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Objective Assessment of the Evolution of Microplastic Contamination in Sediments from a Vast Coastal Area

Authors : Vanessa Morgado, Ricardo Bettencourt da Silva, Carla Palma

Abstract : The environmental pollution by microplastics is well recognized. Microplastics were already detected in various matrices from distinct environmental compartments worldwide, some from remote areas. Various methodologies and techniques have been used to determine microplastic in such matrices, for instance, sediment samples from the ocean bottom. In order to determine microplastics in a sediment matrix, the sample is typically sieved through a 5 mm mesh, digested to remove the organic matter, and density separated to isolate microplastics from the denser part of the sediment. The physical analysis of microplastic consists of visual analysis under a stereomicroscope to determine particle size, colour, and shape. The chemical analysis is performed by an infrared spectrometer coupled to a microscope (micro-FTIR), allowing to the identification of the chemical composition of microplastic, i.e., the type of polymer. Creating legislation and policies to control and manage (micro)plastic pollution is essential to protect the environment, namely the coastal areas. The regulation is defined from the known relevance and trends of the pollution type. This work discusses the assessment of contamination trends of a 700 km² oceanic area affected by contamination heterogeneity, sampling representativeness, and the uncertainty of the analysis of collected samples. The methodology developed consists of objectively identifying meaningful variations of microplastic contamination by the Monte Carlo simulation of all uncertainty sources. This work allowed us to unequivocally conclude that the contamination level of the studied area did not vary significantly between two consecutive years (2018 and 2019) and that PET microplastics are the major type of polymer. The comparison of contamination levels was performed for a 99% confidence level. The developed know-how is crucial for the objective and binding determination of microplastic contamination in relevant environmental compartments.

Keywords : measurement uncertainty, micro-ATR-FTIR, microplastics, ocean contamination, sampling uncertainty
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