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Atmospheric Microplastics as An Emerging Pollutant: A Bibliometric Analysis

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KEYWORDS

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ABSTRACT

Atmospheric microplastics are tiny plastic particles, typically less than 5 mm, suspended in the air. Identifying key publications, authors, and countries is crucial for regulatory decisions and standardizing methodologies. This study used bibliometric analysis through a Scopus analyzer to evaluate publication trends, analyzing 685 publications, mostly journal articles. The data shows a fluctuating but overall increasing trend in publications from 2015 to 2024, with China leading in the number of publications in this area.

1. INTRODUCTION

The widespread use of plastic products has significantly contributed to global environmental pollution despite the conveniences they provide in modern society [1].

Plastics are synthetic materials made from petrochemicals that can break down into smaller particles called microplastics, defined as particles smaller than 5 mm in size. This degradation can occur through various processes, including mechanical wear, exposure to sunlight (photodegradation), and biological breakdown [2]. These microplastics can infiltrate different parts of the environment, including land, water, and air systems.

Microplastics in the atmosphere primarily originate from the breakdown of larger plastic debris and the shedding of synthetic fibers from textiles and other products [3]. Research has identified various urban environments as significant sources of these pollutants, especially in densely populated areas [4]. For example, studies have revealed a high prevalence of polyester fibers in the atmosphere of urban locations such as Metro Manila and Paris, underscoring the impact of human activities on the generation of airborne microplastics [3]. Microplastics in the atmosphere result from direct emissions and involve atmospheric transport mechanisms that can carry these particles over long distances. Evidence shows that microplastics can even be found in remote regions far from their source [5].

The atmospheric transport of microplastics is facilitated by their physical characteristics, such as size and shape. Fibers and thin films, a significant portion of atmospheric microplastics, have large surface area-to-volume ratios that enhance their dispersal in the air [6]. This transport can lead to the deposition of microplastics in various ecosystems, including aquatic environments, where they can contribute to marine pollution [7]. Studies have shown that atmospheric microplastics can be a substantial source of ocean microplastic contamination, with significant implications for marine life and ecosystems [8].

Recently, there has been a growing global emerging concern about microplastic contamination [9]. Microplastics pose a significant environmental threat due to their potential to contaminate ecosystems, impact organisms, and enter the food chain, including humans [10]. Research on microplastics and their impact is necessary to understand microplastic pollution's environmental and human health effects [11].

This study conducted a bibliometric analysis to investigate the current understanding of atmospheric microplastics and identify key topics and research trends through network analysis, aiming to improve the comprehension of studies on atmospheric microplastics.

2. EXPERIMENTAL PROCEDURE

The study employed a systematic approach to identify the search terms for retrieving articles. The study commenced by gathering 685 articles online and querying the Scopus database for all publications related to atmospheric microplastics and pollution as of May 14, 2024. The following search strategy was employed: TS = TITLE-ABS-KEY (atmospheric AND microplastic* AND pollut*). The search was conducted from 2015 to 2024, including all relevant references to these topics. Search terms were limited to studies published in English. Bibliometric analysis was conducted using refinements from Tables 1.

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Table 1 The search string

Scopus	TITLE-ABS-KEY (atmospheric AND microplastic* AND pollut*)

3. RESULTS AND DISCUSSION

The bibliometric analysis of documents indexed in Scopus reveals significant insights into the global research output on atmospheric microplastics. The distribution of publications by country or territory indicates distinct research focus and productivity trends. The chart in Figure 1 displays the number of documents published by various countries or regions.

China is the leading contributor to the understanding of atmospheric microplastics, with over 250 published documents. This is due to its rapid industrialization, increasing environmental awareness, and substantial investment in environmental sciences, supported by a vast network of academic institutions and researchers.

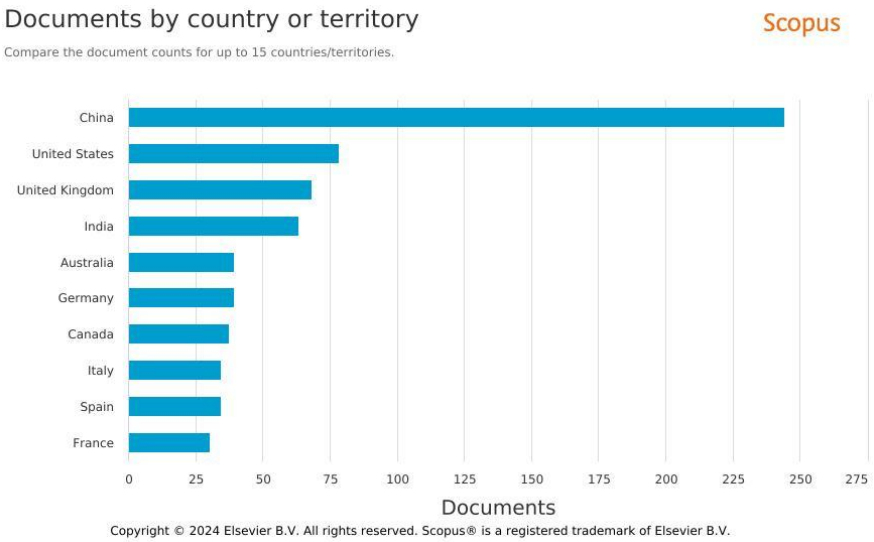

Figure 1. The ten countries with the highest articles published yearly.

The United States ranks second in publications, with many exceeding 100. As a leader in scientific innovation, the U.S. addresses environmental challenges like microplastic pollution, supported by top research institutions and funding agencies that promote multidisciplinary approaches.

The United Kingdom ranks third, producing nearly 75 research documents. Its focus on environmental sustainability and pollution mitigation has significantly advanced studies on atmospheric microplastics, with strong collaboration among academic institutions, government agencies, and international organizations.

India and Australia are taking important steps to tackle microplastic pollution, acknowledging its significance as an environmental issue. India's developing academic infrastructure and increased awareness of pollution's health effects are enhancing research efforts. In Australia, a focus on understanding microplastic pollution within its unique ecosystems reflects its commitment to environmental conservation.

Germany, Italy, Spain, and France significantly contribute to research on atmospheric microplastics. Germany is a leader in high-quality environmental science, while France, Spain, and Italy are also notable for their commitment to addressing pollution through their scientific communities.

Canada ranks alongside European nations in its comprehensive approach to environmental research. Its active participation in global initiatives and focus on Arctic microplastic pollution have shaped its research priorities.

The global distribution of publications highlights the collaboration of developed and developing nations in addressing atmospheric microplastics. It underscores the need for international cooperation, with research-rich countries often having advanced scientific infrastructure and funding for environmental science.

The uneven research output among countries highlights the need for greater global involvement, especially from underrepresented regions. Promoting collaboration, building capacity, and sharing knowledge can enhance research on atmospheric microplastics and their global effects.

4. CONCLUSION

A bibliometric analysis of atmospheric microplastics and emerging pollution was conducted using the Scopus database from 2015 to 2024. The study showed a steady increase in publications, with China emerging as a critical contributor across various fields, including environmental and marine science.

Although research mainly focuses on the aquatic environment, there is a need for more studies on atmospheric microplastics. This research highlights essential areas and future directions, encouraging international collaboration and knowledge exchange.

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