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Multiscale analysis of nitrogen adsorption and desorption isotherms in soils developed over sandstone and basic parent materials with contrasting texture

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Mono- and multifractal analysis of soil nitrogen adsorption isotherms (NAI) have been proven to be useful, allowing a better characterization of soil surface properties and soil porous system. Multiscale analysis of nitrogen desorption isotherms (NDI), which was less frequently performed, can also provide very valuable information. The multifractal theory was used to analyse both soil adsorption and desorption isotherms from soils developed over contrasting parent material and with different texture. We sampled 32 soil horizons from 6 soil profiles in neighbouring sites from São Paulo State, Brazil. Three of the profiles, developed over sandstone, were sandy loam or loamy, whereas the other three profiles, developed over weathered sediments or basic parent material, were clayey textured. Soil specific surface area (SSA) varied, from about 3.0 to 46 m^2 g^{-1}. Surface parameters showed a strong correlation with clay content, but they were not correlated with cation exchange capacity (CEC). The scaling properties of both nitrogen adsorption and desorption isotherms from all the studied soil horizons could be fitted reasonably well with multifractal models. Multifractal parameters from NAIs and NDIs showed great differences. The singularity spectra, f(α) of the desorption isotherms had an asymmetrically long left part and its asymmetry was in general higher compared with adsorption isotherms. Moreover, adsorption isotherms behaved like more clustered measures, showing lower entropy dimension, D_1, smaller correlation dimension, D_2, and higher heterogeneity than desorption isotherms. Differences in multifractal behaviour of NAIs and NDIs had been proven to be mainly related to the characteristics of the hysteretic loop measured at high relative pressures. Several multifractal parameters extracted from NAIs and NDIs also distinguished between sandy-loam and loam soils and clayey soils. Multifractal parameters calculated from NAIs and NDIs provide new insight to assess soil surface properties.