



Assessment of heavy metals pollution using multivariate statistical analysis methods in Wadi El Bey (Tunisia)

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ABSTRACT

Heavy metal pollution is a major environmental problem worldwide because of the longstanding toxicity and bioaccumulation of metals. The risk is pronounced in the environment adjacent to large industrial complexes and cities historically located along rivers. The aim of this paper was the application of multivariate statistical techniques: cluster analysis (CA), principal component analysis (PCA), and discriminant analysis (DA) to evaluate spatial and temporal variations of the heavy metals fraction of Pb, Cu, Zn, Fe, Ni, Cr, and Al during monitoring of surface water of Wadi El Bey in northern part of Tunisia. Water samples were collected seasonally from 13 sites along the Wadi during 2 years (2012–2013). Results indicated that the concentrations and distribution of heavy metals appear to be largely controlled by natural processes, anthropogenic activities, and climatic conditions. CA classified the sampling sites into three clusters: Lowly Polluted sites “LP” (S2, S3 and S6–S11), Moderately Polluted sites “MP” (S4 and S5), and Highly Polluted Site “HP” (S1) based on similarities of water quality characteristics. PCA applied to the data-sets indicated that the total variance of water quality in the HP, MP, and LP sites were about 94.91, 91.06, and 80.14%, respectively. DA results seem to identify Cu, Fe, Zn, and Al as the most significant parameters for discrimination between seasons; whereas, Pb, Cu, Ni, Cr, and Al were the most significant parameters used to control the spatial variation. Thus, DA allowed reduction in dimensionality of the large data-set, delineating a few indicator parameters responsible for large variations in water quality. This study presents necessity and usefulness of multivariate statistical techniques for evaluation and interpretation of large complex data-sets with a view to get better information about the water quality and design of monitoring network for effective management of water resources.

Keywords: Heavy metals; Multivariate analysis; Tunisia; Wadi El Bey; Water quality

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