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Microplastics in Urban Environment – Coimbra City Case Study

Authors : Inês Amorim Leitão, Loes van Shaick, António Dinis Ferreira, Violette Geissen

Abstract : Plastic pollution is a growing concern worldwide: plastics are commercialized in large quantities and it takes a long time for them to degrade. When in the environment, plastic is fragmented into microplastics (<5mm), which have been found in all environmental compartments at different locations. Microplastics contribute to the environmental pollution in water, air and soil and are linked to human health problems. The progressive increase of population living in cities led to the aggravation of the pollution problem worldwide, especially in urban environments. Urban areas represent a strong source of pollution, through the roads, industrial production, wastewater, landfills, etc. It is expected that pollutants such as microplastics are transported diffusely from the sources through different pathways such as wind and rain. Therefore, it is very complex to quantify, control and treat these pollutants, designated current problematic issues by the European Commission. Green areas are pointed out by experts as natural filters for contaminants in cities, through their capacity of retention by vegetation. These spaces have thus the capacity to control the load of pollutants transported. This study investigates the spatial distribution of microplastics in urban soils of different land uses, their transport through atmospheric deposition, wind erosion, runoff and streams, as well as their deposition in vegetation like grass and tree leaves in urban environment. Coimbra, a medium large city located in the central Portugal, is the case-study. All the soil, sediments, water and vegetation samples were collected in Coimbra and were later analyzed in the Wageningen University & Research laboratory. Microplastics were extracted through the density separation using Sodium Phosphate as solution (~1.4 g cm−3) and filtration methods, visualized under a stereo microscope and identified using the u-FTIR method. Microplastic particles were found in all the different samples. In terms of soils, higher concentrations of microplastics were found in green parks, followed by landfills and industrial places, and the lowest concentrations in forests and pasture land-uses. Atmospheric deposition and streams after rainfall events seems to represent the strongest pathways of microplastics. Tree leaves can retain microplastics on their surfaces. Small leaves such as needle leaves seem to present higher amounts of microplastics per leaf area than bigger leaves. Rainfall episodes seem to reduce the concentration of microplastics on leaves surface, which suggests the wash of microplastics down to lower levels of the tree or to the soil. When in soil, different types of microplastics could be transported to the atmosphere through wind erosion. Grass seems to present high concentrations of microplastics, and the enlargement of the grass cover leads to a reduction of the amount of microplastics in soil, but also of the microplastics moved from the ground to the atmosphere by wind erosion. This study proof that vegetation can help to control the transport and dispersion of microplastics. In order to control the entry and the concentration of microplastics in the environment, especially in cities, it is essential to defining and evaluating nature-based land-use scenarios, considering the role of green urban areas in filtering small particles.

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