Geophysical Research Abstracts
Vol. 16, EGU2014-16980, 2014
EGU General Assembly 2014

Mustiscaling Analysis applied to field Water Content through Distributed Fiber Optic Temperature sensing measurements

Javier Benitez Buelga (1), Leonor Rodriguez-Sinobas (1), Raul Sanchez (1), Maria Gil (1), Ana M. Tarquis (1,2)
(1) E.T.S. Ingenieros Agrónomos, Technical University of Madrid, Madrid, Spain (UPM), (2) CEIGRAM, ETSI Agrónomos, Ciudad Universitaria sn, 28040 Madrid, UPM.

Soils can be seen as the result of spatial variation operating over several scales. This observation points to "variability" as a key soil attribute that should be studied. Soil variability has often been considered to be composed of "functional" (explained) variations plus random fluctuations or noise. However, the distinction between these two components is scale dependent because increasing the scale of observation almost always reveals structure in the noise. Geostatistical methods and, more recently, multifractal/wavelet techniques have been used to characterize scaling and heterogeneity of soil properties among others coming from complexity science.

Multifractal formalism, first proposed by Mandelbrot (1982), is suitable for variables with self-similar distribution on a spatial domain (Kravchenko et al., 2002). Multifractal analysis can provide insight into spatial variability of crop or soil parameters (Vereecken et al., 2007). This technique has been used to characterize the scaling property of a variable measured along a transect as a mass distribution of a statistical measure on a spatial domain of the studied field (Zeleke and Si, 2004). To do this, it divides the transect into a number of self-similar segments. It identifies the differences among the subsets by using a wide range of statistical moments.

Wavelets were developed in the 1980s for signal processing, and later introduced to soil science by Lark and Webster (1999). The wavelet transform decomposes a series; whether this be a time series (Whitcher, 1998; Percival and Walden, 2000), or as in our case a series of measurements made along a transect; into components (wavelet coefficients) which describe local variation in the series at different scale (or frequency) intervals, giving up only some resolution in space (Lark et al., 2003, 2004). Wavelet coefficients can be used to estimate scale specific components of variation and correlation. This allows us to see which scales contribute most to signal variation, or to see at which scales signals are most correlated. This can give us an insight into the dominant processes

An alternative to both of the above methods has been described recently. Relative entropy and increments in relative entropy has been applied in soil images (Bird et al., 2006) and in soil transect data (Tarquis et al., 2008) to study scale effects localized in scale and provide the information that is complementary to the information about scale dependencies found across a range of scales. We will use them in this work to describe the spatial scaling properties of a set of field water content data measured in an extension of a corn field, in a plot of 500 m^2 and an spatial resolution of 25 cm. These measurements are based on an optics cable (BruggSteal) buried on a ziz-zag deployment at 30cm depth.

References

Bird, N., M.C. Díaz, A. Saa, and A.M. Tarquis. 2006. A review of fractal and multifractal analysis of soil pore-scale images. J. Hydrol. 322:211–219.

Kravchenko, A.N., R. Omonode, G.A. Bollero, and D.G. Bullock. 2002. Quantitative mapping of soil drainage classes using topographical data and soil electrical conductivity. Soil Sci. Soc. Am. J. 66:235–243.

Lark, R.M., A.E. Milne, T.M. Addiscott, K.W.T. Goulding, C.P. Webster, and S. O'Flaherty. 2004. Scale- and location-dependent correlation of nitrous oxide emissions with soil properties: An analysis using wavelets. Eur. J. Soil Sci. 55:611–627.

Lark, R.M., S.R. Kaffka, and D.L. Corwin. 2003. Multiresolution analysis of data on electrical conductivity of soil using wavelets. J. Hydrol. 272:276–290.

Lark, R. M. and Webster, R. 1999. Analysis and elucidation of soil variation using wavelets. European J. of Soil Science, 50(2): 185–206.

Mandelbrot, B.B. 1982. The fractal geometry of nature. W.H. Freeman, New York.

Percival, D.B., and A.T. Walden. 2000. Wavelet methods for time series analysis. Cambridge Univ. Press, Cambridge, UK.

Tarquis, A.M., N.R. Bird, A.P. Whitmore, M.C. Cartagena, and Y. Pachepsky. 2008. Multiscale analysis of soil transect data. Vadose Zone J. 7: 563-569.

Vereecken, H., R. Kasteel, J. Vanderborght, and T. Harter. 2007. Upscaling hydraulic properties and soil water flow processes in heterogeneous soils: A review. Vadose Zone J. 6:1–28.

Whitcher, B.J. 1998. Assessing nonstationary time series using wavelets. Ph.D. diss. Univ. of Washington, Seattle (Diss. Abstr. 9907961).

Zeleke, T.B., and B.C. Si. 2004. Scaling properties of topographic indices and crop yield: Multifractal and joint multifractal approaches. Agron J., 96:1082-1090.