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Geostatistics in Soil Sciences, Agronomy and Environmental Sciences

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Soil Science is a discipline of interest in Agronomy and Environmental Sciences. So, carrying out efficient and sustainable agriculture, environmentally friendly, has become an important issue in recent years. Agricultural production has to keep up with an ever-increasing population. A key to this is the usage of modern technologies such as GPS (for precision agriculture) and data acquisition techniques to account for soil heterogeneity. The large amounts of data that are nowadays virtually collected on crop and soil spatial have to be analysed and should be used to their full extent. Interpolation is used to convert data from point observations to continuous fields. Curricula in various basic Geosciences disciplines frequently include classic deterministic interpolation methods such as Thiessen polygons, inverse distance weighting and thin-plate splines are examples of traditional interpolation techniques. The widely used digital elevation models frequently are introduced as special cases of continuous surfaces. Geostatistical methods of interpolation, popularly known as *kriging*, attempt to optimize interpolation by dividing spatial variation into three components: i) deterministic variation that can be describes as a trend, ii) spatially autocorrelated variation, and iii) uncorrelated noise.

Geostatistical methods for interpolation start with the recognition that the spatial variation of any continuous attribute is often to irregular to be modelled by a simple smooth mathematical function. Kriging interpolation provide ways to deal with the limitations of deterministic methods and ensures that the prediction at unsampled points is optimal. The validity of the results in Geostatistics depends on theoretical assumptions that include ideas of stationarity, the intrinsic hypothesis and normality, and these are sometimes difficult o meet with real data (Webster and Oliver, 2000). This is an additional concern for an efficient didactics. For a basic module there it is now possible to work in an interactive way using the R software (Govaerts et al., 2010). The introductory modules allows the participant to analyse his/her own data using under supervision. Alternatively, tutorial data sets are also provided to the students. In this way all the steps that are needed in geostatistical analysis are presented. These steps include: error detection, summary statistics, semivariogram analysis and modelling, kriging and mapping. The R-based above mentioned modulus permit visualization of the effect of adding or deleting data points, changing parameters of semivariogram, varying semivariogram model or using various kriging techniques. Therefore, Geostatistics is presented as to tool to extract the most important information from a vast data set and to uncover previously unknown patterns that may be relevant to current soil science, agricultural and environmental problems, thereby helping to transform data sets into underlying spatial correlation structures and use that to guide interpolation. Application may vary from soil pollution or pest control to more traditional ones such as nutrient management or variability of general physico-chemical attributes.

Govaerts, A., Vervoort, A., Darius, P. 2010. Interactive modules for the visualization and teaching of geostatistical concepts. In: Cockx, L., Van Meirvenne, M., Bogaert, P, D´Or, D. (Eds.). Book of abstracts of GEOENV 2010. pp 183-184.

Webster, R. and Oliver, M. A. 2001. Geostatistics for environmental scientists. John Wiley and Sons. 271 pp.