FastTIMES

September 2009
Volume 14, Number 3
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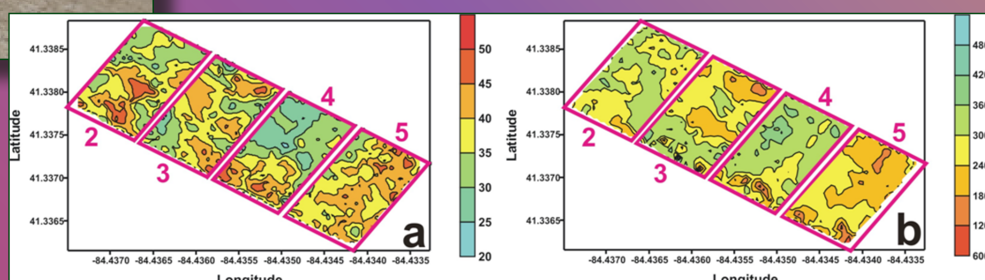
Magazine for the Near-Surface Geophysical Sciences

Published by the Environmental & Engineering Geophysical Society

Advances in Agricultural Geophysics

GPR Soil Suitability Map



Apparent Soil Electrical Conductivity and Soybean Crop Yield Maps

Also in this issue . . .

- Best of SAGEEP 2009
- 9th SEG Japan International Symposium
- 4th ICEEG Conference in China
- Call for Nominations: Frank Frischknecht Leadership and EEGS / Geonics Early Career Awards

. . . and more!

Measuring Apparent Soil Conductivity

On the Cover

This issue features recent advances in the use of geophysics in agricultural engineering. **Upper right:** Ground Penetrating Radar soil suitability map of the conterminous United States. **Center left:** Barry Allred (USDA Soil Drainage Research Unit) conducts a GPR survey.to locate drainage pipes. **Center right:** apparent soil electrical conductivity and the associated soybean crop yield map. **Lower right:** EM induction measurements of apparent soil conductivity (ECa) using the Dualem-1S instrument.

What We Want From You

The ***FastTIMES*** editors appreciate most any geophysical contribution. The suggested topic for the December 2009 issue is the application of geophysics in hydrology. We also welcome photographs and brief noncommercial descriptions of new instruments with possible environmental or engineering applications, news from geophysical or earth-science societies, conference notices, and brief reports from recent conferences. Please submit your items to a member of the ***FastTIMES*** editorial team by November 21, 2009 to ensure inclusion in the next issue.

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FastTIMES

FastTIMES (ISSN 1943-6505) is published by the Environmental and Engineering Geophysical Society (EEGS). It is available electronically (as a pdf document) from the EEGS website (www.eegs.org).

About EEGS

The Environmental and Engineering Geophysical Society (EEGS) is an applied scientific organization founded in 1992. Our mission:

"To promote the science of geophysics especially as it is applied to environmental and engineering problems; to foster common scientific interests of geophysicists and their colleagues in other related sciences and engineering; to maintain a high professional standing among its members; and to promote fellowship and cooperation among persons interested in the science."

We strive to accomplish our mission in many ways, including (1) holding the annual Symposium on the Application of Geophysics to Engineering and Environmental Problems (**SAGEEP**); (2) publishing the ***Journal of Environmental & Engineering Geophysics (JEEG)***, a peer-reviewed journal devoted to near-surface geophysics; (3) publishing ***FastTIMES***, a magazine for the near-surface community, and (4) maintaining relationships with other professional societies relevant to near-surface geophysics.

Joining EEGS

EEGS welcomes membership applications from individuals (including students) and businesses. Annual dues are currently $90 for an individual membership, $50 for a student membership with a ***JEEG*** subscription ($20 without ***JEEG)***, and $650 to $3750 for various levels of corporate membership. The membership application is available at the back of this issue, from the EEGS office at the address given below, or online at www.eegs.org. See the back for an explanation of membership categories.

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The next ***FastTIMES*** will be published in December 2009. Please send articles to a member of the editorial team by November 21. Advertisements are due to Jackie Jacoby by November 21.

Calendar

*Please send additions, errors, and omissions to a member of the **FastTIMES** editorial team.*

2009		2010	
September 7–9	Near Surface 2009: 15th European Meeting of Environmental and Engineering Geophysics, Dublin, Ireland	June 14–17	ICEEG 2010: 4th International Conference on Environmental and Engineering Geophysics, Chengdu, China
September 7–11	ISEG 2009: 10th Symposium on Environmental Geotechnology and Sustainable Development, Bochum, Germany	August 22-26	ASEG/PESA 2010: 21st International Conference & Exhibition of the Australian Society of Exploration Geophysics, Sydney, Australia
September 8–10	Bouyoucos Conference for the Advancement of Geophysical Technologies Applied to Agroecosystems, Albuquerque, New Mexico	September 5–10	IAEG 2010: 11th Congress of the International Association for Engineering Geology and the Environment, Auckland, New Zealand
October 12–14	9th Symposium, Society of Exploration Geophysicists of Japan, Sapporo, Japan		
October 18–21	Geological Society of America Annual Meeting, Portland, Oregon		
October 25–30	SEG International Exposition and 79th Annual Meeting, Houston, Texas		
December 14–18	2009 AGU Fall Meeting, San Francisco, California		

President's Message: No Child Left Inside

Jonathan Nyquist, President (nyq@temple.edu)

October 11-17 is Earth Science Week, a time to celebrate the geosciences! Tuesday of that week, October 13th has been designated "No Child Left Inside Day." I have already rounded up Temple Geology majors as helpers, and made contact with several of the local middle schools in Philadelphia to see if we can get the kids outside for a seismic demonstration (going to have to keep my eye on that sledge hammer).

You should consider how your company or you personally can become involved. The American Geologic Institute (www.agiweb.org), an umbrella organization comprised of 32 geological societies and professional organizations, has created an Earth Science Week website (www.earthsciweek.org) filled with resources for teachers, students, the media, as well as a list of events in your state. Plan a geophysics event to add to the list!

Each year, Earth Science Week has a theme. This year's theme is "Understanding Climate." AGI has assembled a wonderful "toolkit" of materials that includes color earth science posters, a calendar, a "dynamic earth" DVD of NASA imagery, a report on the ecological impacts of climate change, a CD of free GIS activities, bookmarks, activity sheets, earth science contest entry forms, and even a shirt pocket-sized Rite in the Rain field book. Geoff Camphire of AGI tells me that value of the materials in the kit probably exceeds a hundred dollars, but sponsorship has allowed AGI to sell the kits for only $7 each. But wait! As a member society EEGS will receive 50 free toolkits, which I will distribute on a first-come, first-served basis to EEGS members. Just email your request to me at: nyq@temple.edu.

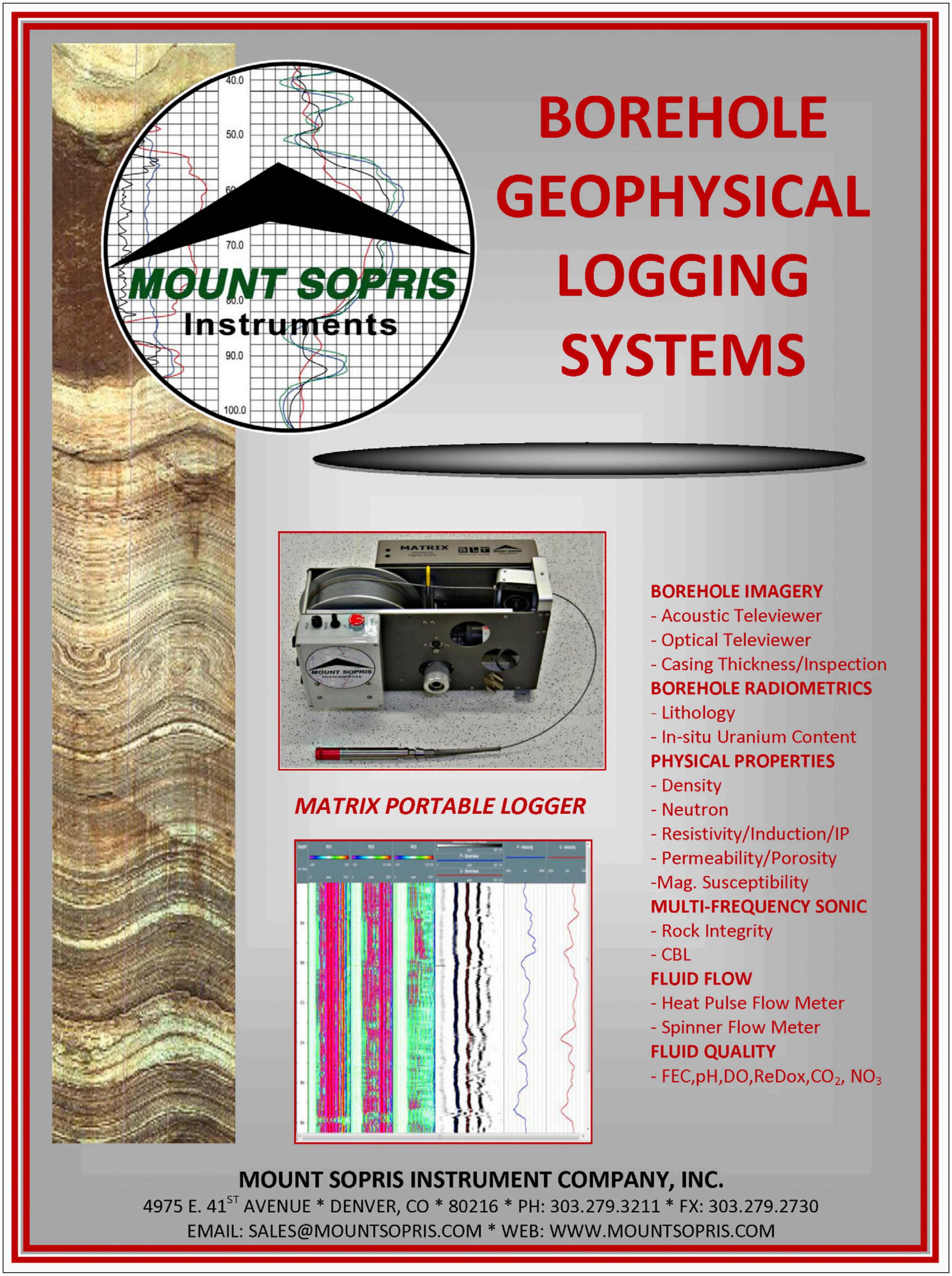
I urge all EEGS members to find a way to participate in Earth Science Week, and to help ensure that on October 13th there is No Child Left Inside.

Renew your EEGS Membership for 2009

Be sure to renew your EEGS membership for 2009! In addition to the more tangible member benefits (including a print subscription to ***JEEG***, ***FastTIMES*** delivered to your email box quarterly, discounts on EEGS publications and SAGEEP registration, and benefits from associated societies), your dues help support EEGS's major initiatives such as producing our annual meeting (SAGEEP), publishing ***JEEG***, making our publications available electronically, expanding the awareness of near-surface geophysics outside our discipline, and enhancing our web site to enable desired capabilities such as membership services, publication ordering, and search and delivery of SAGEEP papers. New this year is an opportunity to donate to the EEGS Foundation during the renewal process. Members can renew by mail, fax, or online at www.eegs.org.

Sponsorship Opportunities

There are always sponsorship opportunities available for government agencies, corporations, and individuals who wish to help support EEGS's activities. Specific opportunities include development and maintenance of an online system for serving SAGEEP papers from the EEGS web site and support for the 2010 SAGEEP conference to be held in Keystone, Colorado. Contact Jon Nyquist (nyq@temple.edu) for more information.



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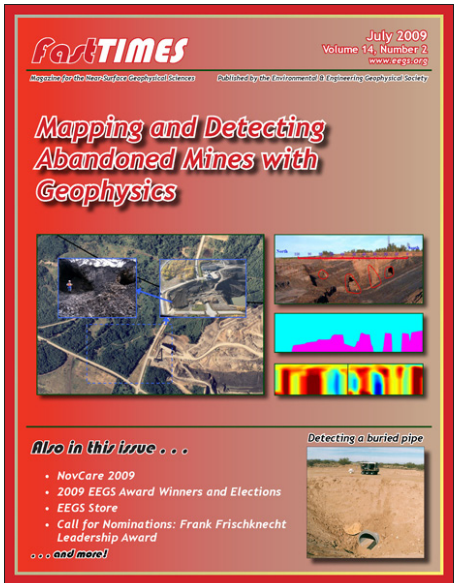


From the FastTIMES Editorial Team

FastTIMES is distributed as an electronic document (pdf) to all EEGS members, is sent by web link to several related professional societies, and is available to all for download from the EEGS web site at www.eegs.org/fasttimes/latest.html. The most recent issue (July 2009, cover image at left) has been downloaded more than 8,000 times through August, and past issues of ***FastTIMES*** continually rank among the top downloads from the EEGS web site. Your articles, advertisements, and announcements receive a wide audience, both within and outside the geophysics community.

To keep the content of ***FastTIMES*** fresh, the editorial team strongly encourages submissions from researchers, instrument makers, software designers, practitioners, researchers, and consumers of geophysics—in short, everyone with an interest in near-surface geophysics, whether you are an EEGS member or not. We welcome short research articles or descriptions of geophysical successes and challenges, summaries of recent conferences, notices of upcoming events, descriptions of new hardware or software developments, professional opportunities, problems needing solutions, and advertisements for hardware, software, or staff positions.

The ***FastTIMES*** presence on the EEGS web site has been redesigned. At www.eegs.org/fasttimes, you'll now find calls for articles, author guidelines, current and past issues, and advertising information.

EAGE Near Surface 2009

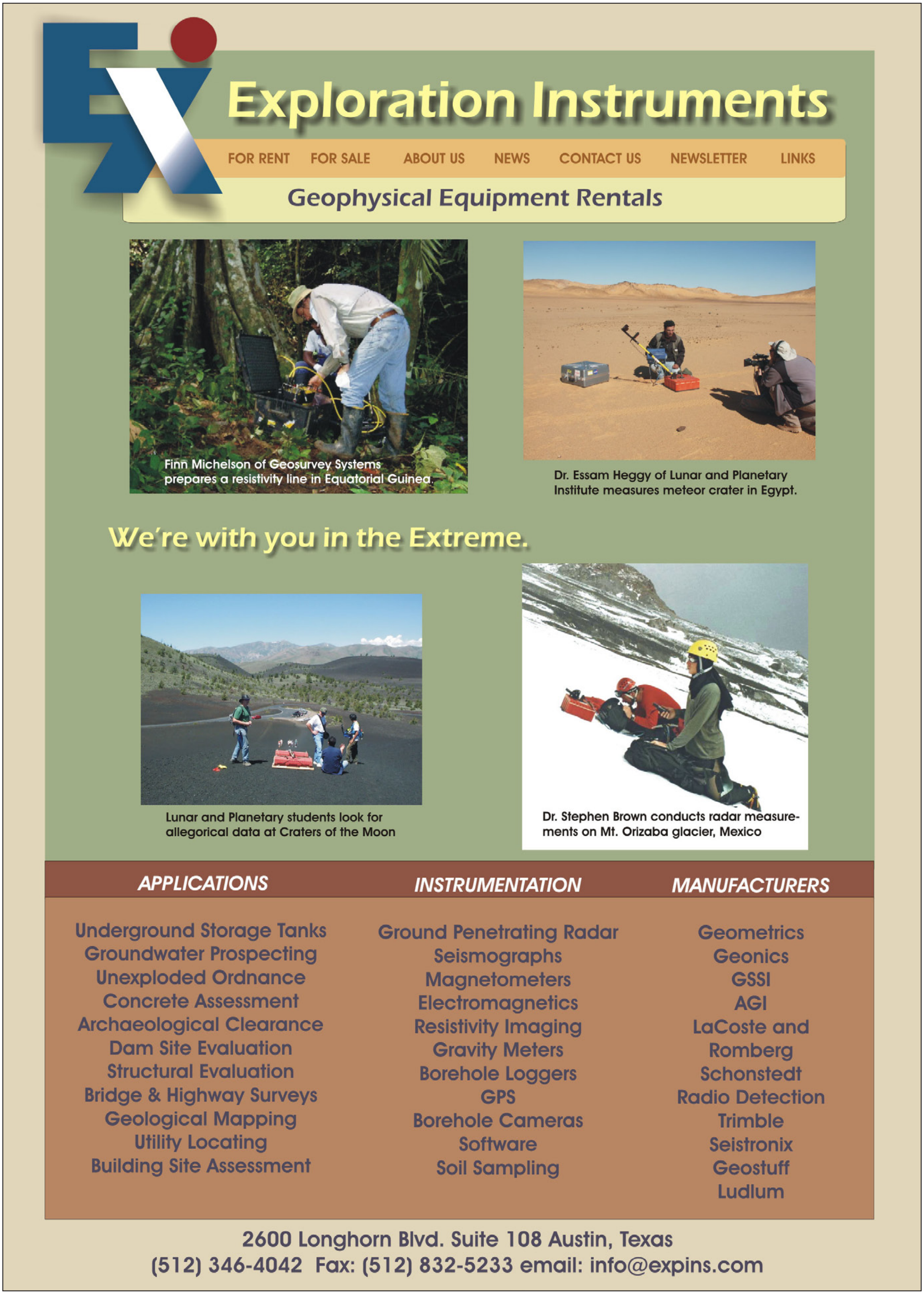
The following "Best of SAGEEP 2009" papers will be presented at the 15th European Meeting of Environmental and Engineering Geophysics of the Near Surface Geoscience Division of EAGE. The meeting was held 7 – 9 September 2009 in Dublin Ireland (see Conferences at http://www.eage.org) for more information.

Geophysics in the Search for Homer's Ithaca
G. Hodges (Fugro Airborne Suveys), D. Kilcoyne (Furgo-Aperio), R. Eddies (Furgo-Aperio) & J.R. Underhill (University of Edinburgh)*

Estimating Debye Parameters from GPR Reflection Data Using Spectral Ratios
J.H. Bradford (Boise State University)*

Application of Magnetic Susceptibility for Wetlands Delineation
A.R. Lobred (U.S. Army Corps of Engineers) & J.E. Simms (U.S. Army Engineer Research and Development Center)*

A New Approach to Predict Hydrogeological Parameters Using Shear Waves from Multichannel Analysis of Surface Waves Method
A.E. Cameron (University of South Carolina) & C.C. Knapp (University of South Carolina)*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The JEEG Page

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Contents of the September 2009 Issue

Journal of Environmental & Engineering Geophysics
v. 14, no. 3, September 2009

Editor's Scratch

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The ***Journal of Environmental and Engineering Geophysics (JEEG)*** is the flagship publication of the Environmental and Engineering Geophysical Society (EEGS). All topics related to geophysics are viable candidates for publication in ***JEEG***, although its primary emphasis is on the theory and application of geophysical techniques for environmental, engineering, and mining applications. There is no page limit, and no page charges for the first ten journal pages of an article. The review process is relatively quick; articles are often published within a year of submission. Articles published in ***JEEG*** are available electronically through GeoScienceWorld and the SEG's Digital Library in the EEGS Research Collection. Manuscripts can be submitted online at www.eegs.org/jeeg/index.html.

EAGE's Near Surface Geophysics Journal, August 2009

*As a courtesy to the European Association of Geoscientists and Engineers (EAGE) and the readers of **FastTIMES**, we reproduce the table of contents from the August issue of EAGE's **Near Surface Geophysics** journal.*

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Near Surface Geophysics

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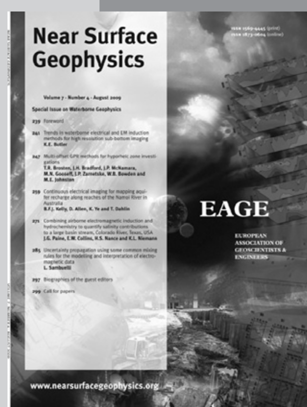
Content

Special Issue on Waterborne Geophysics



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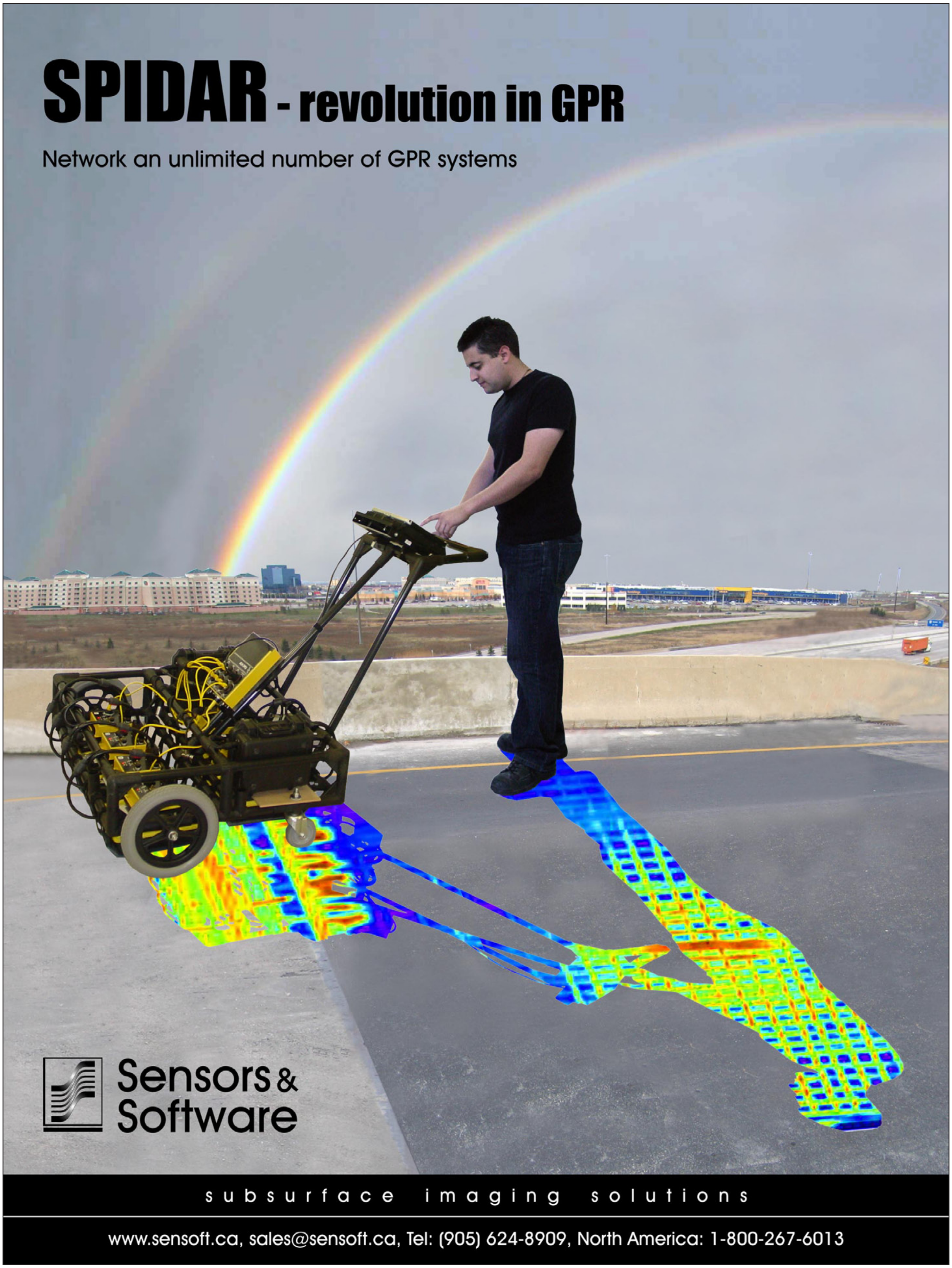
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Success with Geophysics

FastTIMES *welcomes short articles on applications of geophysics to the near surface in many disciplines, including engineering and environmental problems, geology, soil science, hydrology, archaeology, and astronomy. In the articles that follow, the authors present the latest application of geophysical techniques to improve agricultural processes.*

Application of GPS and Near-Surface Geophysical Methods to Evaluate Agricultural Test Plot Differences

by Barry Allred, USDA/ARS, Soil Drainage Research Unit, Columbus, OH (barry.allred@ars.usda.gov), Bruce Clevenger, Ohio State University, OSU Agricultural Extension, Defiance, OH, and Dharmendra Saraswat, University of Arkansas, Department of Biological and Agricultural Engineering, Little Rock, AR.

Introduction

Surface elevation measurements obtained using real-time kinematic (RTK) global positioning system (GPS) receivers and near-surface geophysical surveys can provide important information on topography, buried infrastructure, and soil properties within agricultural settings. This article describes the use of RTK-GPS and near-surface geophysical methods to determine differences between test plots at a agricultural field research facility. The study conducted at this site provides a good example of how RTK-GPS and near-surface geophysics can be employed to characterize farm fields.

The field research facility itself is located in northwest Ohio near the Defiance town airport, and it is being used to evaluate the impacts on crop yield and water quality due to different shallow water table management strategies. Shallow water tables are controlled at the site with subsurface drainage pipe networks that have integrated hydraulic control structures. The decision to construct this research facility was due largely to an airport expansion that encroached on northern portions of pre-existing test plots. Much of the subsurface drainage pipe infrastructure was already in place, and with limited modifications a research facility was built having two pairs of replicated test plots (four total). All four test plots have an area of 1 hectare. The drainage pipe infrastructure, based on construction reports, was expected to be the same for both test plots within a replicated pair of test plots. The drainage pipe infrastructure characteristics described in both the older and also more recent construction reports are listed as follows:

> Test Plot 2 – drainage pipe diameter = 5 cm; drain line spacing distance = 3 and 6 m; drainage pipe depth = 0.51 to 0.61 m.
>
> Test Plot 3 – drainage pipe diameter = 10 cm; drain line spacing distance = 6 and 12 m; drainage pipe depth = 0.76 to 0.91 m.
>
> Test Plot 4 – drainage pipe diameter = 5 cm; drain line spacing distance = 3 and 6 m; drainage pipe depth = 0.51 to 0.61 m. (Same as Test Plot 2.)
>
> Test Plot 5 – drainage pipe diameter = 10 cm; drain line spacing distance = 6 and 12 m; drainage pipe depth = 0.76 to 0.91 m. (Same as Test Plot 3.)

Test Plots 2 and 4 are a replicated pair, and likewise, Test Plots 3 and 5 are a replicated pair. Every test plot is divided into two water table management zones, with each water table management zone having its own hydraulic control structure and drainage pipe system. Figure 1 is a schematic of the facility showing drainage pipe, main conveyance pipe, and hydraulic control structure locations.

Either corn or soybeans are grown on all four test plots, and each year the crop is alternated. The subsurface drainage flow and water quality are monitored at each hydraulic control structure. The advantage this test plot set-up is that in any year, for each replicated test plot pair, two different water table management strategies can be employed and then compared with one another. However, before these comparisons can be carried out, test plot differences regarding topography, subsurface drainage system characteristics, and soil properties needed to be assessed, because these differences can in turn affect differences in the hydrologic response and crop yield between test plots.

Therefore, the objective of this investigation was to evaluate test plot differences using global positioning system (GPS) receivers and near-surface geophysical methods. Real-time kinematic GPS was used to map topography, while also determining coordinates for soil sampling locations and some geophysics measurement locations. Ground penetrating radar (GPR) geophysical methods were employed to assess test plot differences in subsurface drainage system characteristics, since drainage system construction reports are not always accurate. Ground penetrating radar was chosen for this purpose, because it has been proven capable of detecting buried drainage pipes. The feasibility of using GPR to map drainage pipe locations and determine drainage pipe depths has been documented by Allred and others (2004; 2005a; 2005b). Spatial variations in soil properties were gauged by mapping apparent soil electrical conductivity with resistivity methods. There has been substantial research (Banton and others, 1997; Lund and others, 1999; Johnson and others, 2001) demonstrating the usefulness of apparent soil electrical conductivity (EC_a) mapping with resistivity geophysical methods as a means to evaluate spatial changes in soil properties. For this investigation, EC_a maps were employed to determine cone penetrometer probing and soil sampling locations. The soil samples obtained were analyzed in the laboratory, and along with the cone penetrometer readings, then used to quantify the spatial variability of soil properties across the four test plots. Consequently, only through a very rigorous approach involving GPS, GPR, resistivity surveys, cone penetrometer probing, and soil sample analysis could test plot differences in topography, subsurface drainage system characteristics, and soil properties be determined at this particular research site.

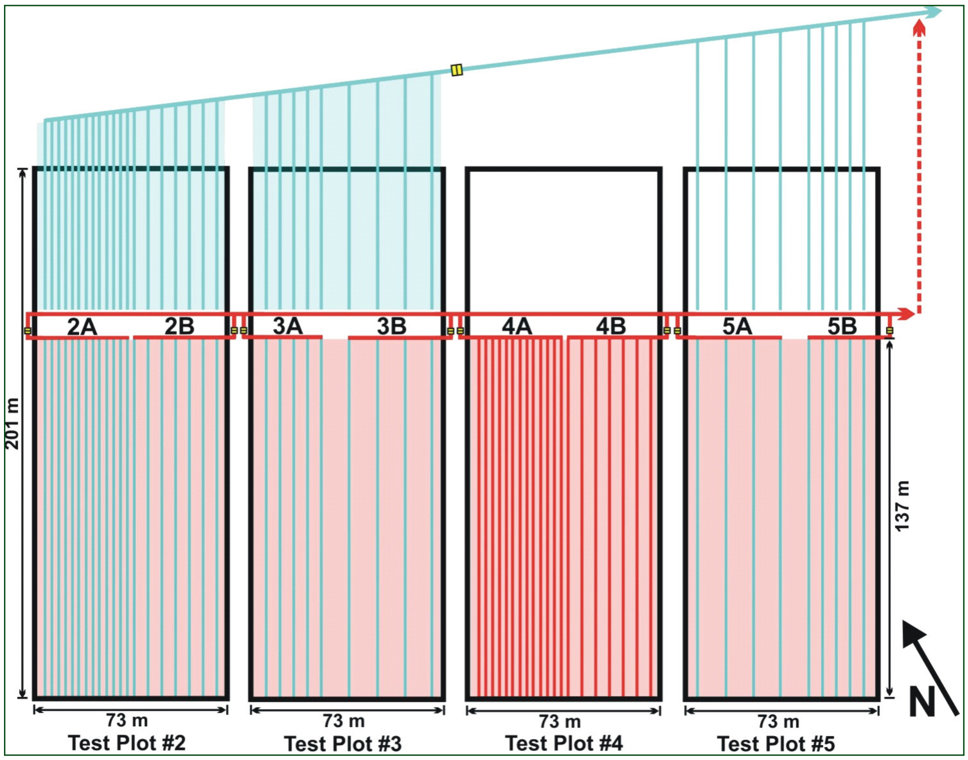

Figure 1. Field research facility schematic based on construction reports. The four test plots are shaded in pink. Blue lines represent pre-existing drainage pipes or main conveyance pipes. Red lines represent recently installed drainage pipes or main conveyance pipes. Small yellow boxes mark positions of hydraulic control structures.

Methods and Equipment

Topographic Surveying

Test plot elevation measurements referenced to sea level along with their associated surface coordinates were obtained with RTK-GPS using a Trimble Navigation Limited (Sunnyvale, CA), A_gGPS 432 receiver (Figure 2a) and A_gGPS RTK Base 450 base station. There were 72 random elevation measurements collected for each test plot. Mean and median elevation values were then calculated for each test plot. A contour map of the surface elevation measurements encompassing all four test plots and a surface gradient vector map that includes all four test plots were generated with the Surfer 8 software package (Golden Software, Inc., Golden, CO).

Figure 2. Site investigation equipment, (a) Trimble Navigation Limited, A_gGPS 432 receiver, (b) Sensors & Software Inc., Noggin[plus] GPR unit with 250 MHz center frequency antennas, (c) Veris Technologies Inc., Veris 3100 Soil EC Mapping System, (d) Veris Technologies Inc., Profiler 3000 cone penetrometer, and (e) Giddings Machine Company, #25-SCT Model HDGSRPST trailer mounted drilling rig.

Evaluation of Subsurface Drainage System Characteristics

The GPR measurements were collected with a Sensors & Software Inc. (Mississauga, Ontario, Canada), Noggin[plus] GPR unit with 250 MHz center frequency antennas (Figure 2b). The 250 MHz antennas were employed because this was the antenna frequency found by Allred and others (2005a) to work best for agricultural drainage pipe detection. Ground penetrating radar measurements were obtained along five southeast-to-northwest transects, numbered 0 through 4 in Figure 3. Each GPR measurement transect was approximately 330 m long. The end points for the GPR measurement transects were determined using the previously described RTK GPS equipment. The distance between GPR measurement points along a transect was 5 cm, and 32 signal traces were stacked at every measurement point. The GPR transects were each divided into eleven segments, and the EKKO_View Deluxe software package (Sensors & Software Inc.) was then utilized to construct a GPR profile for all segments within the five GPR measurement transects. The data processing steps used to generate each GPR profile included a signal saturation correction filter and a constant gain factor of 10, 25, or 50. The GPR profile depth scale is based on a soil profile radar velocity of 0.07 m/ns, which was established via reflection hyperbola curve fitting. The reflection hyperbola responses shown in the GPR profiles were additionally used determine the horizontal positions along the transect for the drainage pipes and the depths of the drainage pipes.

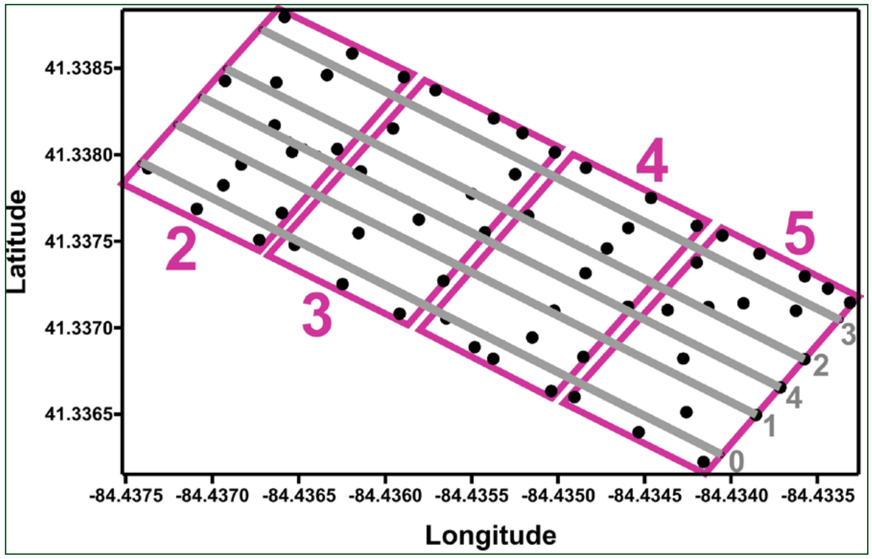

Figure 3. Test plot schematic showing the orientations of the five GPR measurement transects (gray lines) and the locations where both cone penetrometer readings and soil samples were obtained (black dots). Boundaries of the numbered test plots are depicted with purple lines.

Assessment of Soil Property Variation

Apparent soil electrical conductivity (EC_a) is itself a soil property and was measured with galvanic contact resistivity methods using a Veris Technologies Inc. (Salina, Kansas), Veris 3100 Soil EC Mapping System (Figure 2c). The electrodes for the Veris 3100 Soil EC Mapping System are mounted on a steel frame and comprised of 43 cm diameter steel coulters (disks) that cut through the soil to depths of approximately 2.5 to 7.5 cm as they are pulled along behind a vehicle at field speeds of up to 25 km/h. The Veris 3100 Soil EC Mapping System obtains continuous EC_a measurements as it is being pulled, and the data-logging rate is one measurement per second. Measurement locations were determined using an integrated A_gGPS 432 Global Positioning System receiver. The Veris 3100 Soil EC Mapping System has six coulters with non-adjustable spacing (two for electric current application and four for voltage measurement), thereby providing two Wenner electrode array configurations. The shorter Wenner array (0.7 m in length) maps the top 0.3 m of the soil profile, and a longer array (2.1 m in length) maps the top 0.9 m of the soil profile. The focus of this study was on data collected with the longer electrode array, since its depth of investigation coincides better with crop root zone and drainage pipe depths. Mean and median EC_a values were calculated for each test plot for the purpose of directly assessing EC_a differences between test plots. Additionally, an EC_a contour map encompassing all four test plots was generated with the Surfer 8 software package.

The EC_a response is generally considered to be a function of other soil properties. Consequently, the EC_a map covering the four test plots was used as guide for determining cone penetrometer probing and soil sampling locations. Cone penetrometer probing locations and soil sampling locations coincided. The number of cone penetrometer - soil sampling locations for Test Plots 2, 3, and 4 were fifteen, while Test Plot 5 had eighteen cone penetrometer - soil sampling locations (Figure 3). Accurate and precise coordinates for the cone penetrometer - soil sampling locations were determined with RTK GPS. A Veris Technologies Inc. (Salina, Kansas), Profiler 3000 cone penetrometer was employed to evaluate spatial variations in soil compaction (Figure 2d). Cone penetrometer resistance readings from the surface to a depth of 90 cm were averaged at each measurement location used to assess soil compaction at that location. The mean and median values of these cone penetrometer location averages were calculated for each test plot, followed by assessment of differences between test plots for soil compaction. The averaged cone penetrometer resistance (soil compaction) values from each measurement location were then input into Surfer 8 to produce an interpolated grid and contour map across the four test plots for cone penetrometer resistance (soil compaction). The soil samples collected at each location were analyzed for the purpose of evaluating spatial variations of other soil properties. At each soil sampling location, three soil samples were collected, one at a depth interval of 0.0 to 0.2 m, one at a depth interval of 0.5 to 0.7 m, and one at a depth interval of 1.1 to 1.3 m. The three soil samples from different depth intervals at each sampling location were collected using a Giddings Machine Company (Windsor, CO), #25-SCT Model HDGSRPST trailer mounted drilling rig with a 10 cm diameter auger to clear the borehole and a manual 7.6 cm diameter bucket auger to retrieve the actual soil sample. The drilling rig is shown in Figure 2e. Standard laboratory methods were employed to analyze soil sample salinity (Whitney, 1998), pH (Watson and Brown, 1998), percent by weight organic matter (Combs and Nathan, 1998), cation exchange capacity (Warncke and Brown, 1998), polar liquid measured specific surface (Pennell, 2002), percent by weight sand (Wray, 1986), percent by weight silt (Wray, 1986), and percent by weight clay (Wray, 1986). At each sampling location, the three measured values (from different depth intervals) for each soil property were averaged. Therefore, a single averaged salinity, pH, organic matter content, cation exchange capacity (CEC), specific surface, % sand, % silt, and % clay value were determined at each soil sampling location. The mean and median values of these soil property location averages were calculated for each test plot, followed by assessment of differences between test plots for each soil property. The averaged soil property values from each soil sampling location were then input into Surfer 8 to produce an interpolated grid across the four test plots for each soil property. These interpolated soil property grids were statistically correlated to one another, the cone penetrometer resistance interpolated grid, and the EC_a interpolated grid using MapCalc Professional, a map analysis software package (Red Hen Systems, Inc., Fort Collins, CO). This map correlation analysis was conducted to gain insight into the soil properties that have the greatest impact on EC_a.

Results and Discussion

Topography

A surface topographic map of the test plots produced with RTK GPS is shown in Figure 4a. The mean (and median) surface elevations for Test Plots 2, 3, 4, and 5 were 215.87 (215.86), 215.79 (215.80), 215.49 (215.42), and 215.43 (215.40) m, respectively. The maximum elevation difference across the test plot facility is approximately 1 m. The highest elevations are found in the southern portions of Test Plots 2 and 3, while the lowest elevations are present in the northern portions of Test Plots 4 and 5. Tests Plots 3, 4, and 5 appear to have steeper surface gradients than Test Plot 2. Consequently, there may be less surface runoff leaving Test Plot 2 than Test Plots 3, 4, and 5. Grass lined waterways separate the test plots so that no surface runoff can cross from one test plot to an adjacent test plot. The surface gradient vector map (Figure 4b) indicates that the surface water runoff patterns are quite complex and different between test plots.

Subsurface Drainage System Characteristics

The GPR profiles determined that Figure 1 is accurate and that the construction reports are essentially correct for all four test plots in regard to the number of drain lines present and the spacing distance between the drain lines. The construction report drainage pipe depths of 0.76 to 0.91 m for Test Plot 3, 0.51 to 0.61 m for Test Plot 4, and 0.76 to 0.91 m for Test Plot 5 also appear to be accurate. However, GPR profiles show the drainage pipes to be substantially deeper in Test Plot 2 than was indicated by the construction reports. In fact, as is shown in Figures 5a and 5b, there is a drainage pipe depth

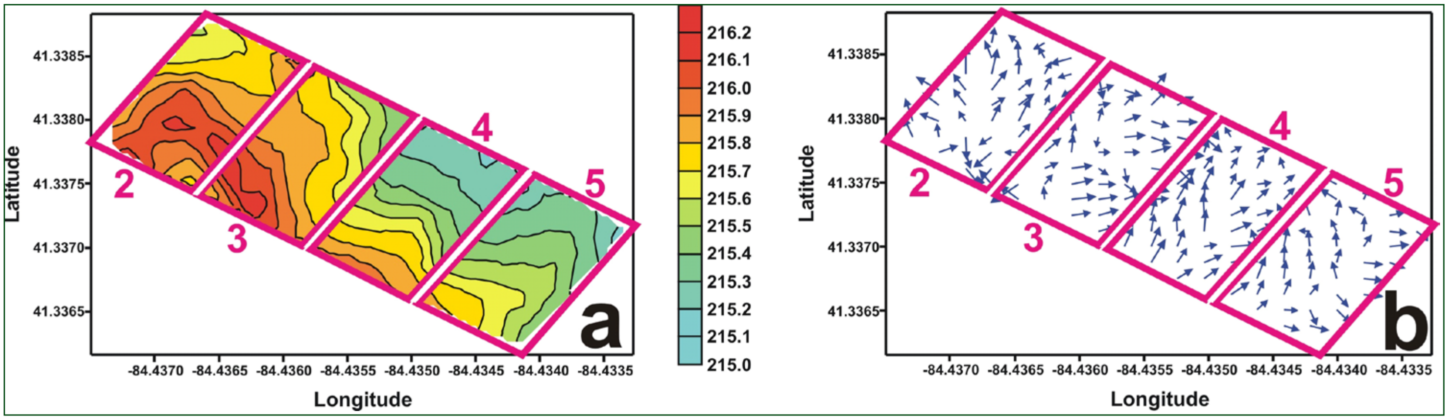

Figure 4. (a) Topographic map of the field research facility with surface elevation values given in meters. (b) Surface gradient vector map.

dissimilarity of 0.25 m between Test Plot 2 and Test Plot 4, which are a replicated pair of test plots. The greater thickness of soil above the drain lines in Test Plot 2 compared to Test Plot 4 could potentially result in more subsurface drainage in Test Plot 2 than Test Plot 4, given certain water table management scenarios. Interestingly, the reflection hyperbola drainage pipe responses are much stronger in the Test Plot 4 GPR profiles than the Test Plot 2 GPR profiles (see Figure 5). This finding may be due to the greater drainage pipe depths in Test Plot 2, or because the Test Plot 2 drainage pipes are partially filled with sediment (Figure 5c), as was discovered when the test plot subsurface drainage systems were being modified. The partially sediment filled drainage pipes in Test Plot 2 could cause problems by restricting the rate of subsurface drainage during extreme flow events.

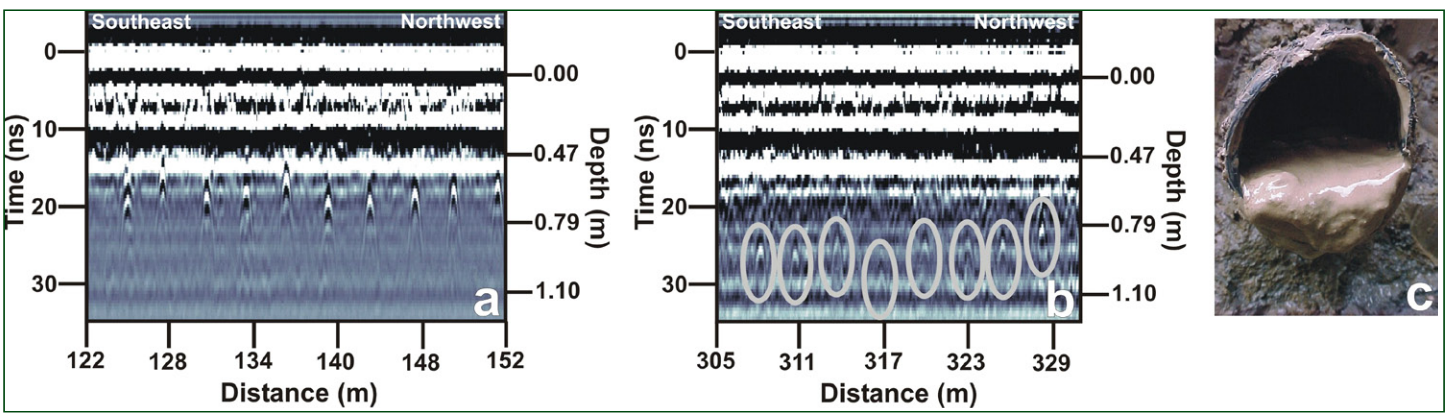

Figure 5. (a) Test Plot 4 GPR profile from measurement transect 2 showing strong drainage pipe reflection hyperbola responses that are positioned shallower in the profile. (b) Test Plot 2 GPR profile from measurement transect 2 showing weak drainage pipe reflection hyperbola responses (highlighted within gray line ovals) that are deeper in the profile. (c) Example of a partially sediment filled drainage pipe from Test Plot 2 discovered during modification of subsurface drainage system infrastructure.

Soil Properties

Figure 6a is an EC_a map covering the four test plots, which was produced from measurements collected with the Veris 3100 Soil EC Mapping System. As shown in Figure 6a there is substantial spatial variability for EC_a within individual test plots and across all four test plots as a whole. For reference, the 2007 soybean yield map is depicted in Figure 6b. As is typical, there is a moderately strong spatial correlation ($r = -0.52$) between EC_a and crop yield, as is also typically the case for EC_a and soil survey map units. The cone penetrometer resistance map is shown in Figure 7, and from appearances, there is not much patter similarity between it and the EC_a or soybean yield maps. Again, the EC_a map shown in Figure 6a was employed as a guide for the cone penetrometer - soil sampling locations, where other soil properties were measured.

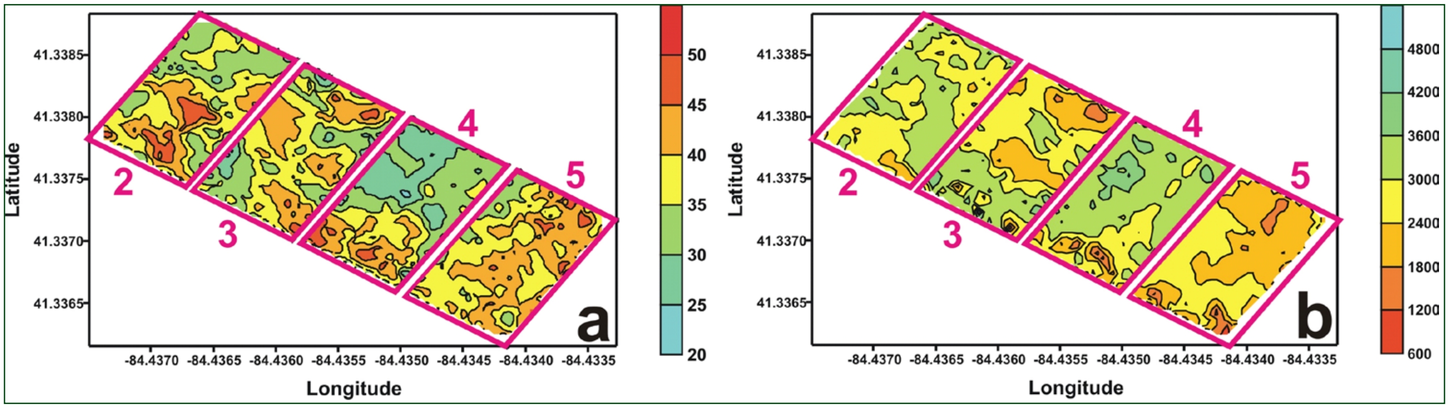

Figure 6. (a) Apparent soil electrical conductivity (EC_a) map (0 cm to 90 cm depth range) of the field research facility with EC_a values given in mS/m. (b) 2007 soybean crop yield map with yield values given in kg/ha.

The mean and median values of each test plot for EC_a and other soil properties are provided in Table 1. As previously discussed, the values in Table 1 are representative of the bulk soil profile from the surface to a depth of 0.9 m for both EC_a and cone penetrometer resistance, and from the surface to a depth of 1.3 m for all other soil properties. Table 1 shows that significant soil property differences exist from one test plot to the next, particularly for cone penetrometer resistance, salinity, percent organic matter, specific surface, and percent sand. To a lesser extent, there are also differences from one test plot to the next for EC_a, CEC and percent clay. Given the same water table management strategy for all test plots, these test plot soil property differences could potentially affect test plot differences in surface runoff amounts, subsurface drainage flow, and subsurface drainage water quality. Interestingly, in Table 1, the trend for EC_a from one test plot to the next is not completely similar to any of the trends found with the other soil properties.

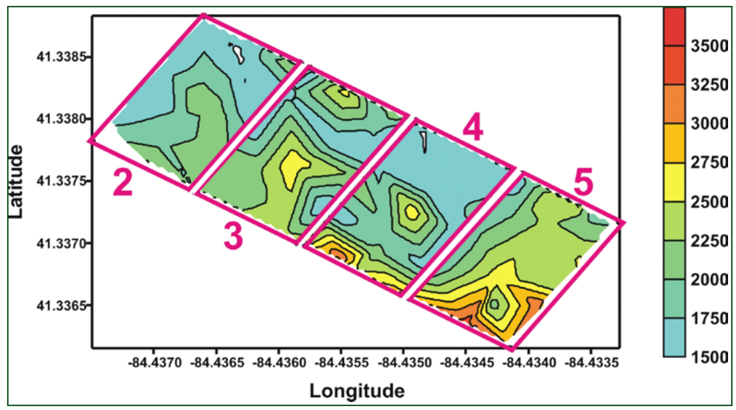

Figure 7. Cone penetrometer resistance map (0 to 90 cm depth range) used to evaluate soil compaction. Values are given in kPa.

Interpolated grids across the four test plots were created for each of the soil properties, including EC_a, and Table 2 provides the spatial correlation coefficients (r) between these interpolated soil property grids. Color highlights indicate the strength of the spatial correlation (either direct or inverse). As indicated by Table 2, EC_a is not strongly correlated with any of the other soil properties. Furthermore, when considering the other soil properties separately (not including EC_a), with a few exceptions, these soil properties do not show extremely strong correlations to one another. These findings presented in Tables 1 and 2, when taken together, are an indication that the EC_a response at this field research facility is not governed by a single soil property, but rather, the EC_a response is governed in a complex manner by a number of soil properties, which themselves are not strongly correlated with one another. Allred and others (2005c) also found poor correlation between EC_a and other soil properties at a test plot in central Ohio. However it should be pointed out that the complex interaction of spatially variable soil properties does produce a spatial pattern of soil productivity reflected by the crop yield maps, which in turn do exhibit moderately strong spatial correlation to EC_a.

Table 1. Test Plot Mean and (Median) Soil Property Values

	Test Plot #2	Test Plot #3	Test Plot #4	Test Plot #5
EC_a[1] - mS/m -	37.1 (36.5)	36.6 (36.7)	34.1 (32.4)	39.7 (39.6)
CPR[2] - kPa -	1869 (1870)	2015 (2119)	2037 (1674)	2350 (2295)
Salinity - mS/m -	78.8 (73.7)	87.6 (94.0)	87.0 (93.2)	93.2 (97.2)
pH	7.20 (7.23)	7.50 (7.55)	7.49 (7.55)	7.31 (7.34)
Organic Matter - % by weight -	0.80 (0.75)	0.88 (0.85)	0.88 (0.84)	1.28 (1.32)
CEC[3] - meq/100g -	26.0 (27.0)	26.7 (26.7)	26.4 (26.7)	28.7 (29.1)
Specific Surface - m^2/g -	93.3 (101.1)	114.0 (112.7)	123.5 (125.0)	128.3 (131.0)
Sand - % by weight -	9.8 (6.3)	10.1 (10.0)	10.0 (9.6)	4.7 (3.7)
Silt - % by weight -	35.9 (36.5)	37.7 (36.9)	37.7 (36.9)	36.9 (36.7)
Clay - % by weight -	54.3 (56.5)	52.2 (51.7)	52.3 (51.9)	58.4 (59.7)

1 EC_a = apparent soil electrical conductivity measured with Veris 3100 Soil EC Mapping System.
2 CPR = cone penetrometer resistance (kPa)
3 CEC = cation exchange capacity.

Table 2. Correlation Matrix for Soil Properties Measured at the Field Research Facility[1]

	EC_a[2]	CPR[3]	Salinity	pH	OM[4]	CEC[5]	SS[6]	%Sand	%Silt	%Clay
EC_a	1.000	0.418	0.502	0.328	0.046	0.467	0.024	-0.156	0.051	0.119
CPR		1.000	0.473	0.453	0.056	0.369	0.003	0.059	-0.035	-0.035
Salinity			1.000	0.158	0.188	0.788	0.150	-0.112	-0.101	0.173
pH				1.000	-0.438	0.046	-0.252	0.294	0.333	-0.497
OM					1.000	0.427	0.743	-0.570	-0.166	0.660
CEC						1.000	0.338	-0.466	-0.099	0.516
SS							1.000	-0.733	0.179	0.600
%Sand								1.000	-0.282	-0.793
%Silt									1.000	-0.360
%Clay										1.000

1 Cells in purple represent strong correlation (direct or inverse), cells in blue represent moderately strong correlation, cells in green represent modest correlation, and cells in yellow represent weak correlation.

[2] EC_a = apparent soil electrical conductivity measured with Veris 3100 Soil EC Mapping System.
[3] CPR = cone penetrometer resistance (kPa)
[4] OM = organic matter (% by weight).
[5] CEC = cation exchange capacity.
[6] SS = specific surface.

Conclusions

Real-time kinematic GPS, ground penetrating radar, resistivity surveying, cone penetrometer probing, and soil sampling proved to be a useful combination for delineating test plot differences at a field research facility. A topographic map generated from measurements collected with RTK GPS show that there was a 1 m elevation differences across the four test plots that were being investigated. Ground penetrating radar determined that for one pair of replicated test plots, there was a 0.25 m difference in drainage pipe depth when comparing one test plot to the other. The resistivity survey found substantial spatial variations for ECa both within individual test plots and across the four test plots as a whole. The ECa map of the field research facility was used as guide for guide for cone penetrometer - soil sampling locations, where other soil properties were measured. Mean and median values of ECa and the other soil properties were calculated for each of the four test plots. These mean and median values indicate that significant differences exist from one test plot to the next in regard to soil properties. Furthermore, the test plot soil property mean and median values (including those for ECa), along with spatial correlation coefficients, all provide strong evidence, that for this particular site, the ECa response is governed in a complex manner by a number of soil properties, which themselves are generally not strongly correlated with one another. The complex interaction of spatially variable soil properties does produce a spatial pattern of soil productivity reflected by the crop yield maps, which do have a moderately strong spatial correlation to ECa. Overall, the RTK GPS and near-surface geophysical information obtained at this site provided valuable insight on test plot dissimilarities potentially causing differences in the hydrologic response between replicated test plots. Consequently, the significant elevation, subsurface drainage system, and soil property differences between test plots, especially within both replicated pairs of test plots, resulted in a decision to collect baseline hydrologic data at all four test plots under the same water table management strategy. This baseline hydrologic data, which has been collected for two years, will be used to quantify the effects of these test plot differences with respect to subsurface drainage flow, subsurface drainage water quality, and crop yield. This investigation serves as a very good example of how RTK GPS and near-surface geophysical methods can be successfully employed to better characterize a farm field.

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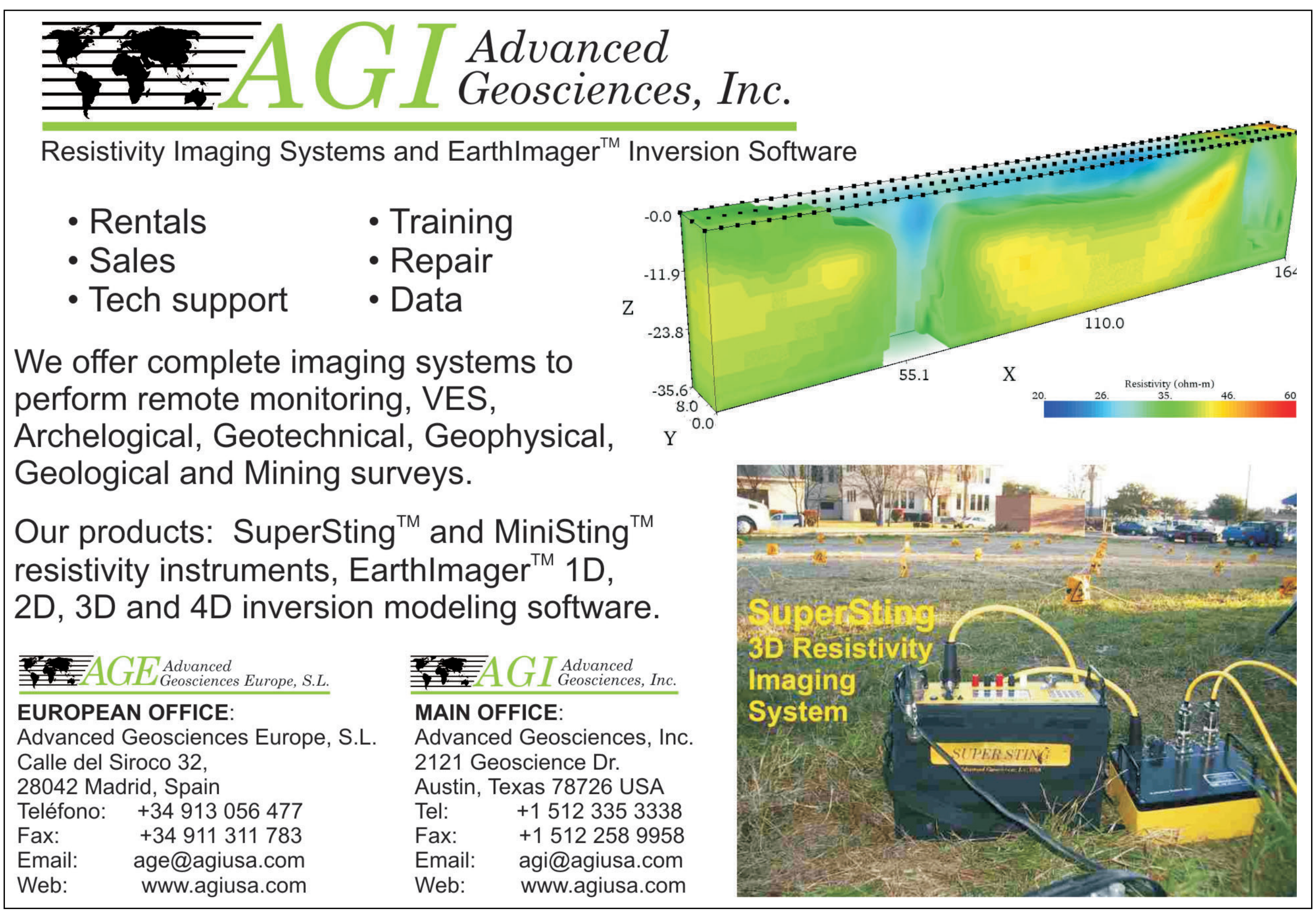
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Ground-Penetration Radar for Soil-Depth Determinations

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The year 2009 marks the thirtieth anniversary of the use of ground-penetrating radar (GPR) within the United States Department of Agriculture (USDA) Soil Survey Division and the National Cooperative Soil Survey (NCSS) Program. Within the NCSS, GPR has been principally used as a quality control tool for estimating the composition of soil map units and improving soil interpretations based on the presence and depth to diagnostic horizons and soil features (e.g., bedrock, stratigraphic layers). In addition, researchers have taken advantage of the high resolution and continuous spatial coverage of GPR to characterize the variability of soils and soil properties.

One of the most effective uses of GPR within the NCSS has been the interpretation of bedrock depths within the soil polygons shown on soil maps. The depth to bedrock not only affects crop yields and forest productivity, but the suitability of sites for roads, shallow excavations, dwellings, small commercial buildings, septic tank adsorption fields, sewage lagoons, and ponds. Soil depth classes are used to distinguish soils and provide appropriate interpretations for their use, management, and behavior. For each soil map unit, soil scientists estimate the dominant soil depth class (es) and provide appropriate interpretations. In many upland areas, however, it is difficult to excavate and examine soil profiles, and determine the depth to bedrock with conventional soil surveying tools (tiling spades, augers, and probes). Rock fragments slow and limit the number of observations and reduce the effectiveness of these hand tools. Soil scientists are often uncertain as to whether auger refusal was caused by bedrock or a large rock fragment. Studies have indicated that the depth to bedrock is frequently underestimated with traditional soil survey tools (Schellentrager and Doolittle, 1991; Collins et al., 1989).

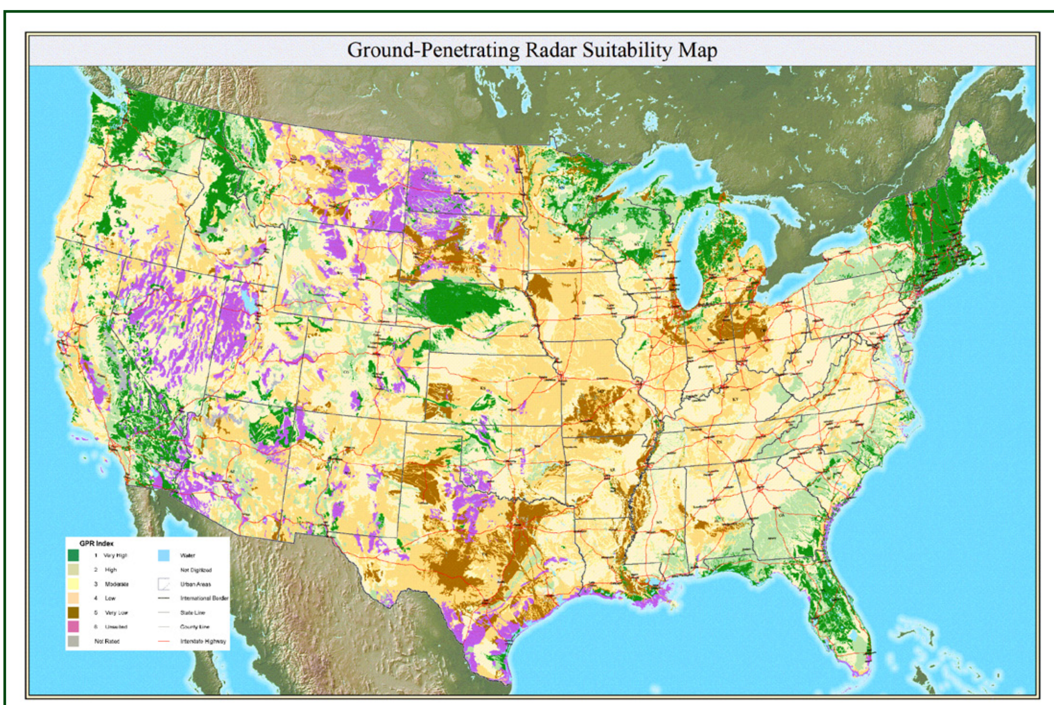

Figure 1. The GPR Soil Suitability Map of the Conterminous United States characterizes the soils in New England as being comparatively well suited to GPR soil investigations.

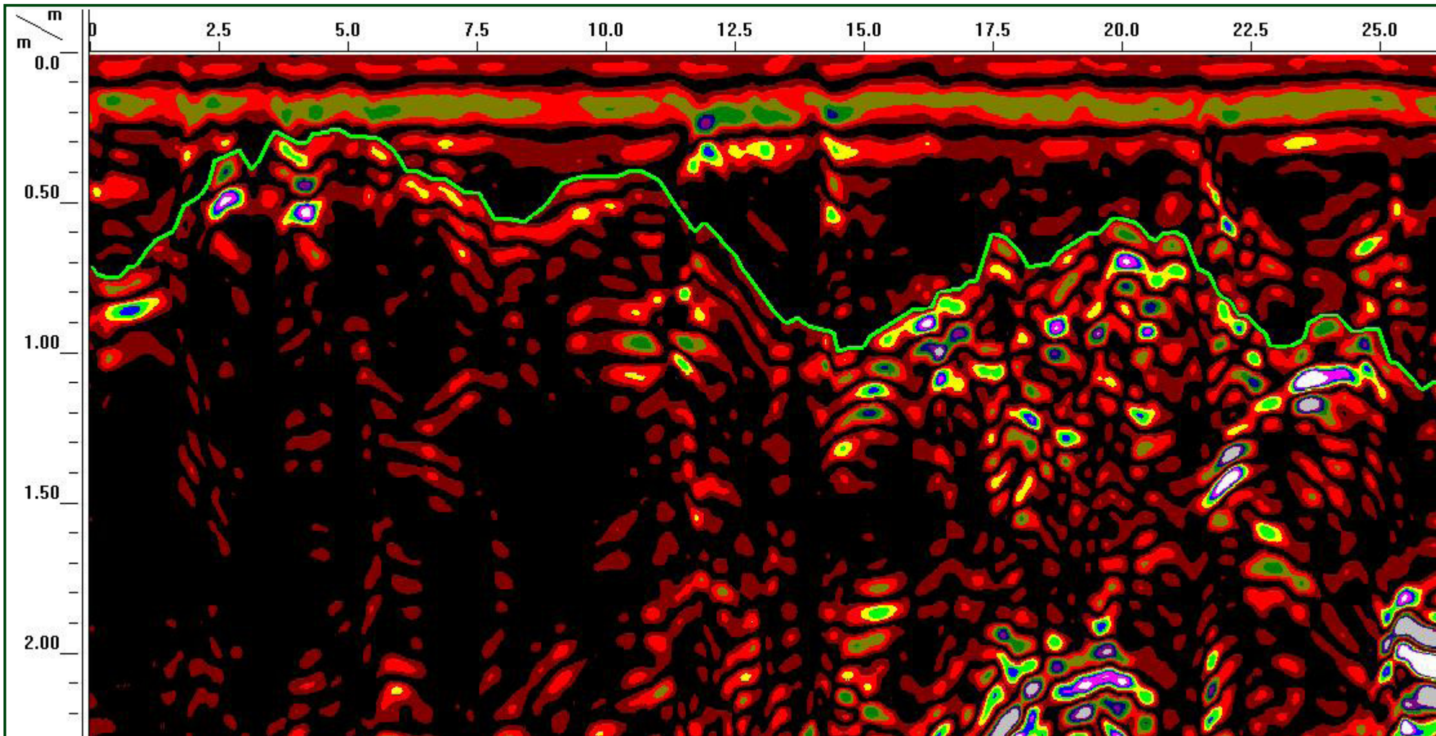

Figure 2. On this radar record from an area Berkshire-Tunbridge fine sandy loam, very stony, on 3 to 8 % slopes, the interpreted bedrock surface has been highlighted with a green-colored line.

Ground-penetrating radar has been used extensively to chart the depths to bedrock (Collins et al., 1989; Davis and Annan, 1989). Ground-penetrating radar can provide high-resolution data on the underlying bedrock, which aids the extrapolation of information obtained with traditional surveying techniques (Davis and Annan, 1989). In upland soils, GPR has been observed to be more reliable and effective than traditional soil surveying tools for determining the depth to bedrock and the composition of soil map units based on soil-depth criteria (Schellentrager and Doolittle, 1991; Collins et al., 1989). Perhaps the most successful and effective use of GPR in the NCSS program has been to estimate the depth to bedrock in upland soils that have relatively low electrical conductivities.

Figure 3. GPR has been successfully integrated with GPS in soil investigations.

Compared with other areas of the United States, New England is characterized on the GPR Soil Suitability Map of the Conterminous United States (Figure 1) as having high potential for most GPR soil investigations (http://soils.usda.gov/survey/geography/maps/GPR/index.html). In New England, upland areas are characterized by soils formed in a thin mantle of glacial drift overlying bedrock. These soils have low clay and soluble salt contents and are considered generally well suited to GPR soil investigations. For soil investigations, GPR must provide consistent penetration depths of 2 to 4 m with high resolution of subsurface soil horizons, stratigraphic and/or lithologic layers.

Figure 2 is a portion of a radar record that was obtained in an area of Berkshire-Tunbridge fine sandy loams, very stony, on 3 to 8 % slopes. This radar record was obtained in the Berkshire Highlands of northwestern Franklin County, Massachusetts. The well drained, very deep (>150 cm) Berkshire and moderately deep (50 to 100 cm) Tunbridge soils formed in till on glaciated uplands. On the radar record shown in Figure 2, the interpreted contact of the soil materials with the underlying schist bedrock has been highlighted with a green-colored line. Rock fragments in the overlying soil, irregular bedrock surfaces, and fracturing make the identification of the soil-bedrock interface ambiguous in some portions of the radar record. Because of the lack of a single, well expressed, continuous, high-amplitude reflection, the picking of the soil-bedrock interface is more unclear in these portions of the radar records, and consequently, the accuracy of interpreted soil depth measurements is lessened. Radar depth-to-bedrock measurements, even in areas of ambiguity, are considered reasonably accurate and infinitely faster and easier to collect than depth-to-bedrock information obtained with traditional soil survey methods.

During the 1990s, it was recognized that GPR soil data needed to be more fully integrated with available digital soil data and maps. A logical trend was to integrate GPR with global positioning system (GPS) (see Figure 3). As noted by Rial et al. (2005), under favorable conditions GPR/GPS integration allows for the accurate positioning of radar data and its importation into geographical information systems (GIS) and other imaging systems. New mapping modules have been incorporated into GPR software programs to visually georeference the GPR data (GSSI, 2008) and widen the scope of GPR surveys (Gustafsson, 2007).

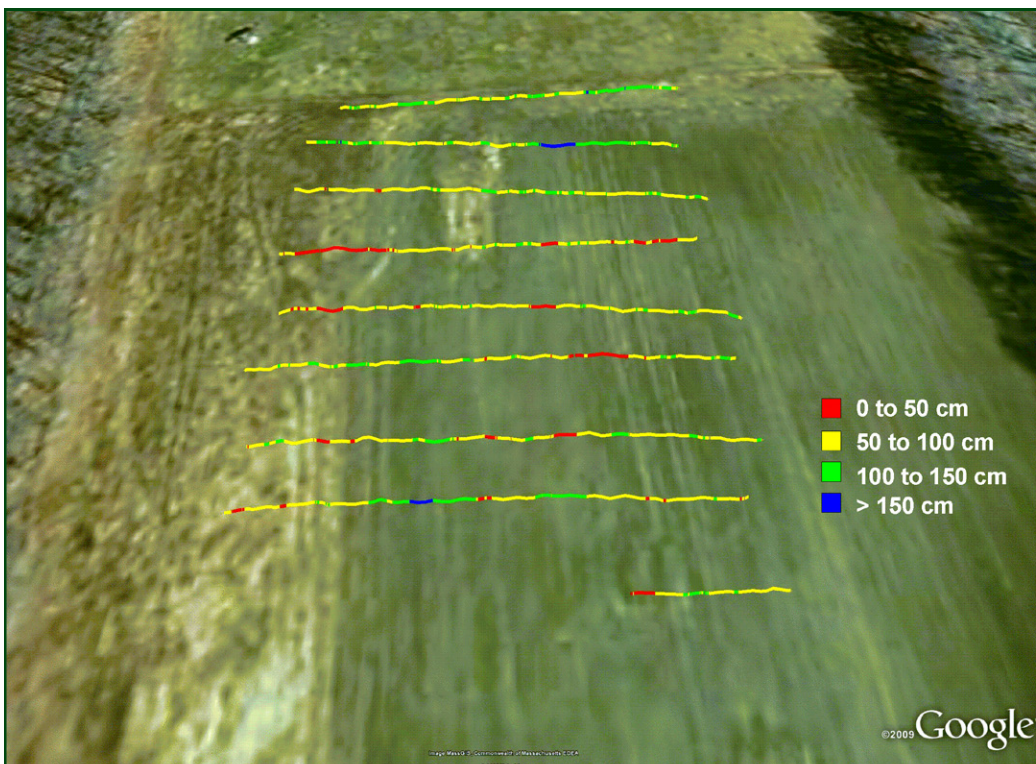

Figure 4. This Google Earth image of a study site in western Massachusetts showing the locations of GPR traverse lines and the interpreted depth to bedrock (by soil depth classes) along these lines.

Current GPR systems and processing software provide for the georeferencing of GPR data collected with a suitable GPS receiver. With GPS, observation points no longer need to be measured or paced-off along traverse lines. As the radar is moved across a soil delineation, its position is continuously tracked with GPS. During post-survey processing of the radar data, the position of each radar scan is proportionally adjusted according to the time stamp of the two nearest positions recorded with the GPS receiver. As each scan of the radar is essentially georeferenced, the integration of GPS with GPR results in large data sets. During data processing, depths to bedrock can be quickly and semi-automatically picked, tracked, and recorded. Because of the complicated, ambiguous, and spatially discontinuous nature of many bedrock surfaces, automatic picking and tracking will probably never fully work in soils.

Figure 4 is a Google Earth image of nine radar traverse lines, which were conducted in a relatively open area of Berkshire-Tunbridge fine sandy loams, very stony, on 3 to 8 % slopes, in northwestern Massachusetts. These GPR traverses were quickly and easily completed across this hay field. At this site, as depicted in Figure 4, depths to bedrock are spatially variable and for the most part less than 100 cm. The interpreted depths are shallower than the central concept of the soil map unit. The average depth to bedrock was 84 cm, with a range of 0 to 237 cm. One half of the interpreted depth measurements were between 65 and 100 cm. Based on radar interpretations soils are shallow (0 to 50 cm) at 10 %, moderately deep at 65 %, deep (100 to 150 cm) at 23 %, and very deep at 2 % of the measurements. The moderately deep Tunbridge soil dominates this site. However, the very deep Berkshire occupies only about 2 % of this soil delineation, which bears the soil's name. After further review of this and other data, the name of this soil polygon may be changed to Tunbridge-Berkshire fine sandy loams, very stony, on 3 to 8 % slopes, to reflect the dominance of Tunbridge soil. Presently, there are no deep soils recognized in this upland setting.

The synergistic use of GPR, GPS, and GIS and other imaging technologies permits the collection of large, tabular, georeferenced GPR data sets, which can be stored, manipulated, analyzed, and displayed. These collection, analysis, and display formats should greatly improve the utility of GPR for addressing map unit composition (based on soil depth criterion) issues, and other quality control concerns within the NCSS Program.

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Subsurface Sensors to Manage Cattle Feedlot Waste

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Introduction

Subsurface sensing tools have been valuable in assessing and managing nutrient resources from beef cattle feedlots. These tools aid collection of biosolids from feedlot surfaces to be utilized by crops, control and utilization of nutrient laden liquid runoff, and feedlot surface management to reduce nutrient losses and gaseous emissions. The work described here was all conducted at the U.S. Meat Animal Research Center (USMARC), Clay Center, NE (40°32' N, 98°09' W, altitude of 609 m).

The tool used for mapping the spatially variable biosolids is shown in Figure 1. Electromagnetic induction (mSm^{-1}) measurements of apparent soil conductivity (EC_a) were collected using a Dualem-1S (Dualem Inc., Milton, ON, Canada). The Dualem-1S operates in the horizontal co-planar and perpendicular modes simultaneously, but only the more shallow penetrating perpendicular mode is used in this work. The Dualem-1S was mounted on a nonmetallic trailer or on a plastic sled and pulled by an all-terrain vehicle at approximately 10 km h^{-1}. The EC_a data were recorded and stored (five readings per second) using a Juniper Systems Allegro (Juniper Systems, Inc., Logan, UT) data logger with corresponding global positioning satellite (GPS) coordinates provided by a Trimble (Trimble Navigation Limited, Sunnyvale, CA) AgGPS 332 receiver.

Figure 1. Subsurface sensor (Dualem 1-S) on trailer pulled by ATV using GPS to create maps.

Cattle Feedlots

The pen surfaces are the major source of nutrients to be managed by a feedlot. Understanding the distribution of nutrients on the surface allows the managers to make decisions that are environmentally sound. Subsurface sensing methods have demonstrated that manure nutrient accumulations can be identified. The feedlot pen illustrated in Figure 2 reveals high conductivities around the edges of the pen with lower conductivity in the center; this is typical of a management system that incorporates a central mound constructed of soil. The manure biosolids are deposited around the pen especially on the down slope portion and near the feed bunks. Regression analysis shows apparent soil conductivity, ECa, is highly correlated with volatile solids, total nitrogen, total phosphorus (R^2=0.92, 0.91, 0.93 respectively; Woodbury et al., 2009, in press)

Maps illustrating zones of manure nutrient accumulation could be used to direct pen cleaning efforts. The concentrated biosolids from the feedlot would have added value as fertilizer for land application or composting. Also, zones of higher manure concentrations are more likely to have increased

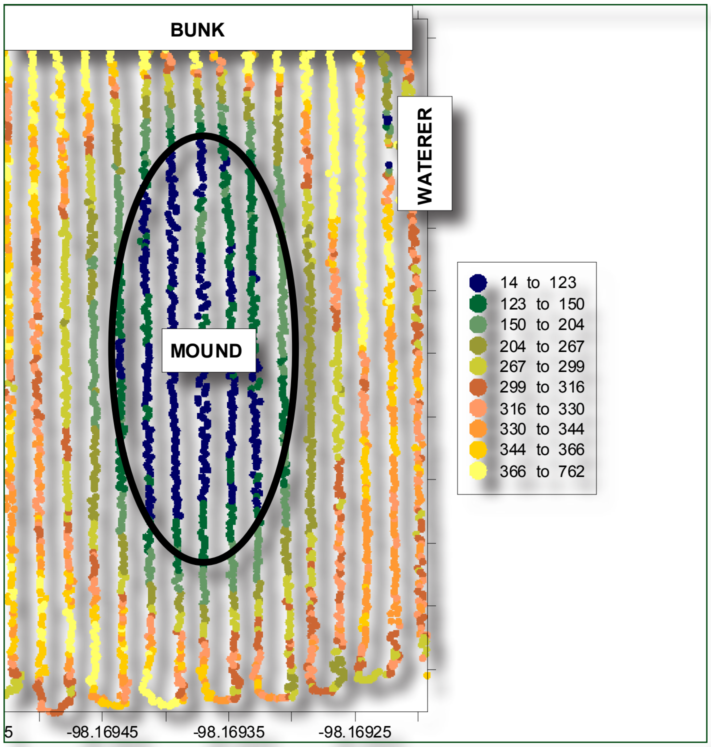


Figure 2. Electromagnetic survey of a feedlot surface. The lower conductivities in the center of the pen are indicative of a feedlot mound constructed of soil.

insect populations and pathogen buildups. The GPS coordinates associated with the mapping technique could be used for precision application of the pesticides or antimicrobial compounds. The same techniques could be applied to reduce malodorous emissions.

Vegetative Treatment Area

Precipitation runoff from beef cattle feedlots can be managed using non-traditional methods; a vegetative treatment system is one such approach that utilized a settling basin and a vegetative treatment area (VTA). The VTA is typically a hayfield designed to utilize nutrients and liquids discharged from the settling basin. Knowledge of liquid distribution is critical for proper management to ensure sustainability. The liquid discharge into the VTA contains high salt levels from the manure on the feedlots making the use of EMI methods viable for tracking liquid flows in the VTA. A Dualem-1S (horizontal response) was used for this study. Figure 3 shows an EC_a map of a VTA at USMARC which has been operating since 1996. The VTA conductivity map shows a range of EC_a values with light areas representing regions of salt accumulation from the liquid discharge.

The EC_a map of the VTA shows relatively uniform flow patterns of salt loading near the discharge areas from the basin. An earlier survey, conducted in August 2005 (not shown) clearly showed greater salt loading near the west end of the VTA (Eigenberg et al., 2008). An investigation revealed that the discharge tubes on that end had settled, allowing more flow into the VTA in that region. A modification was made to the inlets in the spring of 2006 that allowed a more even flow from the tubes. The 2008 image gives evidence of the success of that modification. Also, the image shows salts extending only about one third the length of the VTA which demonstrate the conservative nature of the VTA design. The figure is indicative of a sustainable system since much of the field does not show salt buildup; this view has been supported by nutrient balances showing more nutrients leaving the hayfield in the hay crop than are deposited by the incoming effluent (Woodbury et al., 2002).

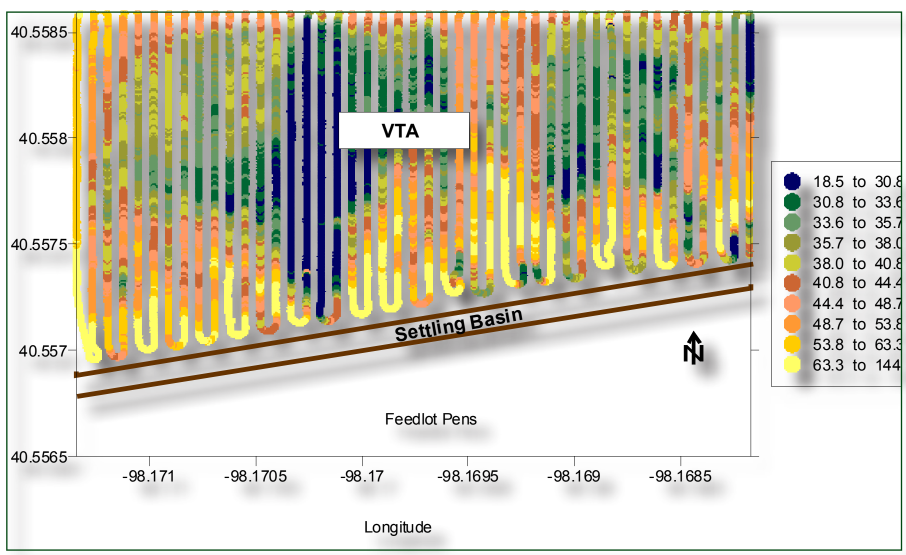


Figure 3. EMI maps survey in 2008 showing feedlot pens that provide precipitation runoff to a VTA at USMARC. Light areas represent high EC_a values.

References

Eigenberg, R.A., Lesch, S.L., Woodbury, B.L., and Nienaber, J.A., 2008, Geospatial methods for monitoring a vegetative treatment are receiving beef feedlot runoff. Journal of Environmental Quality, vol. 37, no. 5 (Supplement), p. S68-S77.

Woodbury, B.L., Nienaber, J.A., and Eigenberg, R.A., 2002, Effectiveness of a passive feedlot runoff control system using a vegetative treatment area for nitrogen control. Applied Engineering in Agriculture, v. 21, no.4, p.581-588.

Woodbury, B.L., Lesch, S.L., Eigenberg, R.A., Miller, D.N., and Spiehs, M.J., 2009, EMI-Sensor data to identify areas of manure accumulation on a feedlot surface. Soil Science Society of America. (Accepted 3/24/09)

Coming Events

***FastTIMES** highlights upcoming events of interest to the near-surface community. Send your submissions to the editors for possible inclusion in the next issue.*

9th SEG Japan International Symposium

October 12-14, 2009, Sapporo, JAPAN

General Chairman: Professor Toru Mogi

The Society of Exploration Geophysicists of Japan (SEGJ) invites you to its 9th International Symposium to be held in Hokkaido University Conference Hall, Sapporo, Japan. The theme of the Symposium is: "Imaging and Interpretation – Science and Technology for Sustainable Development". More than 130 technical papers have been submitted covering a broad range of fields from theoretical developments, laboratory to case studies, in fifteen categories in nineteen sessions.

The three keynote speeches delivered on the first day of the Symposium are:

- "Hokkaido University's Challenges for Realizing Sustainable Society" by Dr. Takeo Hondo (Vice President, Director, Hokkaido Univ.),
- "The Future of People on Planet Earth: Challenges for Geophysicists" by Dr. Daivd Denham (Hon. Secretary of Australian SEG), and
- "Earth Science and Technology for Sustainable Human Society" by Prof. Shuichi Rokugawa (Univ. of Tokyo, President of SEGJ).

Sapporo is the gateway to Hokkaido which is the most popular tourist resort in Japan famous for wildlife, seafood, farm products, hot springs, and scenic mountains, lakes, capes, active volcanoes and more. October is the best time in Sapporo to enjoy the autumn colors and seasonal delicacies. We plan a beer & barbecue dinner and a one–day technical tour to visit an active volcano. Please visit http://www.segj.org/is/9th/ for more information. We look forward to seeing you at the Symposium in Sapporo.

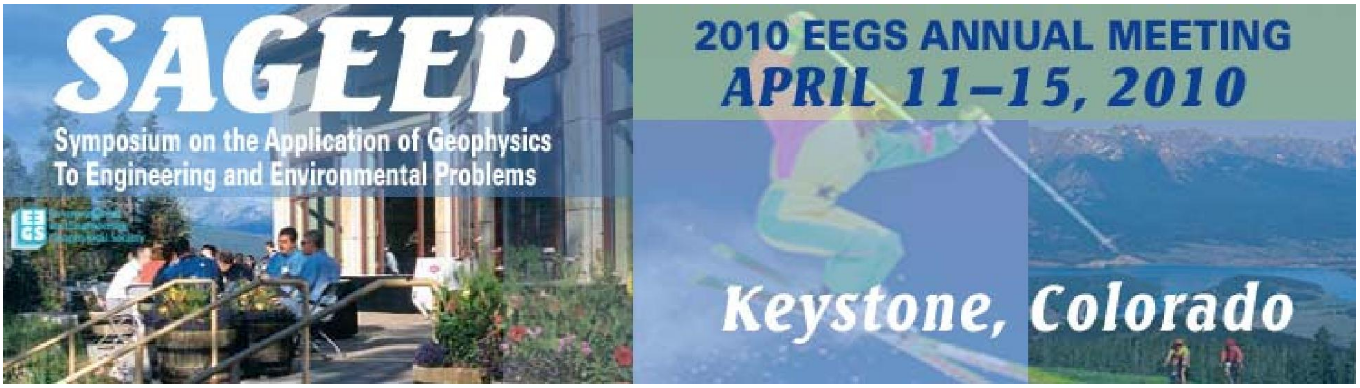
GSA 2009 Annual Meeting & Exposition

October 18-21, 2009, Portland, Oregon

The Geological Society of America is pleased to be holding its 2009 Annual Meeting and Exposition, October 18-21, 2009 in Portland, Oregon, USA. GSA is one of the oldest and most prestigious scientific societies in the world, and many of our members are your employees, colleagues and friends.

There is no better place than the GSA Annual meeting to showcase research, publications, products, and/or services from your company to the geoscience community.

GSA is growing in service and value to geoscientists, and we encourage you to join over 200 other leading businesses and organizations that are choosing to be a part of it! Fore more information, please call Cindy Lu Thompson, GSA Exhibits Management, at (303) 914-0695. You may also get up-to-date details online at http://www.geosociety.org/meetings/2009/exhibits.htm.



Save the Dates!

The Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP) provides geophysicists, engineers, geoscientists and end-users from around the world an opportunity to meet and discuss near-surface applications of geophysics and learn about recent developments in near-surface geophysics. SAGEEP is internationally recognized as the leading conference on the practical application of shallow geophysics. Near-surface geophysics has developed into a valuable tool applied to a wide range of needs and SAGEEP is the one conference where you'll be exposed to the latest developments, equipment and software. It's also where you'll update skills... and contacts.

SAGEEP 2010 is offering exceptional educational opportunities in a quintessential mountain village setting: Keystone, Colorado. April in the Rockies can mean outdoor dining or nearby downhill skiing—but, no matter how you choose to spend your free time, epic scenery and 300 days of sunshine a year make Keystone a perfect SAGEEP 2010 location. Easy access from Denver, Colorado (DIA - Denver International Airport) via a shuttle service, its 21st century conference facilities, free WI-FI in the conference center, your choice of hotel, condo or lodge accommodations, free parking and a fantastic in-town transportation system assure attendees of a memorable and worthwhile SAGEEP experience in Keystone, Colorado.

Call for Sessions/Call for Session Chairs

SAGEEP 2010 conference planners are **seeking session chairs**. Proposed SAGEEP 2010 sessions listed below. Also being accepted are **session title suggestions**.

Call for **Session Ideas Deadline**	Aug. 14, 2009	Call for **Papers**	Sept. 14, 2009
Call for **Student Poster Abstracts**	Sept. 14, 2009	**Paper Deadline**	Dec. 18, 2009

Dam and Levee Session • Near Surface Geophysics in Government Stimulus • Military Uses of Geophysics • Rock Mechanics Session • Infrastructure • Tunneling • Hydrogeology • Urban Geophysics • Salt-Water Intrusion • Geochemistry • Energy Session • Uranium Session • Extreme Geophysics • GPR Session • Geophysical Instruments & Compliance with National Calibrations & Standards • Near-surface Geophysics on Mars

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SAGEEP 2010 Technical Chair
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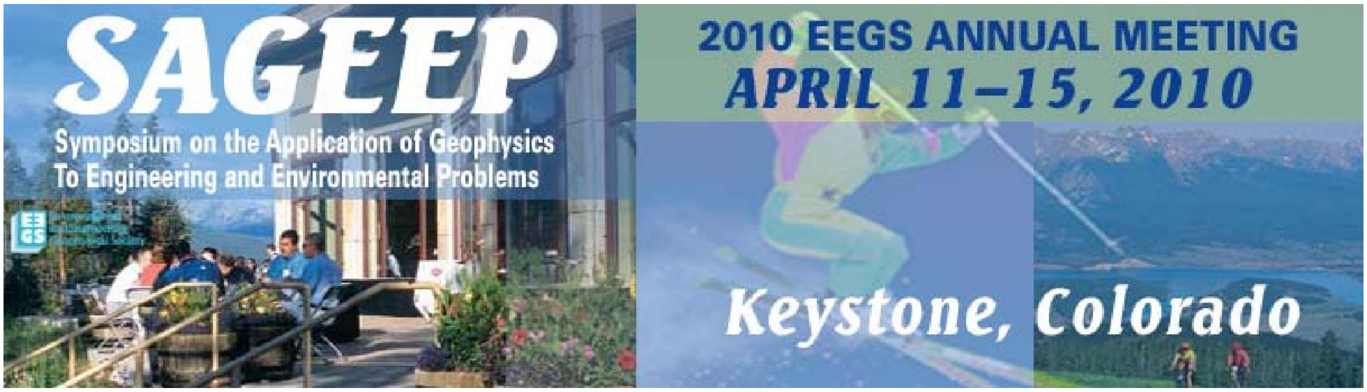

SAGEEP 2010
April 11-15, 2010
Keystone, Colorado USA

SAGEEP is the leading international conference on non-invasive technology for engineering and environmental site characterization. Approximately 400 professionals in the environmental and engineering geophysical community will attend this year's event. Exhibiting companies receive one full complimentary conference registration and two complimentary exhibit personnel registrations for each paid 10' x 10' booth space occupied. So, take advantage of your opportunity for quality exposure at this prestigious symposium.

Exhibitors—Space Available

Who should exhibit? Geophysical and geo-engineering service companies; developers and distributors of geo-scientific hardware and computer software; college/universities; government agencies; manufacturers and sales representatives of geophysical and geo-scientific instruments, equipment, and related supplies; publishers of scientific books and journals; research institutes; and scientific associations. Beginning in August, 2009, access the EEGS web site (www.eegs.org, then click the SAGEEP button and Exhibitor tab), for the SAGEEP 2010 Exhibitor Prospectus.

For more information or to secure your exhibit space at SAGEEP 2010, contact:
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Micki Allen, Exhibit Manager SAGEEP 2010
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Markham, Ontario, L3R 9S9, Canada
Phone: 905.474.9118
Fax: 905.474.1968
E-mail: mickiallen@marac.com

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4th International Conference on Environmental and Engineering Geophysics

June 14~17, 2010, Chengdu, China

The Near-Surface Geophysics and Geohazards

First Announcement

http://www.iceeg.cn/

Sponsoring Hosts

Chinese Geophysical Society
National Natural Science Foundation of China
China University of Geosciences (CUG)
Chengdu University of Technology

Supporters

Chengdu University of Technology

Conference Summary

Geohazard is a kind of natural hazards. In recent years, Geohazards occurred frequently in China and caused serious dangers to people's lives and property. As a branch of geophysics, near-surface geophysics is mainly applied in the detection and assessment rock-soil slopes, ground deformation, mine disasters, and water resource deterioration. The geophysical techniques are non-intrusive, cost-effective, large-scale or small-scale, and can remotely acquire three-dimensional, and even four-dimensional representations of underground media. Due to the broad application of geophysical techniques in the environmental and engineering fields, they are of great significance for the sustainable development of human society.

Having successfully convened the 1st, 2nd, and 3rd International Conference on Environmental and Engineering Geophysics in 2004, 2006, and 2008, respectively, we are once again pleased to be hosting the 4th International Conference on Environment and Engineering Geophysics in Chengdu, China, June 14-17, 2010. It is our pleasure to invite you to participate in this exciting event and to enjoy the hospitality of Wuhan.

This conference is designed to be a wonderful opportunity for all attendees to share your knowledge, experience, and friendship. We strongly believe that you will find great value in your participation in the conference and exhibits. Please do not miss this historic opportunity to present your work.

Invited speakers

Invited distinguished geophysicists and researchers from the Unite States, Canada, Europe, Australia and Asia will present their studies.

Conference topics

The entire spectrum of near-surface geophysical methods and applications.

Call for papers

This conference will offer an opportunity to all geophysicists and engineers to present recent achievements including case studies and theoretical studies in related techniques, software and instruments. The manuscript should not exceed 6 pages (including figures) with an abstract of about 300 words.

Manuscripts should be submitted via email to yechengming@cdut.edu.cn.

The deadline for the manuscripts is December 31, 2009.

Publication of Proceedings

The conference proceedings will be published by an American publisher and be delivered to the International Citation Institution.

Venue and time

The conference will be held on the campus of Chengdu University of Technology, Chengdu, China, June 14-17, 2010.

Registration

Delegate Rate: USD $200; Student Rate: USD $150; 5% off for early birds (early bird deadline is April 30, 2010). Registration includes: icebreaker, keynote session, oral and poster presentations, exhibits, conference program book, Proceedings volume, and all conference lunches and dinners. **Registration will begin on September 1, 2009. You may register via E-mail or fax.**

Hotels

Accommodations during the conference are available on the campus of Chengdu University of Technology. Hotels near the campus are also available.

Social program

Hospitality Suites: Tour of modern and antique places in the city of Chengdu which offer culture, hospitality and gastronomy in original surroundings and downtown shopping.

Language

The working languages of the conference will be English and Chinese.

Post-session trip

The post-session trip will be designed to visit ruins of Wenchuan Earthquake Park.

Ruins of Wenchuan Earthquake Park

Sponsorship Opportunities

Three levels of exhibiting sponsorship are available as follows:

GOLD: USD $2,500, including 10 m^2 exhibit space, 3 complimentary registrations, ten volumes of proceedings (5 in English, 5 in Chinese), and one page in the Conference Program & Exhibitors Directory designed to introduce your company.

SILVER: USD $1,500, including 6 m^2 exhibit space, 1 complimentary registration, 4 volumes of proceedings (2 in English, 2 in Chinese), and a half of a page in the Conference Program & Exhibitors Directory designed to introduce your company.

BRONZE: USD $800, including 1 complimentary registration, 2 volumes of proceedings (1 in English, 1 in Chinese), and one third of a page in the Conference Program & Exhibitors Directory designed to introduce your company. In addition, the icebreaker and farewell dinner during the conference are complimentary for sponsors.

The deadline for booking exhibit space is May 15, 2010. Please visit the website http://www.iceeg.cn/ or contact the organizing committee for details.

About Chengdu

Chengdu, located in southwest People's Republic of China, is the capital of Sichuan province and a sub-provincial city. Chengdu is also one of the most important economic centers, transportation and communication hubs in Southwestern China. More than four thousand years ago, the prehistorical Bronze Age culture of Jinsha established itself in this region. The fertile Chengdu Plain, on which Chengdu is located, is called *Tianfuzhi guo* in Chinese, which literally means "the country of heaven", or more often seen translated as "the Land of Abundance". It was recently named China's 4th-most livable city by China Daily.

Giant Panda, Chengdu

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For more details of the conference, please visit our website http://www.iceeg.cn/, or contact:

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ASEG/PESA
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August 22-26, 2010, Sydney, Australia

Visit the ASEG / PESA web site at http://www.aseg.org.au for more information.

EEGS/NSG Frank Frischknecht Leadership Award

Nomination Deadline: September 15, 2009

The EEGS/NSG Frank Frischknecht Leadership Award is established to recognize an individual who shows extraordinary leadership in advancing the cause of near surface geophysics through long-term, tireless, and enthusiastic support of the environmental and engineering geophysics community. Such leadership is often boldly displayed by an invention, a new methodology or technique, a theoretical or conceptual advancement, or a unique innovation that transforms the nature and capabilities of near surface geophysics. The Frischknecht Award is presented jointly by EEGS and the Near Surface Geophysics Section of the Society of Exploration Geophysicists (NSG-SEG). Past recipients of the joint award are Susan Pullan, Robert Corwin and Kenneth Stokoe.

The award alternates on an approximately 18-month interval between EEGS' SAGEEP and the SEG-NSG Section's annual meeting. It will be given next in October 2009 at the SEG-NSG meeting in Houston.

Send nominations to Barbara Luke, chair of EEGS' Nominations and Awards committee, by email to barbara.luke@unlv.edu or call her at (702) 895-1568 to discuss other means of submission. The nomination should contain the name, title and affiliation of the candidate along with a statement describing the reasons for the nomination. Nominations should be received by Monday September 15, 2009 for full consideration.

Two postdocs at the Colorado School of Mines

1. Induced polarization (time and frequency domains, development ofthe theory, field/lab and inversion of IP datasets) for contaminant plume investigations and permeability tomography For further details see *http://www.epa.gov/oamrtpnc/q0900194/index.htm*.The potential candidates can contact André Revil at *arevil@mines.edu* and Dale Werkema at *werkema.d@epa.gov*. The work will be performed at the Colorado School of Mines under the supervision of André Revil (dept of Geophysics, *http://www.andre-revil.com*) and co-supervision of Burke Minsley (USGS, *bminsley@usgs.gov*) and Dale Werkema (EPA). The candidate is expected to have excellent skills in numerical modeling.

Starting date: As soon as possible.

2. A postdoc to strengthen the connection between TOUGHREACT (developed at Berkeley to model transport phenomena in porous media) and geoelectrical methods (time-lapse induced polarization, self-potential and resistivity). Development of forward modeling and stochastic inverse modeling. The work will be performed at the Colorado School of Mines under the supervision of André Revil (dept of Geophysics, *http://www.andre-revil.com*). The candidate is also expected to spend some time at Berkeley National Laboratory. The candidate is expected to have excellent skills in numerical modeling.

Starting date: As soon as possible.

The EEGS / Geonics Early Career Award

Nomination Deadline: October 31, 2009

The Environmental and Engineering Geophysical Society and Geonics Limited are pleased to announce that nominations are now open for the 2010 EEGS / Geonics Early Career Award, which acknowledges academic excellence and encourages research in near-surface geophysics. The award is presented annually at SAGEEP to a full-time university faculty member who, by the nomination deadline, is

- fewer than five years beyond the starting date of his or her current academic appointment;
- within ten years post-completion of his or her PhD.

The award acknowledges significant and ongoing contributions to the discipline of environmental and engineering geophysics. The recipient may have any specialty that is recognized as part of the environmental and engineering geophysics discipline. This specialty is not restricted to departments, colleges, or geographic regions (international applicants are welcome). A committee of five members (three university faculty, one corporate or consulting representative, and one government laboratory representative), appointed by the EEGS Board, is responsible for selecting the awardee.

The award carries the following benefits:

- Free registration to the SAGEEP conference at which the award will be presented
- A plaque, suitable for display
- A $1000 cash award
- A 45-minute time slot to present the awardee's research and vision at SAGEEP
- The citation and, if available, the awardee's presentation, is published in FastTIMES and distributed to cooperating societies

The awardee will be expected to be present during the technical core of SAGEEP 2010 in Keystone, Colorado. Nominations should be sent electronically to:

Dr. Mel Best, Chair of the Early Career Award Committee
3701 Wild Berry Bend
Victoria, B.C. V9C 4M7 CANADA
(T) 250.658.0791
(E) best@islandnet.com

Nomination packages must include:

- A comprehensive vitae for the candidate
- A letter of recommendation outlining the candidate's qualifications for the award
- Copies or pdf files of three representative publications

The deadline for submission of nominations is October 31, 2008. Questions should be directed to Dr. Best at the address listed above.

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Questions? Call (303) 531-7517

*Payments are not tax deductible as charitable contributions although they may be deductible as a business expense. Consult your tax advisor.

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EEGS welcomes membership applications from individuals (including students) and businesses. The membership application is available from the EEGS office or online at www.eegs.org.

Individual $90

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SAGEEP Short Course Handbooks

	0027	NEW 2009 - Principles and Applications of Seismic Refraction Tomography (Printed Course Notes & CD-ROM) - William Doll	$125	$150
	0028	NEW 2009 - Principles and Applications of Seismic Refraction Tomography (CD-ROM including PDF format Course Notes) - William Doll	$70	$90
	0007	2002 - UXO 101 - An Introduction to Unexploded Ordnance - (Dwain Butler, Roger Young, William Veith)	$15	$25
	0009	2001 - Applications of Geophysics in Geotechnical and Environmental Engineering (HANDBOOK ONLY) - John Greenhouse	$25	$35
	0011	2001 - Applications of Geophysics in Environmental Investigations (CD-ROM ONLY) - John Greenhouse	$80	$105
	0010	2001- Applications of Geophysics in Geotechnical and Environmental Engineering (HANDBOOK) & Applications of Geophysics in Environmental Investigations (CD-ROM) - John Greenhouse	$100	$125
	0004	1998 - Global Positioning System (GPS): Theory and Practice - John D. Bossler & Dorota A. Brzezinska	$10	$15
	0003	1998 - Introduction to Environmental & Engineering Geophysics - Roelof Versteeg	$10	$15
	0002	1998 - Near Surface Seismology - Don Steeples	$10	$15
	0001	1998 - Nondestructive Testing (NDT) - Larry Olson	$10	$15
	0005	1997 - An Introduction to Near-Surface and Environmental Geophysical Methods and Applications - Roelof Versteeg	$10	$15
	0006	1996 - Introduction to Geophysical Techniques and their Applications for Engineers and Project Managers - Richard Benson & Lynn Yuhr	$10	$15

Miscellaneous Items

	0021	Geophysics Applied to Contaminant Studies: Papers Presented at SAGEEP from 1988-2006 (CD-ROM)	$50	$75
	0022	Application of Geophysical Methods to Engineering and Environmental Problems - Produced by SEGJ	$35	$45
	0019	Near Surface Geophysics - 2005 Dwain K. Butler, Ed.; Hardcover Special student rate - 71.20	$89	$139
	0024	Ultimate Periodic Chart - Produced by Mineral Information Institute	$20	$25
	0008	MATLAB Made Easy - Limited Availability	$70	$95
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Publications Order Form (Page Two)

Journal of Environmental and Engineer Geophysics (JEEG) Back Issue Order Information:
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