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Soil Phosphorus and Potassium Mapping Using a Spatial Correlation Model Incorporating Terrain Slope Gradient

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Abstract. Variable-rate fertilizer application requires knowledge of the spatial distribution of soil nutrients within fields. Grid soil sampling might be used for acquiring this information, but is often too expensive for resolving spatial patterns in soil nutrients at the scale of precision fertilizer application. The objective of this study was to determine whether grid sampling efficiency can be improved using cokriging estimates with slope gradient as a secondary variable, which is easily obtained from high-resolution digital elevation models. Soils in two northern Montana wheat fields were sampled at the nodes of a 100-m diagonal grid. Soil test phosphorus and potassium maps were constructed with kriging and cokriging. Co-kriging uses the spatial correlation between two variables to predict for the less intensively sampled variable of interest, often with less estimation error than a univariate method such as kriging. The average estimation variance for cokriging compared to kriging was reduced for all values of the correlation considered. The additional complexity of cokriging might be justified provided a secondary variable exists that is spatially cross correlated with the primary variable of interest.

Keywords: Co-kriging, DEM, soil mapping, soil properties, topography

Introduction

Precision agriculture often incorporates precise, spatial information about soil properties and/or nutrients (e.g., phosphorus and/or potassium) across farm fields to help meet the goal of optimizing input of fertilizers and herbicides while maintaining or increasing yields. The evaluation of soil nutrient levels across farm fields is typically performed by taking soil samples, analyzing them for nutrient content, and interpolating values between sampling points (Wollenhaupt et al., 1997). In many fields, the sampling has been conducted on a two-dimensional grid as needed to determine the spatial distribution in soil phosphorus (P) and potassium (K) levels and make site-specific recommendations