A simplified model for size and shape of microplastics in soil: implications for risk assessment and particle measurement

Isabel Reinhardt[1], Uwe Schnepf*†[1], and Franz Brümmer[1]

[1]University of Stuttgart, Institute of Biomaterials and Biomolecular Systems, Research Unit Biodiversity and Scientific Diving – Pfaffenwaldring 57, 70569 Stuttgart, Germany

Abstract

Microplastics (plastic particles < 5 mm, MP) have become known mainly for their impact on aquatic ecosystems. In contrast, microplastic exposure in soil and potential effects on edaphon have been examined only recently. Unfortunately, probabilistic risk assessment and fate modelling is so far hindered by the lack of continuous representations of size and shape. Hence, the aim of this work was to simplify these properties of microplastics in soil using probability density distributions. To parametrize them, a literature survey was done. In total, 28 studies were found to be eligible, from which empirical data was extracted. Nonetheless, we were unable to obtain a particle size distribution for microplastics in soil, because sufficient data for modeling was only found in 14 % of the included studies. They showed that frequency either decreased or increased with particle size, resulting in a regression coefficient between -1.33 and 1.10, depending on sampling site. This finding questions whether particle size of microplastics in agricultural topsoils follows a power law, which is the case for microplastics in aquatic environments. The shape of microplastics was predominantly classified as fibers, that had a proportion of 40 %, followed by 23 % irregular particles, 15 % films, 4 % pellets, and 3 % foams. From this, Corey's shape factor was derived, that followed a with a bimodal-like mixture of two normal distributions. Overall, this shape distribution was comparable to the one for microplastics in aquatic ecosystems, but with a higher amount of films, that most likely originated from mulch films used in agriculture. Altogether, our study can only provide preliminary model parameters for size and shape of microplastics in soil. To overcome this, open data on comprehensive measurements of individual plastic particles from all soil types around the world and from different layers is urgently needed.

Keywords: probability density distributions, risk assessment, particle size distribution, shape descriptors, particle measurment

*Speaker

†Corresponding author: uwe.schnepf@bio.uni-stuttgart.de