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Multiscale Analysis of Soil Porosity from Hg Injection Curves in Soils from Minas Gerais, Brazil

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The soil pore space is a continuum extremely variable in size, including structures smaller than nanometres and as large as macropores or cracks with millimetres or even centimetres size. Pore size distributions (PSDs) affects important soil functions, such as transmission and storage of water, and root growth. Direct and indirect measurements of PSDs are currently used to characterize soil structure. Mercury injection porosimetry is useful for assessing equivalent pore size diameters in the range from about 0,5 nm to 100 μm. Here, the multifractal formalism was employed to describe Hg injection curves measured in duplicate samples collected on 54 horizons from 19 profiles in Minas Gerais state, Brazil. Ten of the studied profiles were classified as Ferralsols (Latosols, Oxisols). Besides these, other wide different soil groups were sampled, including Nitisol, Acrisol, Alisol, Luvisol, Planosol, Cambisol, Andosol and Leptosol. Clay content varied from 4 to 86% and pore volume in the range from 100 to 0.005 μm was between 5.52 a 53.76 $cm^3 100g^{-1}$. All the horizons taken on Ferralsols and Nitisols as well as in Bt argic horizons from Acrisol Alisol, Luvisol and Planosol clearly showed a bimodal pore size distribution. Pore volume in the range from 100 to 0.005 μm and microporosity (0,2-0.005 μm) showed a significant relationship with clay content an Al_2O_3. All the Hg injection data sets studied soil showed remarkably good scaling trends and could be fitted reasonably well with multifractal models. The capacity dimensions, D_0, was not significantly different from the Euclidean dimension. The entropy dimension, D_1, varied from 0.590 to 0.946 , whereas the Hölder exponent of order zero, $\alpha_0$was between 1.027 and 1.451, and these two parameters showed a lineal negatives relationship, as expected. The highest D_1 values, ranging from 0.913 to 0.980, were obtained for the Leptosol, whereas the lowest D_1 values, ranging from 0.641 to 0.766 corresponded to the Nitisol. This results reflect that most of the measure concentrated in a small size domain for the horizons sampled from the Nitisol, whereas for the Leptosol the measure was more evenly distributed. In general, multifractal indices have been found to be useful for assessing differences in pore size distributions of the studied soil types.