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Distribution of Toxic Elements in Soils Worldwide: A Multivariate Statistical Approach

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The high variability of the heavy metals soil concentrations obtained at various sampling sites requires a careful evaluation and interpretation. The multivariate statistical approaches such as principal component analysis (PCA) seem to deliver more information on links among sampling sites, pollutant concentrations, correlation patterns and latent factors responsible for the data set structure. In this work PCA was performed on data matrices consisted of information on heavy metals presence in soils and soil characteristics gathered from the relevant published data in order to clarify the soil distribution patterns of these compounds, and also to evaluate their spatial distribution. Data concerning the heavy metal presence in Serbian soils from urban and arable zones have been also included. Similar studies regarding the occurrence of polycyclic aromatic hydrocarbons and organochlorine compounds in soils worldwide have been carried out recently [1,2,3], proving that PCA could be a very useful task for the interpretation of large sets of data.

Two groups of data were analyzed by PCA in order: a) to investigate correlation between the heavy metal loads of soil and soil characteristics, and b) to reveal heavy metal - soil patterns worldwide. Thus, previously assayed results on content of heavy metals (such as Zn, Cu, Fe, Pb, Mn, etc.) in soil samples are taken as variables (column of the input matrix) and various sites throughout the world occurring both in areas without direct pollution sources and the ones affected by industrial activities as mathematical – statistical cases (rows of the matrix). Soil characteristics such as percentage of clay, organic matter content, the acidity (pH), etc. were also included in

the input matrix as variables, for these parameters are known to affect both the current concentrations in the soil system and possible adsorption. In order that certain variables do not dominate the solution, PCA is carried out on the correlation matrices of the data. The Statistica for Windows program package (version 5.0, Tulsa, Oklahoma, USA) was used for PCA.

PCA classified the soil samples worldwide according to their element contents finding out their regional variability. Loading values suggested the correlation between the levels of certain elements and soil characteristics, revealing the underlying structure of analyzed data.

References

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