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# Multifractal and joint multifractal analysis of soil micronutrients extracted with two different solutions along a transect

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We studied the scaling heterogeneity and multiple scale relationships of soil micronutrients measured along a transect using multifractal and joint multifractal techniques. Availability of Fe, Mn, Cu and Zn was analysed after extraction with two different solutions, namely DTPA and Mehlich-3 on a coarse textured Orthic Podsol located at Pernambuco State, Brazil. Soil samples were collected down to 0.20 m depth at equal intervals of 3 m along a 132 transect Nutrient content along the studied transect showed anomalies which were accompanied by singularities. This spatial variability pattern was demonstrated to be driven by both, natural causes, such as parent material and topography as well as by soil use and management. The spatial distribution of all the analysed micronutrients showed multifractal behaviour. The single multifractal spectrum also captured the detailed singularity strength of anomalies in the data sets studied. In general, available micronutrients showed higher scaling heterogeneity than general soil properties. Moreover the degree of multifractality, depended on both, the extracting solution and the element studied. Next the joint multifractal analysis was used to analyse i) the relationships among soil microelementts across the spatial scales superimposed on the sample transect and ii) the relationship between microelement concentrations extracted by DTPA and Mehlich-3 at this superimposed scales. Summarizing, the single multifractal spectrum captured the detailed singularity strength of anomalies in available Fe, Mn, Cu and Zn data extracted by two different methods. The joint multifractal spectra also captured the relationships between trace element concentrations measured by two different extraction solutions, namely DTPA and Mehlich-3 across a wider range of spatial scale and over the full range of data values, and provide insight to compare both methods incorporating the scaling relationships between them.
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