

COKRIGING FIELD MEASURED SOIL HYDRAULIC CONDUCTIVITY AND TEXTURE IN A BRAZILIAN SEMI-ARID WATERSHED

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INTRODUCTION

In this study, a hillslope plot in semi-arid watershed in the Brazilian Northeast has been selected and its hydraulic properties structure analysed. In the same plot, it have been performed rainfall-runoff experiments in the selected plot using a rainfall simulator device. Values between 2cm/h and 8cm/h have been accessed for saturated hydraulic conductivity during the dry season, when bare soil scenarios prevail.

Mackay and Montenegro (1996), Montenegro (1997) and Montenegro et al. (2002) have investigated the geostatistical structure of hydraulic conductivity in the same watershed, particularly in the alluvial valley downstream from the hillslope plot adopted. Ranges of approximately 84 m for the isotropic semivariogram have been found, for the saturated hydraulic conductivity.

In order to investigate spatial variability of hydraulic conductivity, a Guelph permeameter (Soil Moisture, 1991) has been applied in this study, due to its versatility, allowing hydraulic conductivity assessment in about 2 hours time interval, on average.



Figure 1- Rainfall-runoff experiment in a hillslope plot; bare soil condition.

PURPOSE

The purpose of this paper is to apply the cokriging procedure to hydraulic conductivity evaluation and texture data from a semi-arid watershed, and to compare the results to classical kriging procedure.

RESULTS AND DISCUSSION

A regular mesh with 30m spacing and 49 nodes has been adopted in the hillslope plot. In each node, texture has been evaluated and hydraulic conductivity assessed, with at least three replications. The data basic statistics is presented in Table 1. Figure 1 exhibits the Normal theoretical function and the experimental cumulative statistics for Log K. It has been verified that the sand content and the clay content are approximately Normally distributed, whereas hydraulic conductivity can be assumed as log-Normally distributed.

Table 1- Basic statistics for log K, sand content, and clay content.

Variable	n	max	min	average	sd	Average/ sd
Log K(cm/h)	49	2.10	0.12	1.40	0.40	28.57
% sand	49	68.20	39.40	54.46	7.07	12.98
% clay	49	39.00	17.40	27.53	5.46	19.83

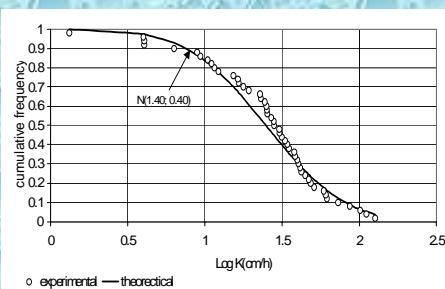


Figure 1- Cumulative frequency of Log (K).

Semivariances:

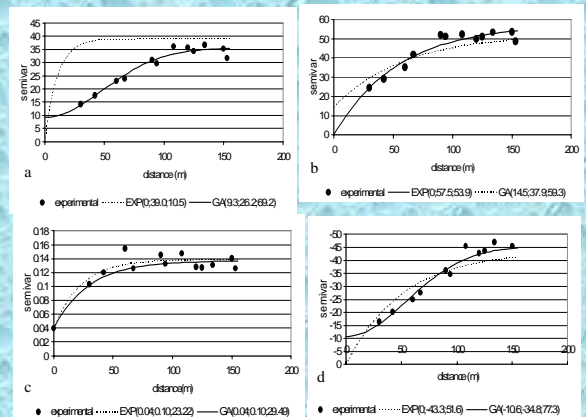


Figure 2- Semivariograms for sand content(a); clay content(b); log K (c) and the cross semivariogram clay-sand (d)

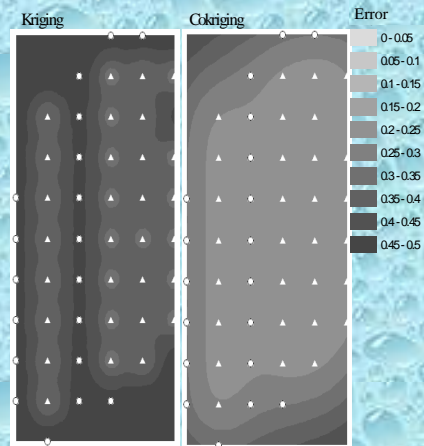


Figure 5. Prediction error map for kriging and cokriging estimation.

Conclusions

In this study, performed in a watershed hillslope in the Brazilian semi-arid, it has been verified the relevance of cokriging procedure for mapping hydraulic conductivity, which is an expensive variable to assess in the field, based more frequently sampled variables, as sand and clay contents. For the studied domain, such soil fractions exhibit larger ranges than the hydraulic conductivity, and also present spatial correlation to hydraulic permeability. Texture were found to be normally distributed, while hydraulic conductivity distributed Log-Normally over the field. Kriging and cokriging have been used for spatial prediction of saturated hydraulic conductivity at a 30 points approximately regular mesh, with 30 nodes, obtained from a 49 nodes regular mesh by removing a transect and some random points. Cokriging procedure reduced the prediction error of the estimates, and constitutes an important tool to provide, at unrecorded points, an unbiased estimation of Log K parameter with a minimum standard deviation.

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