Pedometrics 2009 (Beijing, China)
August 26, 2009

Application of Electromagnetic Sensing to Delineate Spatially Variable Soil Characteristics and Drought Susceptibility in Field-Managed Screening of Rice under Rainfed Lowland Conditions

Viacheslav Adamchuk *Joselito Villa and Rachid Serraj*

University of Nebraska – Lincoln
Lincoln, Nebraska, USA

International Rice Research Institute
Los Banos, Philippines

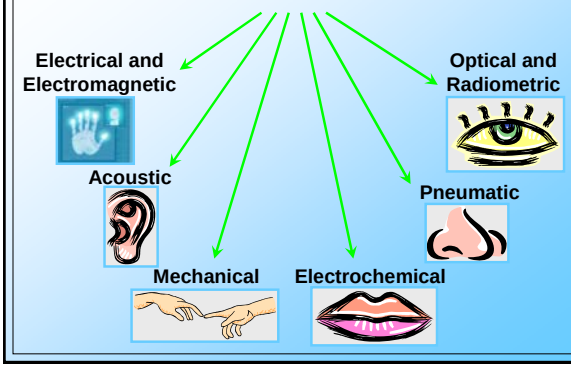
Background

- Spatially variable water holding potential is a well recognized limitation for the precision of field-managed drought stress screening in a variety of rice growing environments around the world
- Rice growth and production in volcanic soils presents an example situation when relatively shallow topsoil over virtually impermeable parent material has significant spatial variability within paddy fields commonly used for varietal screening
- Mapping apparent electrical conductivity using non-invasive electromagnetic induction (EMI) sensing technology allows to delineate relatively small field areas responsible for spatial heterogeneity of drought susceptibility, which may interfere significantly with genotypic variation

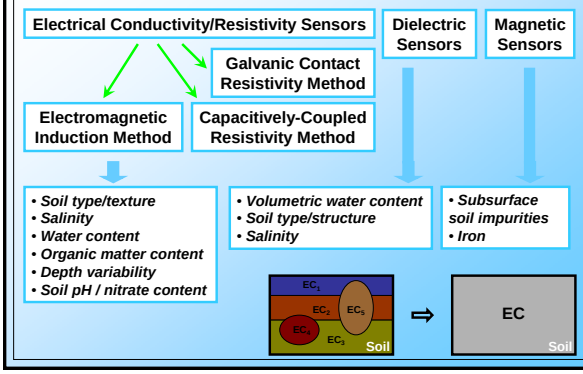
Objectives

- To apply high-density maps obtained using Geonics EM-38-MK2 instrument in several rice research paddy fields to define spatial variability of important soil profile characteristics throughout these fields
- To deploy EMI sensing to optimize rice drought stress management under rainfed lowland conditions

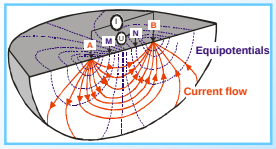
On-the-go Soil Sensors



Electrical and Electromagnetic Sensors

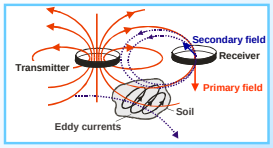


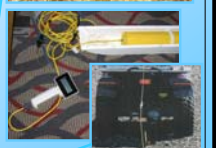
Galvanic Contact Resistivity Method



Veris Technologies, Inc. (Salina, Kansas) *http://www.veristech.com*	Veris® 3100 and MSP (0.3 and 0.9 m)
Geocarta (Paris, France) *http://www.geocarta.net*	Geocarta ARP (0.5, 1, and 2 m)
Crop Technologies, Inc. (Spring, Texas) *http://www.soildoctor.com*	Soil Doctor® System (real-time approach)

Electromagnetic Induction Method





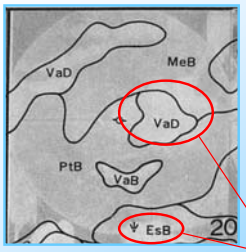
Geonics Limited
(Mississauga, Ontario)
http://www.geonics.com

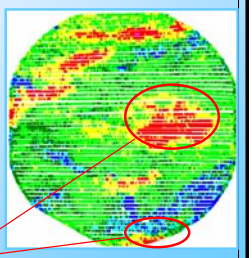
Geonics EM-38
horizontal – 0.75 m
vertical – 1.5 m

Dualem, Inc.
(Milton, Ontario)
http://www.dualem.com

DUALEM – 1S
co-planar – 0.4 m
perpendicular – 0.95 m

Example
Electrical Conductivity Map





Soil Survey

Improved Soil Type Separation

EC Map

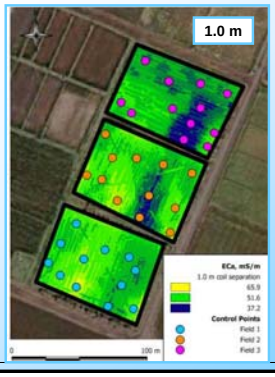
Rice Production Environment

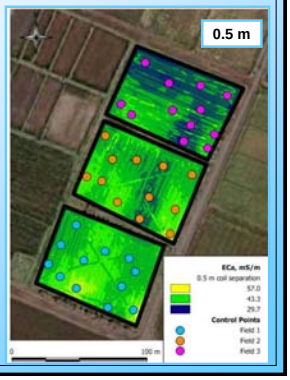
Field Data Collection

Enclosed EM-38-MK2
Ground Conductivity Meter
Vertical dipole mode
Two coil separation distances
(1 and 0.5 m from transmitter)

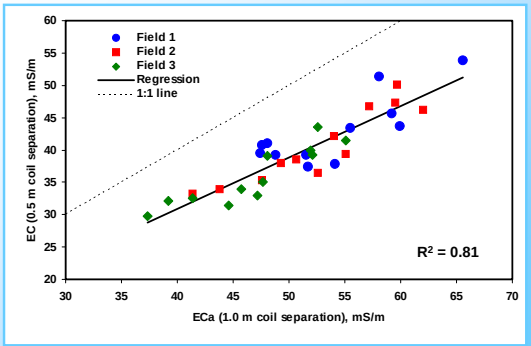
Wooden sled with a housing for the ground conductivity meter and a GPS receiver

Apparent Electrical Conductivity

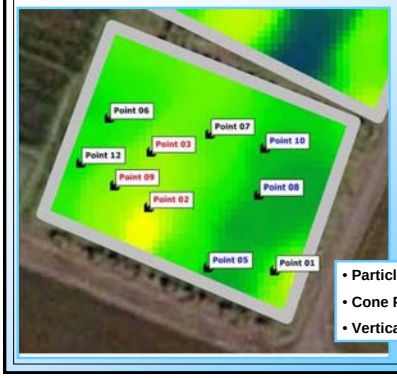




Coil Separation Effect

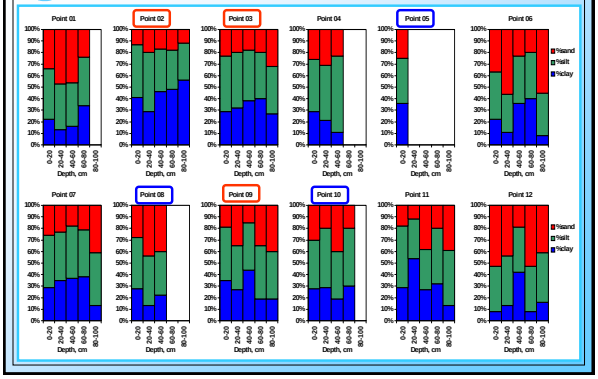


Data Calibration

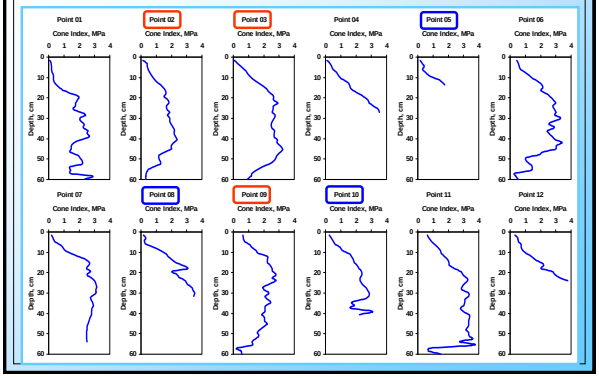


- Particle Size Analysis
- Cone Penterometer Profiles
- Vertical Sounding Scans

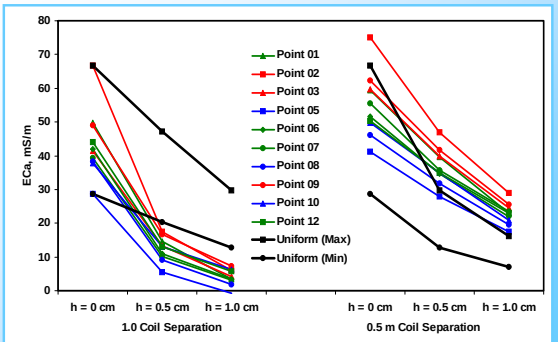
Particle Size Analysis



Cone Penetrometer Profiles



Vertical Sounding Scans



Summary

- Maps of apparent soil electrical conductivity reveal spatial variability of soil conditions in rainfed lowland fields
- Depth of parent material is the most likely cause of this variability
- It does not look that soil profile structure can be represented using a conventional bi-layer model
- More systematic definition of the depth of topsoil is needed to calibrate electrical conductivity measurements in each site
- Spatially variable drought susceptibility may be related to apparent electrical conductivity maps

http://bse.unl.edu/adamchuk
E:mail: vadamchuk2@.unl.edu