. 7C).

Distribution along the rivers

In the rural area, LMP concentrations were rather stable and low, with the exception of one site (Fig. 6B). This site is a deposition zone for eroded soil. In the urban area, LMP concentrations were higher on pathways bordering the city than in the center of the city (Fig. 6C).

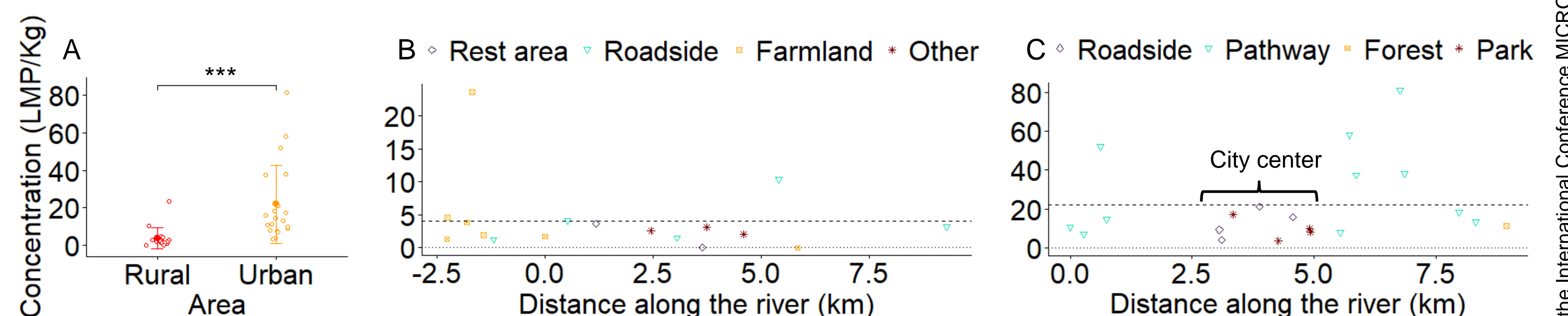


Figure 6. LMP concentrations per kg of the dry soil (LMP/kg). A) Mean concentrations for both sites; Large solid circles and bars represent the means and standard deviation from the mean, respectively; Open circles represent concentrations at all individual sites; ***: Very highly significant (p -value < 0.001; Wilcoxon test). B,C) Concentrations along the Scarpe River in the conurbation of Douai (B) and the Planquette River basin (C); Negative distances indicate sites located in a sub-basin upstream of the river; Dashed lines indicate mean concentrations.

Conclusions

- 35/37 contaminated sites.
- >50% PE films and fragments.
- Rural area: accumulation in areas of eroded soil deposits.
- Perspective:
 - small MP (0.05-1 mm): ~10³ SMP/kg (to be confirmed).
- Urban area: less contaminated sites in the city centers: more rubbish collection?