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Soil pollution: a compositional baseline approach in Langreo, Spain.

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Abstract

The complex geochemical behavior associated to the spatial distribution of potentially toxic elements (PTE) in soils can affect ecosystems and/or human health. However, before considering the measurement of soil pollution, there is a need to understand what is meant by pollution-free soil. In many cases, this context, or the basis of pollution, is not defined or only partially known. Since the concentration of the chemical elements is compositional, as the attributes vary together, a new approach is introduced aiming at the construction of compositional indicators based on the principles of Compositional Data Analysis (CoDa). The steps of this new methodology are: 1) Exploratory data analysis through variation matrix, biplots, or CoDa dendrograms; 2) Selection of geological background in terms of a trimmed subsample that can be assumed as non-polluted; 3) Computing the Aitchison distance from each sample point to the trimmed sample; 4) Finding a compositional balance able to predict the Aitchison distance computed in step 3. The identification of a compositional balance, including pollutants and non-polluting elements, with sparse and simple properties, is crucial for building a Compositional Pollution Index (CI). A 150 soil samples dataset, from the contaminated region of Langreo, northwest Spain, corresponding to 37 chemical elements was used as a pilot survey. As a first approach, three CIs were obtained. The corresponding spatial distribution was computed using Gaussian sequential stochastic simulation. The results of the 100 obtained scenarios are summarized through mean image maps and probability maps of exceeding a given threshold. The characterization of the spatial distribution and variability of the CIs allowed a better understanding of relative enrichment patterns and the fate of PTEs.

Key words: PTE, Compositional indicators, Sequential Gaussian Simulation