EGU21-9663, updated on 04 Mar 2021
https://doi.org/10.5194/egusphere-egu21-9663
EGU General Assembly 2021

Soil pollution indexes through the assessment of a compositional baseline - the Langreo case study, Spain

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When considering complex scenarios, such as in environmental characterization, where a multiset of attributes must be considered, a dimensional reduction of the problem is mandatory for a clear apprehension of the reality. Maps, broadly mentioned in the literature, are great for spatial pattern

visualization of pollutant's concentration distribution, or to assign areas of contamination enrichment, either if natural or triggered by anthropogenic activities. In the present study, a set of 15 Potentially Toxic Elements - PTEs - (As, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Tl, V, and Zn) were analyzed in soils gathered in the Langreo area (80 Km2) —Asturias, Spain— and used (a) to analyze how high concentrations in PTEs are spatially distributed and (b) to explore dissemination trends and the definition of clusters of relative enrichment. To quantify soil pollution, it is important to understand what is meant by pollution-free soil. Often, this background, or pollution baseline, is undefined or only partially known. Given that the concentration of chemical elements is compositional, as the attributes vary together, our approach is based on compositional principles. Finding a balance of pollutant (numerator) over non-pollutant (denominator) elements, aiming sparsity and simplicity as properties, is the key issue for the construction of a Compositional Pollution Index, and two approaches have been explored: (1) taking into account the whole observed composition, and (2) taking into account only a subcomposition, based on expert knowledge, in which the reported elements are: Na, K, Ca, Al, Mg, Fe, Cu, Pb, Zn, As, Sb, Hg. In all tested cases, Sb, Pb, and Hg appear in the numerator of the balance, and K, Al, and Zn in the denominator. A conclusion could be that the overall pollution in the Langreo region is dominated by the content of Sb, Pb, and Hg, relative to the content of K, Al, and Zn. Finally, both indexes went through a stochastic sequential Gaussian simulation. The spatial characterization allowed a broad discussion about not only the concentrations' spatial distribution and associated uncertainty, but also a better understanding of the possibility of trends of relative enrichment and insight in PTEs fate.

How to cite: Albuquerque, T., Boente, C., R. Gallego, J. L., Egozcue, J. J., and Pawlowsky, V.: Soil pollution indexes through the assessment of a compositional baseline - the Langreo case study, Spain, EGU General Assembly 2021, online, 19–30 Apr 2021, EGU21-9663, https://doi.org/10.5194/egusphere-egu21-9663,