Irrigation in Western Kentucky: Initial results on soil and crop spatial variation to improve water management

Javier Reyes Ole Wendroth
javier.reyes@uky.edu owendroth@uky.edu
Department of Plant and Soil Sciences, University of Kentucky

Introduction

Even in wet years and for sure in dry years, soils need to be irrigated in relatively humid regions such as western Kentucky to supply water for crop uptake to optimize and stabilize yields. Due to the high soil spatial variability within these areas, site-specific irrigation management is effective to optimize yield and crop water consumption.

Objectives

Through an analysis of spatial and temporal variation of soil and crop variables we identify the variability in the field and aim to characterize and model soil hydraulic and crop development processes to improve irrigation management..

Methods

- The experimental site is a corn field located in Princeton, KY, soil is silty loam (Crider series).
- Soil texture at different depths was measured at 96 locations in a 50 by 50 m grid.
- Electrical conductivity was measured using a Veris 3150 in a wet period (April 2015).
- Soil water potential and temperature were measured in 48 locations and at three depths (20, 40, 60 cm) using watermark sensors and an Arduino in the spring-summer season of 2015.
- NDVI was measured using a handheld Greenseeker on July 10-2015
- Semivariograms, Crossvariograms, Kriging and Cokriging analysis were performed.

Results

- A strong spatial structure was found for variables such as clay content 0-20 cm, NDVI and electrical conductivity.
- Spatial structure of soil texture at deeper layers and soil water potential was weaker.
- Using electrical conductivity as a secondary variable in cokriging analysis increased the quality of the clay map.
- Soil water potential presents spatial and temporal variation through the season, with critical dry spots in the surface layer during July.
- NDVI data reveals spatial growth differences within in the field.

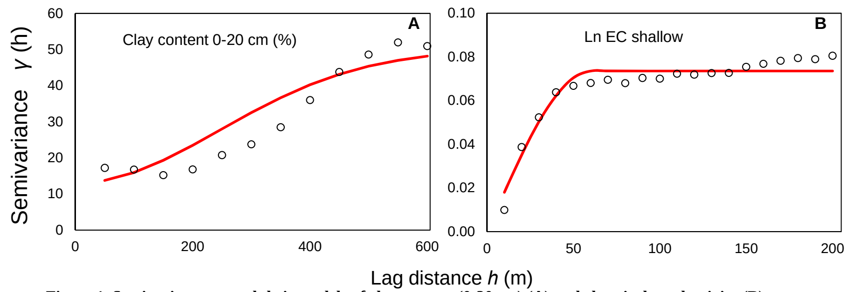

Figure 1. Semivariograms and their models of clay content (0-20 cm) (A) and electrical conductivity (B).

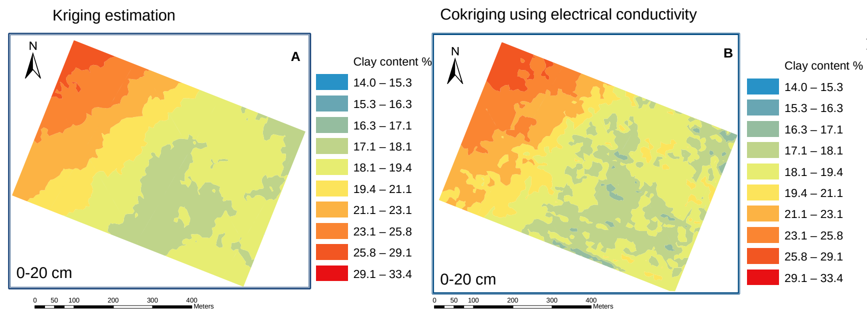

Figure 2. Surface clay content maps obtained with Kriging (A) and Co-kriging analysis (B).

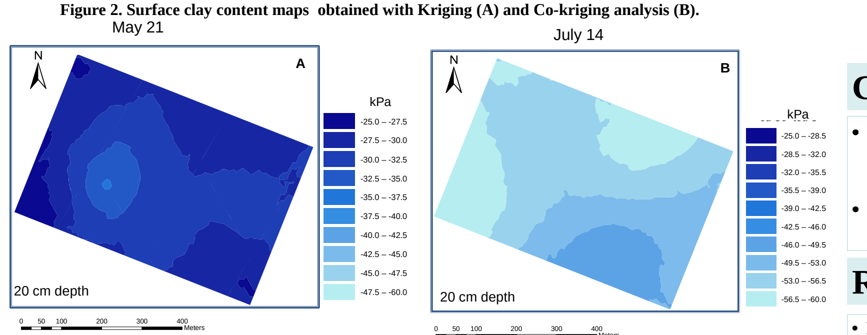

Figure 3. Soil water potential maps at 20 cm depth on May 21 (A) and July 14 (B) of 2015.

Figure 4. Field study (A and B), Veris-electrical conductivity measurement (C) and Arduino instrument used to measure soil water potential (D).

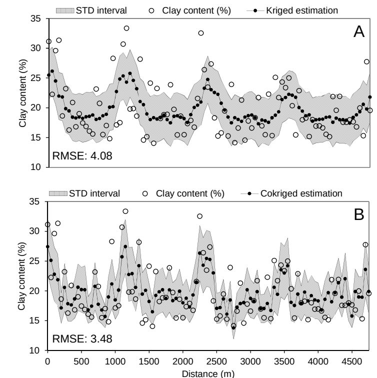

Figure 5. Kriging (A) and Co-kriging (B) estimation of clay content (0-20 cm).

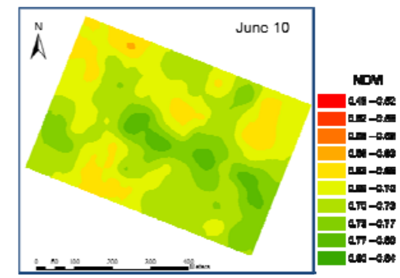

Figure 6. NDVI map obtained on June 10-2015.

Conclusions

- Spatial variations found for several variables in different zones in the field could be considered for a sectored irrigation management.
- Variables will be continued to be monitored to provide a site specific description of soil and crop processes

References

- Heil, K, U. Schmidhalter. 2012. Characterisation of soil texture variability using the apparent soil electrical conductivity at a highly variable site. Computers & Geosciences 39: 98–110.
- Li, T., X. Hao, and S.Kang. 2014. Spatiotemporal Variability of Soil Moisture as Affected by Soil Properties during Irrigation Cycles. Soil Sci. Soc. Am. J. 78:598–608

Acknowledgments

We want to thank the Kentucky Corn Growers' Association, Kentucky Soybean Board and the Kentucky Small Grain Growers' Association for supporting this work. We also appreciate the technical Support of Riley Walton and James Dollarhide, and the Farmer Trevor Gilkey for allowing us to conduct this experiment in his farm.