Analysis of the Representation of Soil Map Units using a Common Apparent Electrical Conductivity Sampling Scheme for the Mapping of Soil Properties

Eric C. Brevik – Departments of Natural Sciences and Agriculture and Technical Studies, Dickinson State University, Dickinson, ND 58622, USA

Introduction

- New technologies such as GIS and GPS have led to a demand for more detailed and accurate soils information than is available through traditional sources
- One technique that has drawn considerable interest is apparent electrical conductivity (EC_a)
- Any time data is collected, a valid concern is how well that data represents the system being studied
- A review of the literature shows it is common to collect EC_a data by driving transects through a field at low speed collecting georeferenced readings at a specified time interval
- It is typically assumed that this sampling technique will collect data representative of the soils in the given field, but this assumption is rarely, if ever, tested
- This research was conducted to evaluate how well data collected using the georeferenced transect survey technique tends to represent the soils within the surveyed fields

Materials and Methods

- Two fields in central Iowa, USA, that had Order 1 soil surveys available were surveyed for EC_a
- These fields are referred to as the Sorenson and Larson Fields (Fig. 1)
- The Sorenson Field is 16 ha, soils were derived from loess over till and there is a wide variety of soils mapped (Fig. 2)
- The Larson Field is 25 ha, soils were derived from glaciolacustrine deposits over till and are much more uniform than in the Sorenson Field (Fig. 3)
- ArcGIS 8.3 (ESRI, Redlands, CA, USA) was used to overlay the transect data points on the soil maps
- Both graphical and tabular approaches were used to determine whether or not the sampling scheme had done a good job of representing the soils present in the field
- The graphical approach allows visual observation of trends
- The tabular approach allows numerical comparison of absolute departure from a standard (% SMU area in the field vs % EC_a data points from the SMU)

Table 1. Key to the soil map units present in the study fields in Iowa, USA.

SMU(s)†	Dominant Soil Series
Soils present in the Sorenson Field	
4	Knoke
27, 27B, 27C	Terril
55	Nicollet
62C2	Storden
90	Okoboji (mucky silt loam)
107	Webster
138, 138B, 138C, 138C3	Clarion
507	Canisteo
707	Delft
828B, 828C3	Zenor
Soils present in the Larson Field	
288	Ottosen
388	Kossuth
Soils present in both fields	
6	Okoboji (silty clay loam)
95	Harps

†Soil map units

Table 2. The percentage of each SMU and of the EC_a data points collected from each SMU in Iowa, USA.

SMU†	% of field area	% of EC_a data points	% deviation‡
Sorenson Field			
4	5.20	4.77	-8.25
6	7.14	8.31	16.50
27	1.50	1.32	-12.19
27B	3.45	3.58	3.66
27C	0.89	0.45	-49.19
55	10.58	11.41	7.83
62C3	0.52	0.42	-20.04
90	1.14	0.90	-20.55
95	7.06	6.51	-7.75
107	21.47	23.33	8.65
138	2.16	2.06	-4.30
138B	11.74	11.92	1.60
138C	11.49	10.18	-11.34
138C3	1.38	1.32	-4.49
507	1.48	2.16	45.99
707	11.94	10.76	-9.85
828B	0.51	0.29	-43.53
828C3	0.36	0.29	-18.57
Larson Field			
6	0.23	0.28	19.57
95	10.02	12.13	21.07
288	32.13	29.76	-7.37
388	57.61	57.82	0.37

†Soil map unit.
‡A negative value indicates the % of EC_a data points are under-represented relative to the % area the SMU covers, a positive value indicates the EC_a data points are over-represented.

Figure 1. Location of the study fields.

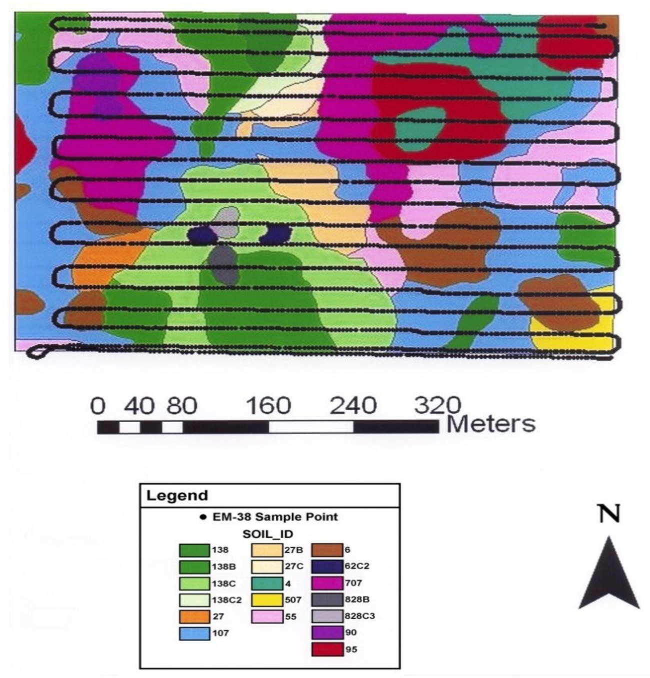

Figure 2. Soils in the Sorenson Field and the EM survey path.

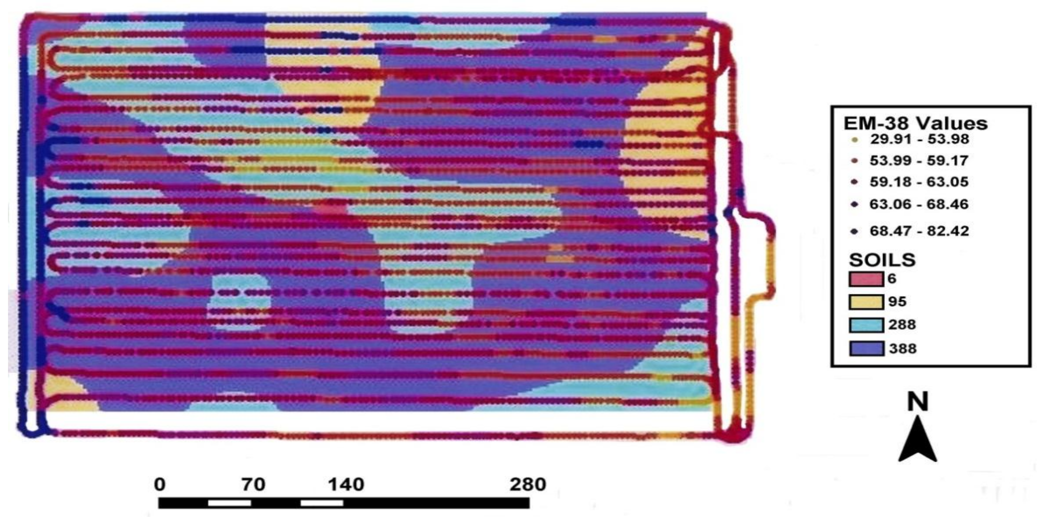

Figure 3. Soils in the Larson Field and the EM survey path.

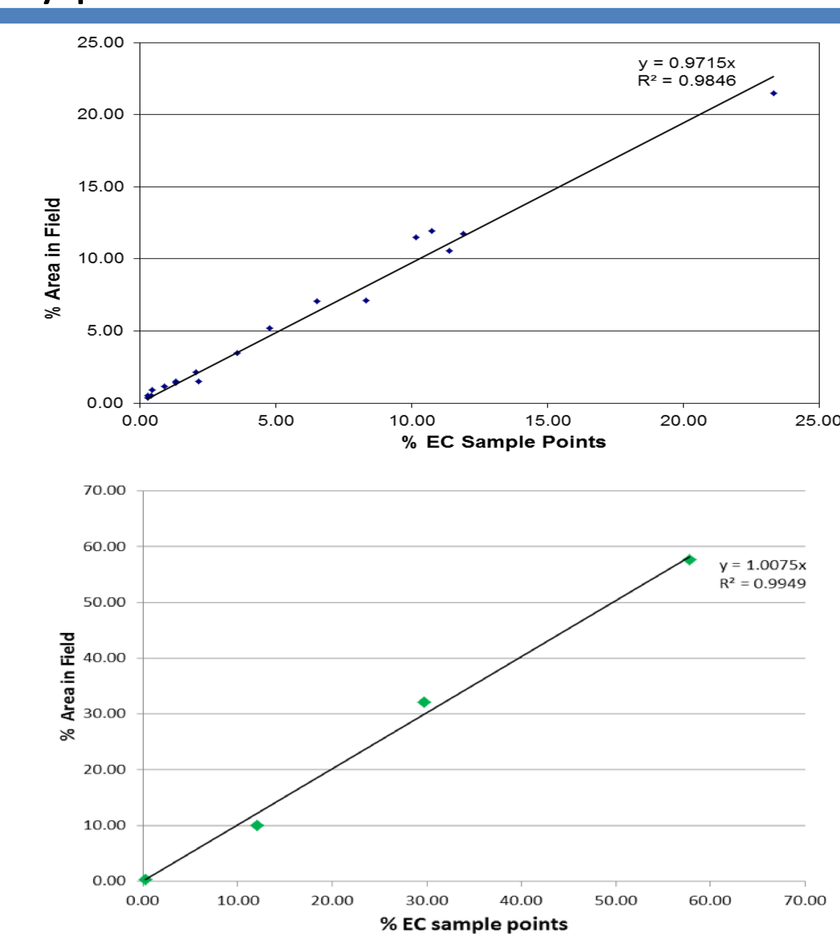

Figure 4. Relationship between % area of each SMU in the Sorenson (left) and Larson (right) Fields and the % of EC_a sample points that came from each map unit. Note the slopes near 1.0 and high R^2 values.

Results and Discussion

- There was a strong, significant correlation between percent area per SMU and percent coverage by EC_a data points (Fig. 4)
- However, not all SMUs were equally well sampled
- The smaller land area SMUs (<5% field area) had the greatest % deviation between the % land area they represent and the % of EC_a data points that came from them (Table 2)
- Overall, this was interpreted as indicating that the sampling design did a decent job of representatively collecting EC_a data from the SMUs that made up more than about 5% of the Fields, but did a much poorer job of representatively collecting EC_a data from the SMUs that made up less than about 5% of the Fields

Conclusions

- A significant amount of work has been done to look at the use of transects to sample soil variability and the accuracy of soil survey, but much less work has been done to investigate how representatively transects sample the soils in a field
- EC_a studies typically assume that transect sampling provides representative EC_a data
- This study indicates this assumption was frequently valid in the fields investigated for SMUs that comprised more than about 5% of the field area, but not for SMUs that comprised less than ~5%

For More Information

For more information on this study, or for a pdf reprint, email Eric Brevik at Eric.Brevik@dickinsonstate.edu

Dickinson STATE UNIVERSITY