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Wavelet Based Multifractal Analysis of Field Scale Variability in Soil Water Retention

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Better understanding of spatial variability of soil hydraulic parameters and their relationships to other soil properties is essential to scale-up measured hydraulic parameters and to improve the predictive capacity of pedotransfer functions (PTFs). The objective of this study was to characterize scaling properties and persistency of the water retention parameters and soil physical properties. Soil texture, bulk density, organic carbon content, and parameters of the van Genuchten water retention function were determined on 128 soil cores from a 384-m transect with a sandy loam soil, located at Smeaton, SK, Canada. The wavelet transform modulus maxima, or WTMM, technique was used in the multifractal analysis. Results indicate that the fitted water retention parameters had higher small-scale variability and lower persistency than the measured soil physical properties. Of the three distinct scaling ranges identified, the middle region (8 to 128 m) had a multifractal type scaling. The generalized Hurst exponent indicated that the measured soil properties were more persistent than the fitted soil hydraulic parameters. The relationships observed here imply that soil physical properties are better predictors of the water retention values at larger spatial scales than at smaller scales.