Geophysical Research Abstracts
Vol. 16, EGU2014-9544, 2014
EGU General Assembly 2014

Sampling design optimization for multivariate soil mapping, case study from Hungary

Gábor Szatmári (1), László Pásztor (2), and Károly Barta (1)

(1) University of Szeged, Faculty of Science and Informatics, Department of Physical Geography and Geoinformatics, Szeged, Hungary (szatmari.gabor.88@gmail.com), (2) Institute for Soil Science and Agricultural Chemistry, Centre for Agricultural Research, Hungarian Academy of Sciences

Direct observations of the soil are important for two main reasons in Digital Soil Mapping (DSM). First, they are used to characterize the relationship between the soil property of interest and the auxiliary information. Second, they are used to improve the predictions based on the auxiliary information. Hence there is a strong necessity to elaborate a well-established soil sampling strategy based on geostatistical tools, prior knowledge and available resources before the samples are actually collected from the area of interest. Fieldwork and laboratory analyses are the most expensive and labor-intensive part of DSM, meanwhile the collected samples and the measured data have a remarkable influence on the spatial predictions and their uncertainty.
Numerous sampling strategy optimization techniques developed in the past decades. One of these optimization techniques is Spatial Simulated Annealing (SSA) that has been frequently used in soil surveys to minimize the average universal kriging variance. The benefit of the technique is, that the surveyor can optimize the sampling design for fixed number of observations taking auxiliary information, previously collected samples and inaccessible areas into account. The requirements are the known form of the regression model and the spatial structure of the residuals of the model. Another restriction is, that the technique is able to optimize the sampling design for just one target soil variable. However, in practice a soil survey usually aims to describe the spatial distribution of not just one but several pedological variables.
In the recent paper we present a procedure developed in R-code to simultaneously optimize the sampling design by SSA for two soil variables using spatially averaged universal kriging variance as optimization criterion. Soil Organic Matter (SOM) content and rooting depth were chosen for this purpose.
The methodology is illustrated with a legacy data set from a study area in Central Hungary. Legacy soil data were collected in the end of the 1980s in the framework of the National Land Evaluation Programme. The auxiliary data were derived from the digital elevation model and from the land-use-map of the study area. Soil data were used to characterize the relationship among the soil variables and the auxiliary information and model the spatial structures of the residuals of the regression models. The known form of the regression models and semivariogram models were used through SSA to optimize a completely new sampling design for 120 soil observations. The optimization process was done twice. First separately for SOM content and rooting depth and second for both soil variables simultaneously based on the combined form of regression models and spatial structures of the residuals. The optimized sampling designs were compared and evaluated by various statistical, geostatistical and spatial statistical (point pattern analysis) tools to examine how they depend on the regression models and semivariogram models and how they cover the geographical and feature space. In the near future, we want to extend the methodology for more than two pedological variables.

Acknowledgement: Our work has been supported by the Hungarian National Scientific Research Foundation (OTKA, Grant No. K105167).