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Heavy metal exposure and risk charaterization of topsoils in urban playgrounds and parks (Hungary)

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Contamination in urban soils can directly pose significant human risks through oral ingestion, particle inhalation and dermal contact, especially in public spaces. Parks and playgrounds are green areas in cities where dwellers (mainly children and seniors) can spend their outside freetime, thus the highest possibility of the human and soil interaction can be presumed here. Therefore, in 2013, composite surface samples (0-5 cm, from 10-15 subsoil samples) were collected from 96 public parks and 89 playgrounds (around playing equipment) of main functional zones (downtown, housing estates, industrial, prestigious, commuting areas) of three Hungarian cities (Budapest, Szeged, Gyula) representing capital, regional city and local town. Pseudo total metal content (Mn, Ni, Pb, Zn, As, Cd, Cr, Cu, Ba, Co) and physical, chemical soil properties influencing metal mobility (artefact, mechanical soil type, carbonate, humus, pH(H2O), salt) were determined to evaluate impacts of various anthropogenic activities in functional zones on the studied soils; to give the environmental buffering capacity and to model human health risk of exposure pathways (by RISC 4.0) in the case of contaminated soils. Insignificant amount of artefact, neutral pH, high humus and carbonate content, mainly loamy and loamy-clay texture, low salt content can provide suitable buffering capacity for the studied soils. The type and spatial location of functional zones have not exerted considerable impact on variability of soil properties. Out of 189 analyzed areas, 36 have exceeded the threshold values regulated by Hungarian government (6/2009. (IV. 14) KvVM-EüM-FVM collective decree). Based on quantitative and qualitative evaluation of results, the identification of spatial patterns and the possible source of metal pollution have been carried out. In accordance with statistical analysis (correlation, cluster, factor analysis), we can explore relationship between metal concentrations and features of sample areas (e.g. age, location, height of surrounding buildings, landfill or/and soil replacement). In this study, factor analysis with special transformation is first application in soil science during which the mutual influence of metals is investigated. In order to gain information on significance of the distance from busy roads in soil contamination weighted vehicle unit was applied. Assessing human health risk of the contaminated soils, the highest human health risk quotient (HRQ) can be detected in town Gyula sampling areas of which there has not been soil replacement and reconstruction opposite to larger cities as yet. Contributing to a more accurate health risk assessment of the soils in recreation areas of cities, our results may support a safer and sustainable urban green area.

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