Geocomputation 2007
Maynooth, Kildare, Ireland
September 3, 2007

Guided Soil Sampling for Enhanced Analysis of Georeferenced Sensor Based Data

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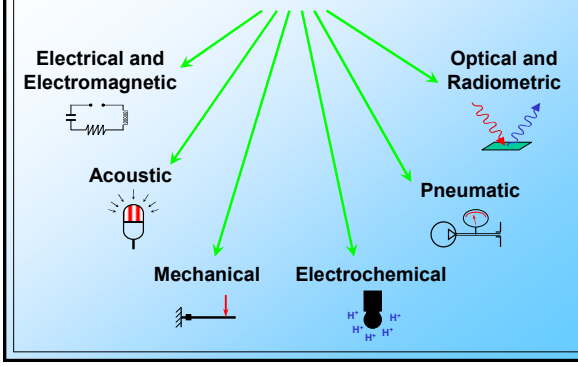
Background

- Assessment of soil variability is essential in site-specific management
- Variable rate application requires accurate information about soil spatial structure
- Obtaining adequate spatial information for a field is expensive using conventional soil sampling and analysis methods
- Accurate mapping of soil attributes requires high density on-the-go sampling
- Recent on-the-go sensors can reveal spatial variation in soils, but improved prescription algorithm are needed

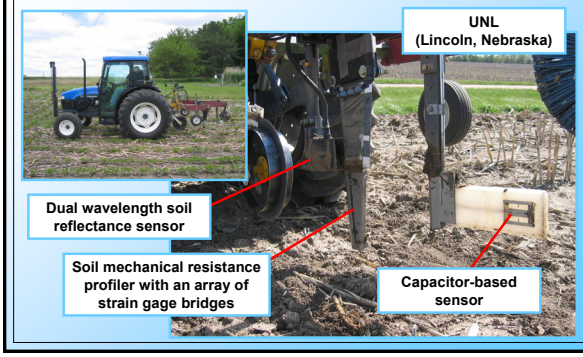
On-the-go Soil Sensors



Applicability of On-the-Go Soil Sensors

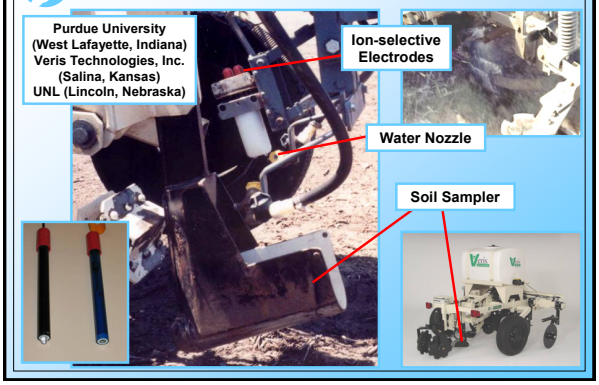
Soil property					
Soil texture (clay, silt and sand)	Good	OK		Some	
Soil organic matter or total carbon	Some	Good			
Soil water (moisture)	Good	Good			
Soil salinity (sodium)	OK				Some
Soil compaction (bulk density)			Good	Some	
Depth variability (hard pan)	Some		OK	Some	
Soil pH		Some			Good
Residual nitrate (total nitrogen)	Some	Some			OK
Other nutrients (potassium)		Some			OK
CEC (other buffer indicators)	OK	OK			

Integrated Soil Physical Properties Mapping System

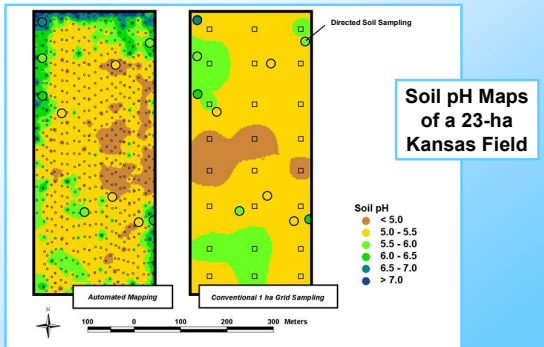


Mobil Sensor Platform (MSP)

Direct Soil Measurement



Soil pH Maps



Objective

- The ultimate goal of our research is to delineate sensor-based field areas that require differentiated soil treatments
- One of intermediate objectives is to develop an algorithm for prescribing guided (targeted) soil sampling
- In this presentation we discuss criteria for evaluating different combinations of guided samples

General Rules

- Guided samples should be collected from relatively homogeneous field areas away from the field boundary and other transitional areas
- They should cover the entire range of sensor-based measurements, especially toward low and high ends
- Guided samples should be physically spread across the entire field
- It should be possible to process multiple sensor-based data layers

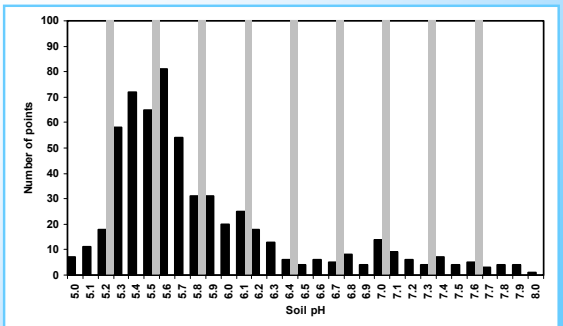
Our Criteria

Homogeneity	Neighborhood variability
Even data spread	D-optimality
Even field coverage	Spatial predictability

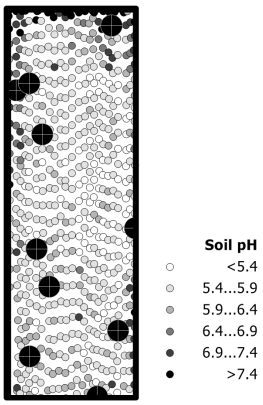
Methodology

- Property: Soil pH
- Instrument: Veris® Mobile Sensor Platform
- Field area: 23 ha
- Number of valid measurements: 598
- Number of guided samples: 10
- Different sets of samples considered: 63
  - Random selection: 20
  - Grid cell spread: 19
  - Even soil pH spread: 20
  - Maximum homogeneity: 1
  - Grid cell centers: 1
  - Subjunctive selection: 2

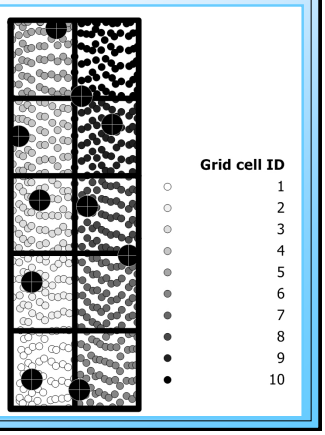
Soil pH Histogram



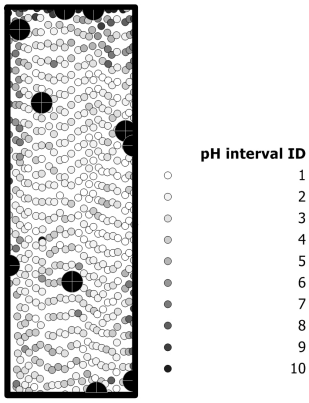
Complete Randomization



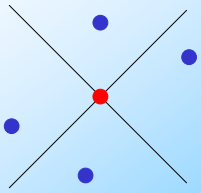
Grid Cell Spread

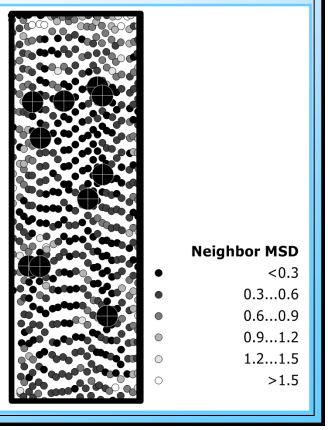


Even Soil pH Spread

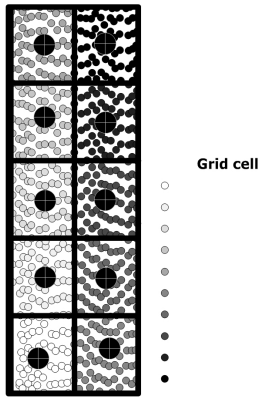


Maximum Homogeneity

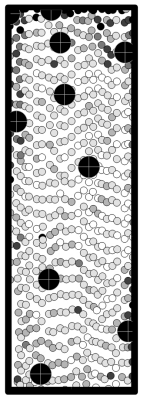




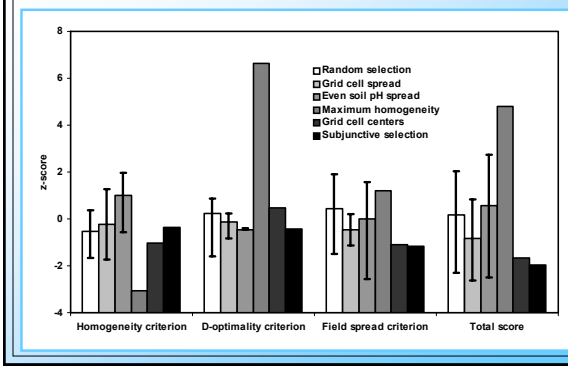
Grid Cell Centers



Subjunctive Selection



Z-Score Comparison



Summary and Future Work

- Satisfactory optimization of the three diverse criteria is feasible
- Certain objective field parameters should be used to set the weight of each criteria
- The number of guided points should be a part of optimization process
- It will be challenging to generate an algorithm dealing with multiple data layers obtained with inconsistent densities
- Any comments and recommendations are welcome

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