Multivariate statistical and geostatistical techniques for assessing groundwater salinization in Sfax, a coastal region of eastern Tunisia

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ABSTRACT

In this study, we investigate the ability to combine a multivariate statistical analysis with the cokriging method to point out the groundwater salinization in the coastal Sfax aquifer (eastern Tunisia). First, multivariate statistical analysis such as principal component analysis (PCA) and cluster analysis were performed on 75 water samples. PCA identifies three main processes influencing groundwater chemistry which are seawater intrusion, water–rock interaction, and contamination by nitrates, these three factors accounted for 76% of total variance of the groundwater. Furthermore, cokriging is applied to take into account spatial dependence between the studied variables. Five variables were processed: concentration of sulfates, chlorides, sodium and the sodium adsorption ratio, as primary variables, and the more numerous data for total dissolved solid, as auxiliary variables. The generated spatial variability maps highlighted the high-risk zone of groundwater contamination of the superficial aquifer of Sfax. The effectiveness of the high estimation capability of the cokriging is demonstrated by cross-validation. Compared with ordinary kriging for a single variable, cokriging can provide an improvement of the uncertainty in terms of reducing the mean-squared error and mean error.

Keywords: Groundwater quality; Principal component analysis; Cluster analysis; Geostatistics; Cokriging; Cross-validation.

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