geoENV 2004 - Fifth European Conference on Geostatistics for Environmental Applications
October, 13th-15th, 2004, Centre for Hydrogeology, University of Neuchâtel, Switzerland

Agrogeomatic techniques application for a more precise management of corn (*Zea mays L.*) cropping system at field scale

Bocchi S.[a], Castrignanò A.[b], Viganò L. S.[a]

[a]Università degli Studi di Milano, Dipartimento di Produzione Vegetale - Sezione Agronomia
Laboratorio di Geomatica per l'ambiente e il territorio, via Celoria 2, 20133 Milano, Italy
[b]Istituto Sperimentale Agronomico, Via Celso Ulpiani 5, 70125 Bari, Italy

ABSTRACT

The present study, carried out at the Educational-Experimental Farm of the State University of Milan (Italy) located in Pavia, aims at analyzing with geostatistic techniques and GIS spatial and temporal variability of a field, where corn has been grown for 3 years, for improving through moduling site-specificly the agrotechniques. Three sets of data (yield, weight of 1000 seeds and position) were collected during three-year period on a 2-ha field. For the high variability of data in space it was necessary to apply smoothing and interpolation in unsampled locations through geostatistical techniques. Data were regularised on a grid by applying cokriging interpolation and LMC (Linear Model of Coregionalization) techniques.

For a better analysis of the variability in time and space, Blackmore & Larschield (1997) methodologie was applied.

INTRODUCTION

Most of agricultural fields show spatial variability in terms of soil texture and structure, chemical composition and properties, weeds presence, micrometeorological conditions. Arable crops respond to this variability to different extents, but the fields are cultivated as if they were uniform in time and space so that inefficient use of natural resources, energetic losses and furthermore environmental pollution are possible.

Yield mapping has often been suggested as a powerful technique for detecting and quantifying within-field variability.

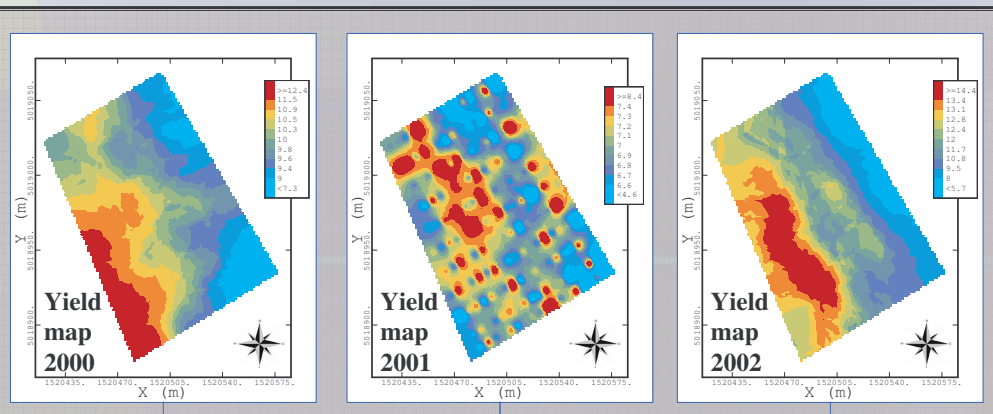
However, to achieve the goal of sustainable cropping systems, variability must be considered both in space and time (Pierce F.J.& Nowak P., 1999).

A better agronomic knowledge is possible through agrogeomatic techniques and new technologies such as GIS (Geographical Information Systems), GPS (Global Positioning Systems) and VRT (Variable Rate Technologies). Such tecniques, carrying information into a spatiotemporal continuos flux, may be useful for implementing site-specific management at farm and field level accountig for spatio-temporal variability.

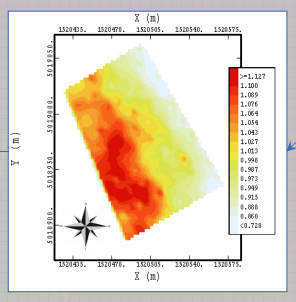
This process will improve the overall efficency of of the agronomic process which will be beneficial to the farm both economically and environmentally.

RESULTS & DISCUSSION

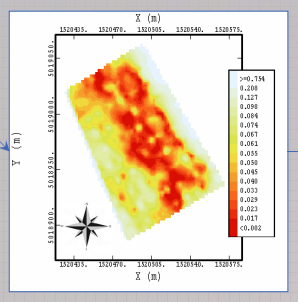
Temporal variability can be seen by comparing a number of yield (t/ha) maps that had been recorded over time.



For better understanding some of the spatial aspects the temporal trend was removed by representing yields in normalised form to show the underlying stable characteristics of the field.

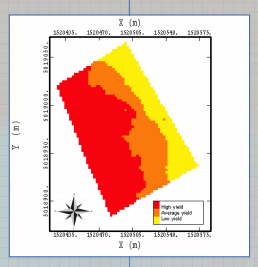


Normalized yield map

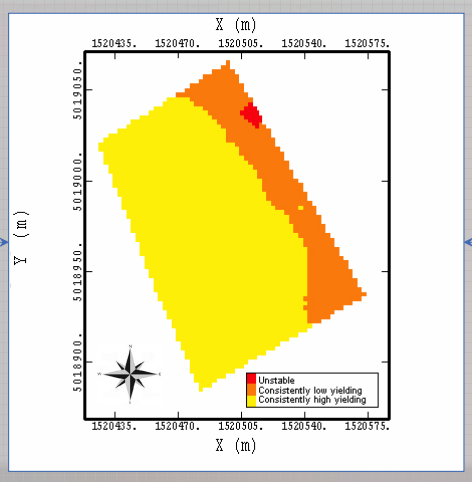


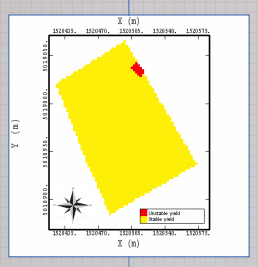
CV Yield map

A temporal stability map can be created by calculating the variation coefficient; it identifies area that have been stable (or highly variable) over the time period.



Spatial trend map





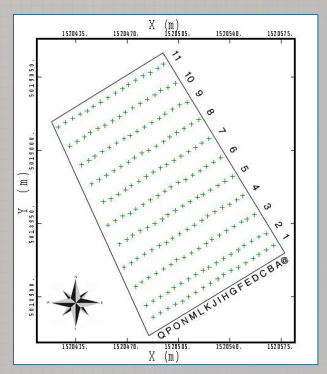
Stability map

The spatial trend and stability maps have been combined to produce a management map that includes the three fundamental aspects needed for trend management.

MATERIALS AND METHODS

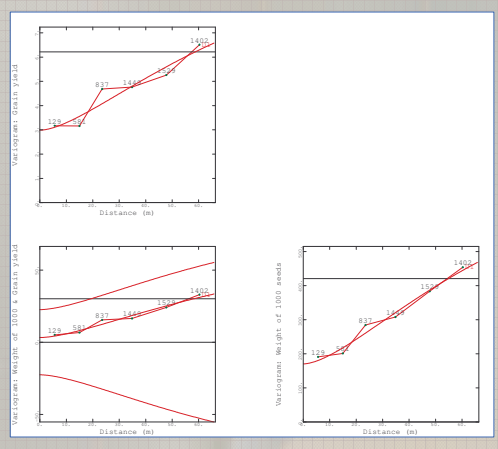
Three sets of data (position, yield and weight of 1000 seeds) were handly collected and stored for three years on a 2-ha field at the node of a rectangular grid (5,6 x 16 m).

Description of field scale spatiotemporal processes related to yield requires understanding of both spatial variability structure and its change in time.



Survey location map

Geostatistics (Goovaerts, 1997) provides different tools for joint analysis of the space and time variation of the attribute of interest. In the present work spatiotemporal continuity has been modelled via the Linear Model of Coregionalization (LMC) and estimation was possible through cokriging applied to yield and weight of 1000 seeds.



Fitting experimental LMC (Grain yield 2002)

The spatial-temporal dependence was assessed by fitting a omnidirectional linear model of coregionalization to yield data sets recorded on two dates. Two basic structures were used for the fitted LMC: Nugget effect and Bessel K-model.

After having observerd the lack of spatial dependence for the year 2001 (probably due to an heavy attack by *Ostrinia nubilalis L.* followed by hail) IDW tecnique was used to plot the yiel map.

Cross validation was used to validate the results.

In this poster only yield maps are shown.

CONCLUSIONS

Management of variability is the key of site-specific management at farm and field level.

Yield maps analisys has prooved to be useful for detecting and quantifying within-field variability.

Yield maps which are going to be used as a basis for decision making must be accurate. Geostatistics is an affordable mean for studying spatial and also temporal variability at field scale.

The classified management map can be a very useful and simple tool for identifying and managing spatial and temporal variability.

REFERENCES

Blackmore B.S. & Larschield G., 1997. *Management Decision based on yield maps.* 1st European Conference on Precision Agriculture, 8-10 Settembre 1997 Warwick UK

Goovaerts P., 1997. *Geostatistics for natural resources evaluation*, Oxford University Press, New York.

Pierce F.J.& Nowak P., 1999. *Aspects of precision agriculture*, Advances in Agronomy, Vol 67 pp 1-80.