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Quantitative assessment of scale-dependence in analysis of soil data and modelling of soil processes.

R.M. Lark (1), R. Corstanje (1), A.E. Milne (1)
(1) Rothamsted Research (murray.lark@bbsrc.ac.uk)

The variation of soil properties shows scale-dependence, as does the covariation of soil properties and soil processes. Understanding this scale-dependence is critical in circumstances such as the application of modelling to problems at particular spatial scales. In this paper we will focus on two particular approaches to the quantitative analysis of scale-dependence. These are the nested analysis of variance, and the wavelet transform.

Nested analysis of variance was first proposed as a tool for spatial analysis of soil properties by Youden and Mehlich (1937). Since then it has been used to study scale-dependent univariate variation of the soil. More recent studies have shown that it can be applied to multivariate problems to study scale-dependent correlation (Corstanje et al, 2007). We shall show how it can be used to analyse the scale-dependent performance of soil process models, and to assess the extent to which the non-linearity of the process model is a significant source of error when a model is to be applied at a coarser spatial scale. We shall also show how the nested model can be extended to account for non-homogeneous variances in the landscape.

Wavelet transforms are used increasingly to tackle geophysical problems. We shall show how the wavelet packet transform offers a flexible methodological framework for the analysis of scale-dependent processes without the assumption of stationarity in the variance. The structure of the best wavelet packet basis provides a basis for making inferences about the underlying variability of a soil property, and we shall demonstrate this with data across a complex sequence of parent materials. Finally, we shall show how the wavelet methodology may be applied to the analysis of model predictions and

their comparison with measurements of a key soil process.

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