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Complexity of depth-dependent soil macroporosity from X-ray CT data

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It has been reported that the spatial records of soil properties exhibit a behaviour close to the so-called multifractal structures. Advanced visualisation techniques such as X-ray computed tomography (CT) are required to assess and characterise the multifractal behaviour of soil pore space. In this work we develop the multifractal description of soil porosity values as a function of depth with data from binary 2-D images from X-ray CT scans of 20 cm-long soil columns with diameters of 7.5 cm. The series of depth-dependent macroporosity values exhibited a well defined multifractal structure that was represented by the singularity and the Rényi spectra. The long range dependencies of these series was characterised using the Hurst exponent and the multifractal model. We obtained multifractal spectra that were consistent with multinomial multifractal measures where larger concentrations were less diverse but more common than the smaller ones. Models of pore space connectivity should incorporate a multifractal random structure compatible with this multinomial structure and the long range dependences that have being observed.