Agricultural Geophysics: Past/Present Accomplishments and Future Advancements

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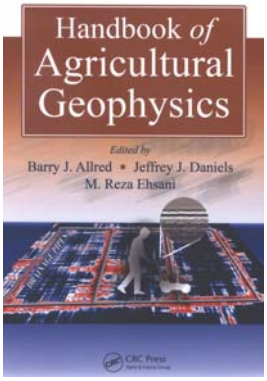
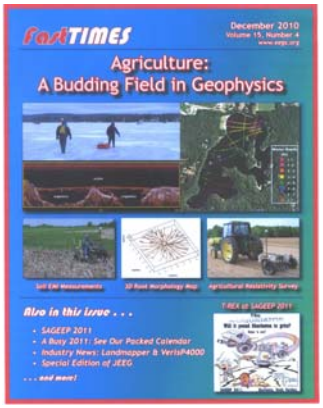
USDA Agricultural Research Service





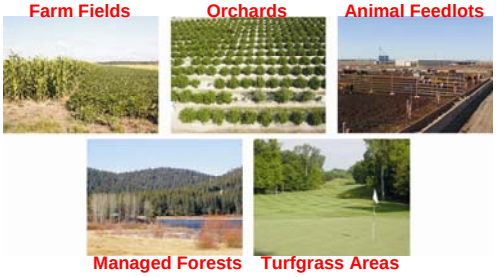
Bouyoucos Conference on Agricultural Geophysics

September 8-10, 2009

Albuquerque, New Mexico

Agroecosystems

Farm Fields | Orchards | Animal Feedlots



Managed Forests | Turfgrass Areas

Scales of Geophysical Investigation

Agroecosystem geophysical measurements often tend to exhibit substantial variability.

Temporal

Soil Electrical Conductivity = *f*(Temperature, Water Content)
Soil Dielectric Constant = *f*(Water Content)

Spatial

Horizontal Changes
Vertical Changes

To date, the predominant geophysical methods employed for agricultural applications have included resistivity, electromagnetic induction, and ground penetrating radar.

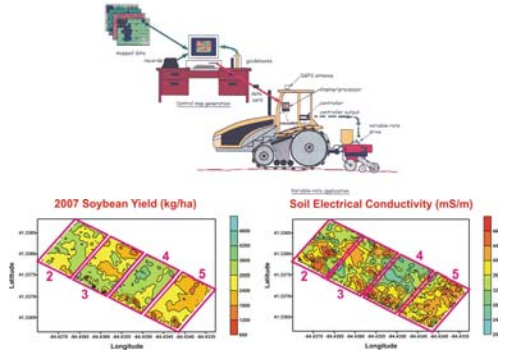
Resistivity | Electromagnetic Induction

Ground Penetrating Radar

Historical Research Development of Agricultural Geophysics

1) 1930s to 1940s – Soil water content monitoring using apparent soil electrical conductivity (EC_a) measurements obtained with resistivity methods.
2) 1960s to 1970s – Soil salinity assessment using EC_a measurements obtained with resistivity methods.
3) 1970s to 1980s - Use of ground penetrating radar (GPR) for updating and improving USDA soil survey maps.
4) 1990s - EC_a mapping with resistivity and electromagnetic induction (EMI) methods are used to evaluate soil property spatial variation.

Agricultural Geophysics and Precision Farming



Some Recent Advances in Agricultural Geophysics

1) Soil water content mapping using GPR.
2) Tree and crop root biomass evaluations using GPR.
3) Soil nutrient monitoring after fertilizer or manure application using EMI and resistivity methods.
4) Determination of clay-pan depth using EMI and resistivity methods.
5) GPR soil suitability maps.

GPR Soil Suitability Map for the U.S.A.

http://soils.usda.gov/survey/geography/maps/GPR/index.html

GPR Suitability Map for Ohio

http://soils.usda.gov/survey/geography/maps/GPR/index.html

Some Recent Advances in Agricultural Geophysics (continued)

6) Identification of subsurface flow pathways.
7) Estimation of herbicide partition coefficients in soil.
8) Agricultural field and golf course drainage pipe detection and assessment.
9) Soil drainage class mapping.
10) Mapping of flood deposited sand depths on farmland located near river.

Future Trends in Agricultural Geophysics

Although resistivity, EMI, and GPR are the predominant agricultural geophysical methods at present, and these methods will continue to find new uses; it is quite likely that other geophysical methods (magnetometry, seismic, self-potential, etc.) will also find important agricultural applications in the near future.

Possible Examples:

1) Delineation of hydric soil boundaries with magnetic susceptibility measurements (magnetometry and EMI).
2) Soil compaction mapping (seismic).
3) Measurement of soil water potential (seismic).
4) Leak detection at animal waste storage ponds and treatment lagoons (self-potential).

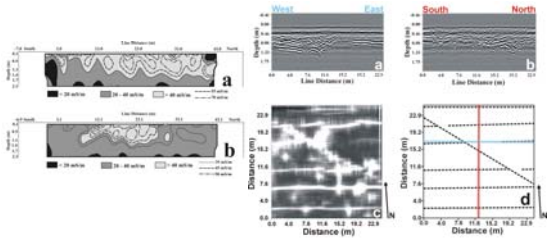
Geophysical equipment may need to be modified for agricultural applications due to rough surface conditions and the need to collect data over large field areas. Furthermore, multi-sensor geophysical systems directly integrated with farm machinery, could allow on-the-go decisions regarding precision farming operations. Seamless integration with RTK-GPS receivers will become commonplace for single or multi-sensor geophysical platforms.

Different geophysical data acquisition approaches may be required where field access is not possible or where large scale watershed areas need to be surveyed.

Possible Solutions:

1) Geotomography.
2) Airborne measureme

Increased use of geographic information systems, inverse modeling, and expert system software will improve agricultural geophysics data analysis capabilities.



Outreach efforts for the agricultural community need to accelerate with regard to training on the appropriate use of geophysical methods and to provide information on the strengths and limitations of using a specific geophysical method for a needed agricultural application.

1) Short Courses
2) Workshops
3) Field Demonstrations
4) Agricultural Group Invited Presentations

Questions?

www.ag-geophysics.org