



MINING AND METALLURGY INSTITUTE BOR
and
TECHNICAL FACULTY IN BOR, UNIVERSITY OF BELGRADE



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International October Conference

**57th International October Conference
on Mining and Metallurgy**

PROCEEDINGS

Editor:
Ana Kostov

05 - 07 October 2026
Bor Lake, Serbia





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CURRENT TRENDS IN ATMOSPHERIC MICROPLASTICS RESEARCH

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Abstract

Atmospheric microplastics (MPs) are widely distributed across diverse environments. Urban areas exhibit the highest concentrations and deposition fluxes due to emissions from traffic, industry, and other anthropogenic activities. Remote regions also contain microplastics, highlighting their long-range atmospheric transport and persistence. Fibers and fragments, mainly composed of polyethylene (PE), polypropylene (PP), polyethylene terephthalate (PET), polyamide (PA), polystyrene (PS), and tire wear particles (TWP), are the predominant forms of atmospheric MPs. Western European countries lead global scientific publication output, whereas studies in the Republic of Serbia remain scarce, highlighting the need for enhanced monitoring and research on MPs occurrences, impacts, and mitigation strategies.

Keywords: atmospheric microplastics, MPs, air pollution.

1. INTRODUCTION

Environmental pollution with plastic has emerged as a global concern, as its degradation leads to the formation of microplastics (MPs) (0.1–5,000 µm) and nanoplastics (NPs) (1–100 nm), environmental pollutants found in nearly every environmental compartment on Earth [1–4]. Microplastics are classified as primary, intentionally manufactured in microscopic sizes (e.g., cosmetic and cleaning products), or secondary, generated by fragmentation of larger plastic items [5,6]. Based on their morphology, microplastics occur in various forms, including fibres, fragments, films, foams, and pellets [7]. The polymer composition of microplastics depends on their source, with polyethylene terephthalate (PET), epoxy resin (EP), polyethylene (PE), and alkyd resin (ALK) among the most identified polymers [8]. Huang et al. [9] found that transparent/white was the most frequently observed colour (39.8%) of MPs, followed by blue (28.7%), red (13.3%), and green (10.1%). Atmospheric microplastics are continuously transported between environmental compartments, facilitating their transfer into food chains and subsequently into the human body through inhalation and consumption of contaminated food and water [6]. Plants act as a temporary sink for microplastics, retaining airborne particles before they are transferred to terrestrial and aquatic environments [10]. Microplastics, because of their small particle size and large

specific surface area, can also act as carriers of co-contaminants (microorganisms, persistent organic pollutants, metalloids and heavy metals, and chemical additives) [11,12]. Among all the environmental compartments affected by MPs, the atmosphere remains the least well-known [13]. This review provides an overview of recent advances in atmospheric microplastics research, highlighting current trends as well as the importance of their detection and characterization in the atmosphere.

2. MICROPLASTICS SOURCES AND TRANSPORT IN THE ATMOSPHERE

Terrestrial sources, such as packaging waste, construction materials, household products, wastewater sludge, cosmetics, and industrial activities, are major contributors to atmospheric microplastics, accounting for 80–90% of environmental microplastic inputs. Marine sources include shipping, fishing equipment, and coastal tourism [7]. Atmospheric particles are transported horizontally by wind and vertically under the influence of turbulence before being removed by wet or dry deposition. Microplastics remain airborne for between 1 h and 6.5 days. Several atmospheric transport models are used to simulate microplastics movement [14]. The HYSPLIT (Hybrid Single-Particle Lagrangian Integrated Trajectory) model tracks individual particles and predicts transport and deposition based on meteorological conditions. Simulations have shown that particle size and morphology are key factors governing atmospheric transport, with fibrous particles exhibiting greater dispersion ranges and wider deposition areas compared with spherical particles [15,16]. The FLEXPART (Flexible Particle dispersion model) model incorporates atmospheric transport processes, including turbulence, convection, and wet and dry deposition. Studies have demonstrated that fibrous particles settle more slowly than spherical particles of the same mass, enabling wider dispersion and longer-range transport [17]. The GEOS-Chem model (an open-access, global 3D model of atmospheric chemistry driven by meteorological data from NASA's Goddard Earth Observing System (GEOS)) uses a grid-based approach to simulate emissions, atmospheric transport, chemical transformations, and deposition on a global scale. Simulations indicate that terrestrial sources dominate global atmospheric microplastics emissions [18].

3. SAMPLING AND ANALYTICAL METHODS FOR ATMOSPHERIC MICROPLASTICS

Passive atmospheric deposition sampling and active sampling with pumped air systems, are two general methods used to collect airborne microplastics. Pretreatment depends on sample type and identification method, and includes sieving, digestion, density separation, filtration and drying, which aim to remove impurities, concentrate MPs and prepare them for subsequent analysis [10]. The measured characteristics of atmospheric microplastics include particle size distributions, shapes, colours, surface morphology and polymer compositions [19]. ZnCl_2 , NaCl or NaI are usually used for density separation of polymers. Sample treatment begins with digestion and selective removal of non-MP organic matter (OM) from sample particles using H_2O_2 , Fenton's reagent or NaOH. Stereomicroscopy provides information about morphology (shape, colour, size, clustering, and surface features). Fourier transform infrared (FTIR) spectroscopy or Raman spectroscopy (RS) are commonly employed to determine

polymer composition. The use of ATR-FTIR and μ -FTIR does not achieve polymer identification of particles $< 10 \mu\text{m}$, whereas μ -RS can provide polymer identification of MP up to $1 \mu\text{m}$ and can therefore be more useful [20,21]. Pyrolysis Gas Chromatography/Mass Spectrometry (Py-GC-MS) has been described as a method to quantify various polymers in airborne particles [5,22,23]. Laser direct infrared spectroscopy (LDIR) and thermochemical methods coupled with mass spectrometry are complementary analytical techniques, where LDIR provides physical and chemical profiling, while thermochemical techniques deliver bulk mass concentrations and molecular structural information [24].

4. LATEST FINDINGS ON ATMOSPHERIC MICROPLASTICS

A search of the Scopus database revealed a significant increase in the number of publications on airborne microplastics (keywords: microplastics, “air pollution”) beginning in 2018 (Figure 1), reaching 662 papers in 2025. This upward trend in publications reflects growing scientific awareness of the presence of microplastics in the atmosphere, due to their potentially harmful effects on the environment and human health. Most of these studies fall within the field of Environmental Sciences, followed by Medicine.

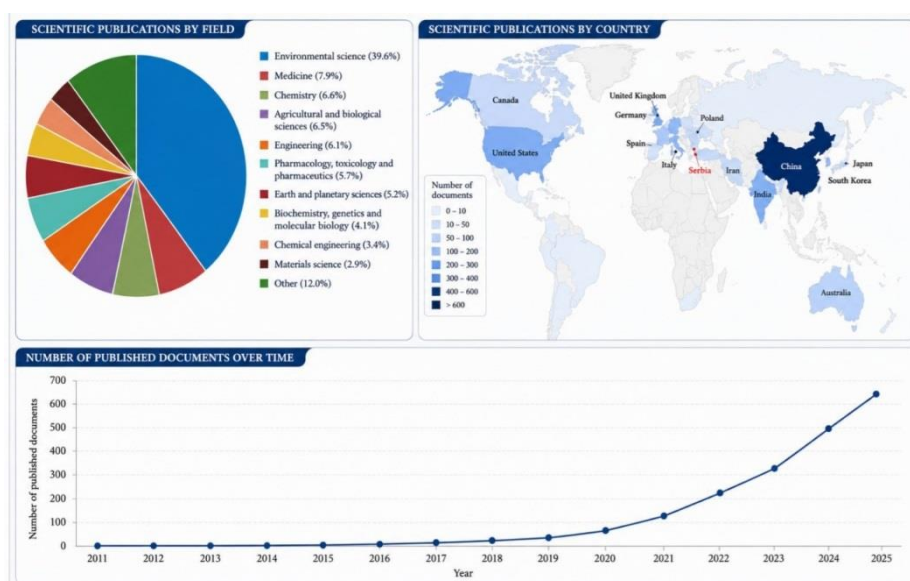


Figure 1. Scientific research trends about MPs in the air

Among the top fifteen countries, China leads in the number of research publications. The scarcity of scientific publications from the Republic of Serbia indicates the need for enhanced research initiatives and targeted funding to comprehensively assess the public awareness of the occurrence, distribution, and potential ecological impacts of microplastics on the environment.

Differences in reported atmospheric microplastic concentrations reflect variations in sampling methods, particle size ranges, reporting metrics, and analytical techniques [25]. Concentrations measured in ambient air have been reported to range from <1 to >1,000 particles m⁻³, while atmospheric deposition fluxes also show pronounced variability depending on geographical location, environmental characteristics, and prevailing meteorological conditions, and range from approximately 0.5 to 1,357 particles m⁻² day⁻¹ [26]. Based on the findings of Arfin and Nakhate [10], from 156 peer-reviewed papers published between 2000 and 2025, airborne MP concentrations ranging from 370 particles m⁻² day⁻¹ in the Pyrenees to 600 particles m⁻² day⁻¹ in urban areas of China. Crésio Targino et al. [27] concluded that the thermodynamic drivers of atmospheric mixing (temperature and pressure) may outweigh the mechanical influence of wind speed on MP concentrations. Table 1 summarizes the latest representative studies on airborne microplastics worldwide, including data about concentrations, deposition fluxes, polymer composition, and used analytical methods. It is noticeable that urban environments generally show the highest microplastic concentrations and deposition fluxes, while remote areas also contain atmospheric microplastics, demonstrating long-range transport and atmospheric persistence. Differences in analytical methods and reported units make direct comparison challenging, leading to the need for standardized monitoring approaches.

Table 1. Some recent findings about atmospheric microplastics

Zone	Concentration	Deposition fluxes	Composition	Method	Ref.
Remote (Norway)	up to ^a 1.3 ng m ⁻³	11.2 µg m ⁻² day ⁻¹	PP, TWP, PVC, PET, PMMA, PA, PS, PE	Py-GC/MS	[5]
Urban (Norway)	up to ^a 272 ng m ⁻³	676 µg m ⁻² day ⁻¹	TWP, PVC, PET, PC	Py-GC/MS	[5]
Urban (Nigeria)	^b 173,900–555,533 MP m ⁻³ ^c 121,730–388,873 MP m ⁻³	Not reported	PA, PET, PE, PVC, PP, PS, PC	FTIR	[28]
Urban (China)	Not reported	^a 51–178 particles m ⁻² day ⁻¹	PET, PAN, PA, PP	µ-FTIR	[9]
Urban (China)	^a 0.37–8.9 particles m ⁻³	^a 441.18–3181.8 particles m ⁻² day ⁻¹	TWP, PET	µ-Raman, SEM-EDS	[29]
Remote (New Zealand)	Not reported	^d 26 MP m ⁻² day ⁻¹	PET, PE, PTFE, PA, PIS, PI, PMMA, CP, PS	µ-FTIR	[30]
Urban (China)	^a 0.15 ± 0.08 items m ⁻³	^a 473.9±349.3 items m ⁻² d ⁻¹	RY, PA, PP, PE, PET	ATR-FTIR	[31]
Urban (India)	Not reported	^a 122.25±76.96 to 387±89.23 n m ⁻² d ⁻¹	PE, PVC, PET, PMMA, PS	FTIR	[32]
Traffic (southern Norway)	^e 5.0–26.3 counts day ⁻¹ ; 0.16–0.95 µg day ⁻¹	Not reported	PES, PA	µ-FTIR, Py-GC/MS	[33]
Residential (Brazil)	^f 1.26–37.13 n m ⁻³	Not reported	PA, PE, PVC	µ-FTIR	[27]
Industrial, traffic (Brazil)	^f 0.14–0.54 n m ⁻³	Not reported	PE, PA, PP	µ-FTIR	[27]

^aannual, ^bdry season, ^crainy season, ^daverage for four 7-day sampling periods, ^ea four-month period, ^feight-week period; PP-Polypropylene, TWP-Tire Wear Particles, PVC-Polyvinyl Chloride, PET-Polyethylene Terephthalate, PA-Polyamide (commonly known as Nylon), PS-Polystyrene, PE-Polyethylene, PC-Polycarbonate, PAN- polyacrylonitrile, PTFE-Polytetrafluoroethylene, PIS-Polyisoprene, PI-Polyimide, PMMA-Polymethyl Methacrylate, CP-Cellulose Propionate, RY-Rayon, PES-Polyester.

5. CONCLUSION

Conducted research confirms the presence of microplastics in the atmosphere across urban, rural, and remote areas, with concentrations varying according to geographical location, intensity and type of anthropogenic activities, meteorological conditions, and analytical methodologies. In the Republic of Serbia, studies on atmospheric microplastics remain scarce, compared with those conducted in Western Europe and other developed regions. Strengthening national research capacity is essential for generating scientific evidence for environmental monitoring, risk assessment, and the development of effective mitigation strategies. Particular attention should be given to industrially impacted areas, as microplastics can act as carriers for heavy metals and other pollutants. Advancing research and strengthening environmental governance are key steps for improving insights into its environmental dynamics, exposure pathways, and potential risks to ecosystems and human health.

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