



## **PAHs contamination in urban soils from Lisbon: spatial variability and potential risks**

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Polycyclic Aromatic hydrocarbons (PAHs) can become major contaminants in urban and industrial areas, due to the existence of a plethora of diffuse and point sources. Particularly diffuse pollution, which is normally characterized by continuous and long-term emission of contaminants below risk levels, can be a major problem in urban areas. Since PAHs are persistent and tend to accumulate in soils, levels are often above the recommended guidelines indicating that ecological functions of soils may be affected. Moreover, due to the lipophilic nature, hydrophobicity and low chemical and biological degradation rates of PAHs, which leads to their bioconcentration and bioamplification, they may reach toxicological relevant concentrations in organisms. The importance and interest of studying this group of contaminants is magnified due to their carcinogenic, mutagenic and endocrine disrupting effects.

In this study, a risk assessment framework has been followed in order to evaluate the potential hazards posed by the presence of PAHs in Lisbon urban soils. Hence, the first step consisted in screening the total concentrations of PAHs followed by the calculation of risks based on existing models. Considering these models several samples were identified as representing a potential risk when comparing with the guidelines for soil protection. Moreover, it was found that for 38% of samples more than 50% of species can be potentially affected by the mixture of PAHs. The use of geostatistical methods allowed to visualize the predicted distribution of PAHs in Lisbon area and identify the areas where possible risk to the environment are likely occurring

However, it is known that total concentration may not allow a direct prediction of environmental risk, since in general only a fraction of total concentration is available for partitioning between soil and solution and thus to be uptake or transformed by organisms (bioaccessible or bioavailable) or to be leached to groundwater. The reason is that once PAHs reach the soils, they can be incorporated into more stable solid phases over time, for instance, they can be retained in the organic phase, and this process known as aging, can be virtually irreversible. This phenomenon can be particularly relevant in urban soils since the highest levels are normally found in historical sites, suggesting a long-term accumulation as observed in the present study. The estimation of this fraction is traditionally performed by using bioassays (bioavailability), yet chemical methods can also be used (chemical availability). Following a higher tier of the risk assessment framework, some selected samples previously identified as representing a potential hazard were tested for their bioavailability (earthworm bioaccumulation assay, OECD test n° 317) and chemical availability (solid phase extraction with Tenax<sup>®</sup> and water). Results showed that in spite of the very high levels found in some samples, the risks can be negligible, since both the bioavailable and water soluble fractions were very low. The relationship between available fraction and soil properties is not clear, and differences observed between samples are probably related to the age of contamination since lower available fractions were observed in the most contaminated soils.