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Spatial variability of soil magnetic susceptibility in an agricultural field located in Eastern Ukraine

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Magnetic susceptibility (MS) have been used to characterize soil properties. It gives an indirect information about heavy metals content and degree of human impacts on soil contamination derived from atmospheric pollution (Girault et al., 2011). This method is inexpensive in relation to chemical analysis and very useful to track soil pollution, since several toxic components deposited on soil surface are rich in particulates produced by oxidation processes (Boyko et al., 2004; Morton-Bernea et al., 2009). Thus, identify the spatial distribution of MS is of major importance, since can give an indirect information of high metals content (Dankoub et al., 2012). This allows also to distinguish the pedogenic and technogenic origin magnetic signal. For example Ukraine chernozems contain fine-grained oxidized magnetite and maghemite of pedogenic origin formed by weathering of the parent material (Jeleńska et al., 2004). However, to a correct understanding of variables distribution, the identification of the most accurate interpolation method is fundamental for a better interpretation of map information (Pereira et al., 2013). The objective of this work is to study the spatial variability of soil MS in an agricultural fields located in the Tcherkascy Tishki area (50.11°N, 36.43 °E, 162 m a.s.l), Ukraine. Soil MS was measured in 77 sampling points in a north facing slope. To estimate the best interpolation method, several interpolation methods were tested, as inverse distance to a weight (IDW) with the power of 1,2,3,4 and 5, Local Polynomial (LP) with the power of 1 and 2, Global Polynomial (GP), radial basis functions - spline with tension (SPT), completely regularized spline (CRS), multiquatratic (MTQ), inverse multiquatratic (IMTQ), and thin plate spline (TPS) – and some geostatistical methods as, ordinary kriging (OK), Simple Kriging (SK) and Universal Kriging (UK), used in previous works (Pereira et al., 2014). On average, the soil MS of the studied plot had 686.05 MS×10-9 m3/kg, and a minimum and a maximum value of 499.33 and 862.27 MS×10-9 m3/kg respectively. The standard deviation was 85.62 and the coefficient of variation 12.48%. This shows that the spatial variability of soil MS was low. The Global Morans I index was of 0.841, a z-score of 7.741 with a $p<0.001$, indicating that soil MS had a clustered pattern. The variogram results showed that the gaussian model was the the best fitted. The nugget effect was 0.1007. the sill 0.9905 and the nugget/sill ratio of 0.10, which shows that soil MS has a strong spatial dependency. The results of the interpolation tests showed that the errors distribution followed the normal distribution, the average predicted values were similar to the observed and the correlation between these two distributions was high (between 0.85-0.90) in all the cases. The method that predicted better soil MS was LP2 and the less accurate was SK. Soil MS presented high values in the southwestern part and low in the northeast area of the plot. It is clearly observed a increase of soil MS from the top of the slope to the bottom.

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