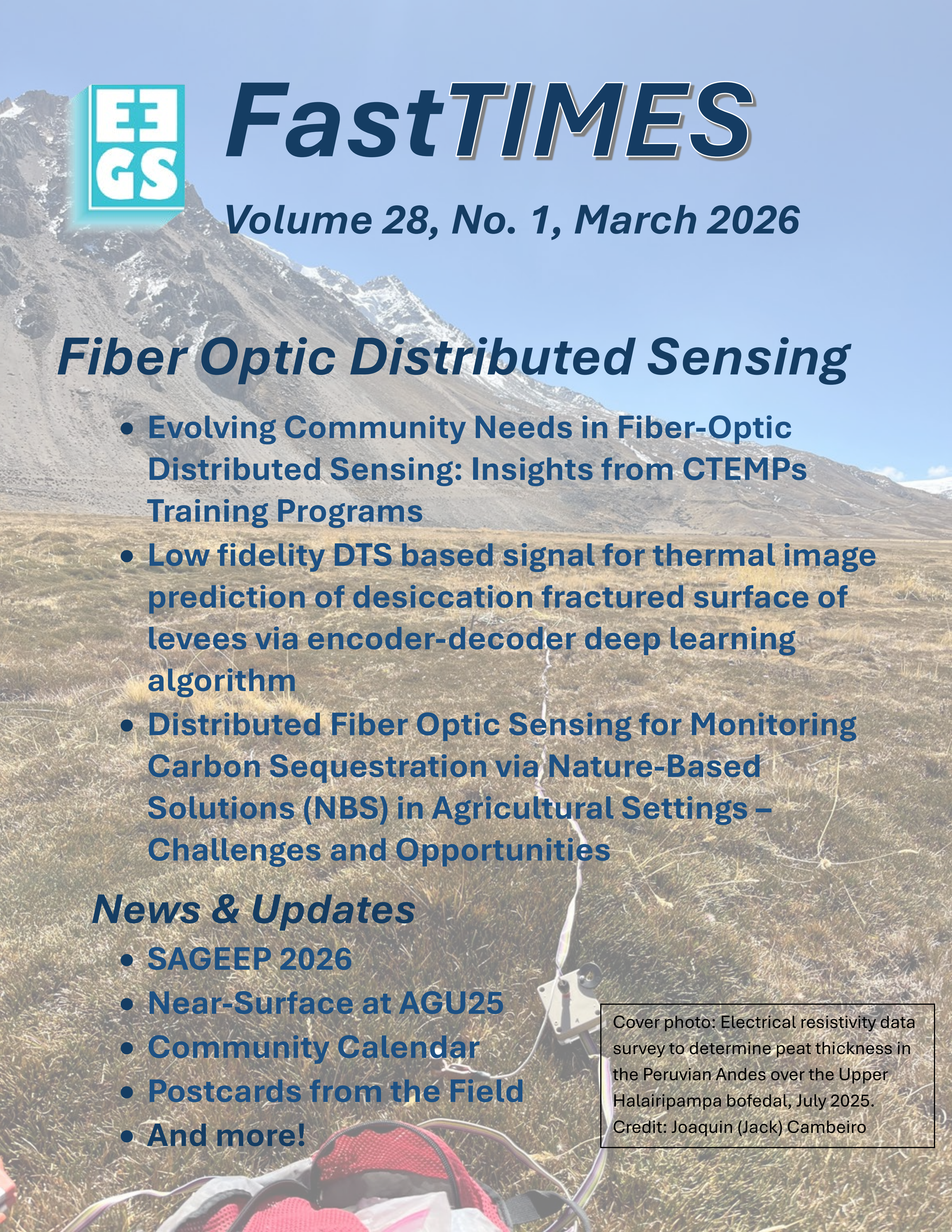

FastTIMES

Volume 28, No. 1, March 2026

Fiber Optic Distributed Sensing

- Evolving Community Needs in Fiber-Optic Distributed Sensing: Insights from CTEMPs Training Programs
- Low fidelity DTS based signal for thermal image prediction of desiccation fractured surface of levees via encoder-decoder deep learning algorithm
- Distributed Fiber Optic Sensing for Monitoring Carbon Sequestration via Nature-Based Solutions (NBS) in Agricultural Settings – Challenges and Opportunities

News & Updates

- SAGEEP 2026
- Near-Surface at AGU25
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- And more!

Cover photo: Electrical resistivity data survey to determine peat thickness in the Peruvian Andes over the Upper Halairipampa bofedal, July 2025. Credit: Joaquin (Jack) Cambeiro

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Corporate Members

The following organizations generously support EEGS and its programs through their corporate membership. We wish to extend our gratitude for their continued support.

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EEGS President

Dale Rucker, President

Certerra Subsurface Imaging

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If you've been in the near-surface world for any length of time, you may have felt that technology is moving faster than words we can use to describe it. We're still "doing ERT," "running seismic," "collecting GPR," but what's changing is what we expect those tools to deliver. We need quick and defensible data to get answers for difficult questions that pertain to infrastructure, minerals, water, and safety. A big part of that shift shows up in this issue's theme on fiber-optic sensing. Fiber is no longer a niche tool that only a few groups can deploy. Heck, we even use it at Certerra (formerly hydroGEOPHYSICS). From the articles in this issue, we see that it's becoming an extremely practical tool.

Once you dive into the articles, you'll notice a pattern that is broadly apparent within our geophysics: more time-lapse monitoring, denser sensor networks, more automation in processing, and more integrated interpretations where geophysics is combined with hydrology, geotechnical observations, remote sensing, and operational datasets. The practical implication is simple in that we're being asked to deliver answers and not just datasets. I see that in my own work.

On the society side, we've got plenty to look forward to in the coming weeks. First, SAGEEP 2026 is coming up March 15–19, 2026, in Pittsburgh. If you're on the fence, I'll give you my biased opinion: go. SAGEEP is where we as near-surface geophysicists stay grounded in real problems and real people. We learn about new methods, hard lessons, and have the kind of hallway conversations that turn into collaborations. And if you're trying to keep costs down, note the Early Bird deadline is March 1, 2026.

Second, our education programs keep getting stronger. GAINS has rolled again in 2026, with 10 weeks of virtual courses, a panel at SAGEEP 2026, and an invitation to connect during the Outdoor Demonstration. All recordings are available to registrants. If you've got early-career staff you want to bring up to speed, or you want a refresher yourself, GAINS is one of the most practical member benefits we offer.

And don't forget TAG (Talk About Geophysics), our webinar series built for interactive learning across a diverse array of technical topics. If you yourself have a topic you'd like to hear, or better yet present, raise your hand. This is your society and I guarantee you will have a big platform from which to share your work.

Finally, a quick note on leadership. EEGS continues to be driven by volunteers who give their time because they care about this community. Our 2024/25 Board roster is posted online, and I'm grateful to work alongside a strong team. Thank you to our outgoing and continuing leaders, and welcome to the new and returning board members and key contributors. Personally, my time as President is quickly coming to an end and I have enjoyed every minute of it.

I hope to see many of you in Pittsburgh.

Best regards,
Dale Rucker
President, EEGS

Environmental and Engineering Geophysical Society

Editor-in-Chief

Cian Dawson

cian@cbdawson.com

Cian discussing community priorities for distributed sensing standards and practices during an AGU25 Science Exchange. Credit: Boris Dessimond.

Welcome to the March 2026 issue of *FastTIMES,* my first issue as the new Editor in Chief. I am excited to build on the long history of *FastTIMES* to share the EEGS community's science and collaborations. My priorities are to:

- Promote EEGS & our community's science.
- Connect members with EEGS activities and with each other.
- Highlight the dynamic and important science being done by our community at all career levels.
- Increase member awareness of opportunities and resources.

Community connections matter more than ever now, at a time when science research is facing significant, often unpredictable funding cuts and downsizing. *FastTIMES* can support community engagement, information sharing, and training within the EEGS community and our partners.

New Recurring Columns

Beginning with this issue, we're launching new recurring topical columns with updates from EEGS and the near-surface community. Most columns will feature a different author each quarter to reflect our diverse expertise and perspectives. Columns debuting in this March 2026 issue include:

- **SAGEEP Updates**:
  News from the SAGEEP coordinating committee.
- **Signals & Systems: Tools & Trends:**
  Updates on innovation, challenges, and opportunities in equipment, software, and systems.
- **Community Meetings:**
  Highlights from recent scientific meetings and conferences of key interest to the community.
- **Learning Lab:**
  Professional development resources, and updates from the EEGS Education Committee.
- **Near-Surface Geophysics Community Calendar:**
  Upcoming conferences, meetings, and deadlines in the broader community.
- **Postcards from the Field:**
  Photos from your recent near-surface geophysics work.

We are also bringing back the **community calendar** to highlight upcoming near-surface events.

Fiber Optic Distributed Sensing: Recent Advancements & Future Directions

Fiber-optic distributed sensing (DxS) has been used in the geosciences for more than 20 years, providing tools for spatially and temporally continuous data at high resolution. While some methods have become routine, others are experiencing rapid expansion and adoption. Examples of DxS include:

- distributed *temperature* sensing (DTS),
- distributed *acoustic* sensing (DAS),
- distributed *chemical* sensing (DCS), and

- distributed *strain* sensing (DSS)

As geophysical tools and methods emerge and rapidly evolve, scientists need training on recommended practices to optimize field survey designs as well as data collection and analysis. **Sara Sayyadi** and colleagues provide an insightful perspective on evolving community professional development needs, based on several years of running CTEMPS training courses. Some of the changes discussed reflect the widespread adoption of DTS and the recent rapid growth of DAS.
Monitoring integrity of flood infrastructure is a vital public safety need, especially as we see changes in precipitation and storms with climate change. **Juan Pablo Aguilar-López and Leonardo Duarte-Campos** share their testing to integrate DTS with remote thermal imaging to detect and characterize desiccation and cracking in an earthen levee.
How can fiber optic systems be used to characterize measuring and forecasting nature-based agricultural outcomes and modeling inputs, such as soil carbon, greenhouse gas emissions, and soil temperature? **Albena Mateeva** explores the potential applications of DAS, DTS, and DCS to address these questions for the agricultural sector.

Community Shoutouts

The saying, "it takes a village" definitely applies to *FastTIMES*, too. I'm sending out a huge thank you to all the community members who took time to brainstorm and share their input. And, thank you to the many formal contributors to this issue, including column authors, technical article authors, and photographers. I also want to express my gratitude to Janet Simms, Immediate Past President, for the time and effort she put into the layout and her support as I learn the ropes of *FastTIMES* production".

Next Issue

Our next quarterly issue, June 2026, will provide highlights and take-aways from SAGEEP 2026 as well as additional community updates. And we may be adding a few additional recurring columns to the mix!

I look forward to continuing to collaborate with all of you!

Cian Dawson
Editor-in-Chief, *FastTIMES*
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SAGEEP Updates

SAGEEP 2026: Geophysics in the 21st Century

SAGEEP is an international gathering of near-surface geophysicists, and this year Pittsburgh, Pennsylvania, was selected as the conference locale. Pittsburgh, for a surprisingly small city has a lot to offer, so the city's selection was prescient. World famous sports teams are located in Pittsburgh including the Steelers, the Pirates, the Riverhounds (soccer), and Forge Rugby. Two major universities are located here, Carnegie Mellon and University of Pittsburgh. Further, 20 additional colleges and universities are located within 100 miles of Pittsburgh. I can go on extolling the benefits of Pittsburgh, including their world-famous Pittsburgh Symphony Orchestra, Carnegie Museum and other museums, but one has to come to Pittsburgh to see why it is often voted the Most Livable City.

Therefore the EEGS Board selected Pittsburgh and with that selection they needed someone local to help organize the conference. I have lived in Pittsburgh for 37 years and started my company 35 years ago here in a suburb so I was asked by Dr. Fred Day-Lewis, VP SAGEEP, to be the General Chair of the conference. This was a task that I have never been asked to perform but as VP of the Pittsburgh Geological Society I had some inkling of the job's tasks. As VP of PGS, my main task for our 275 members (students and professional) was to bring in speakers for our monthly meetings. Interestingly, our monthly meeting in March for our Student Poster Night coincided with SAGEEP's Wednesday events.

My first step as General Chair was to find session chairs for organizing the abstracts, arranging for the courses and organizing student events. Dr. Laura Sherrod (Kutztown University) did an excellent job of organizing the abstracts; Harry Wagner (Pika International) was instrumental in procuring and organizing the courses; and Paul Schwering (PNNL) with Miriam Johnston (USBR) and Dr. Sarah Ranney (USBR), organized the student functions. Finally, the 2026 SAGEEP would not have happened without the astute help of Dr. Fred Day-Lewis (PNNL).

The following tasks more or less happened coevally through our monthly organizing meetings. I introduced the National Aviary, the only one in the country, as an evening event for students to "break bread" with professionals and see the birds for an event I termed "Geophysics is for the Birds." Paul and Miriam worked hard to secure the facility for Monday night and address the evening meal. The facility and dinner ended up being expensive; a subject that I will address subsequently. Next, I suggested that the Carnegie Museum would be an ideal venue for the Tuesday night conference venue. This was also an expensive venue, but I felt that it was worthwhile as it will bring geophysicists together in a very casual atmosphere. Finally, Paul and Miriam organized the GAINS luncheon and Capstone Panel. While not expensive, even though it is a free luncheon, it was becoming painfully clear that we were reaching the financial end for SAGEEP. And I still had to fund and organize the Thursday Field trip to the Tour-Ed coal mine in Tarentum, Pennsylvania.

To meet these venue costs, EEGS needed outside financial support to make SAGEEP 2026 happen. The committee started calling around to companies and people with interest in promoting the conference. We secured over $15,000 from PGS, ASCE-G, AEG, EQT, PCPG, THG, Schnabel, Hager-Richter and Huntley & Huntley. Also, I will be sending a special note of thanks to Keith Mangini from Huntley & Huntley, who donated $5,000 to the Carnegie evening venue and to the Pittsburgh Geological Society for donating an additional $5,000 for various venues including 15 student registrations.

One final task was organizing a field trip that would be appealing to students. Since much of Pittsburgh legacy is based upon the coal industry, I felt it fitting to have the field trip to the Tour-Ed mine, an educational mine that brings visitors ½ mile into a 19th century mine.

The next step or maybe coeval with securing the venues was to find a Keynote speaker and Tuesday luncheon Keynote speaker. In that regard, we got lucky as Dr. Jon Nyquist (Temple University) agreed to be the Monday morning Keynote speaker. Further, Kris Carter of the Pennsylvania Geological Survey agreed to provide a history of the Geological Survey, one of the oldest in the country. Dr. William Harbert, University of Pittsburgh Professor of Geophysics, agreed to provide a Keynote address for the Tuesday luncheon.

All is not finalized as we are currently trying to gain access to Point State Park, the site of French-and-Indian and Revolutionary war forts. To convince the Park authorities to provide access to the site, we are working through a local archeologist to have the Field Demonstration on a portion of the fort footprint with the promise of providing any information we find about the fort to the Park.

All-in-all, SAGEEP 2026 should be a great event with a lot of papers (151) and events.

SAGEEP 2026 takes place March 15–19, 2026. Visit the SAGEEP 2026 website for the technical program, schedule, and more. For SAGEEP questions, please contact staff@EEGS.org

Author: Peter Hutchinson (pjh@thggeophysics.com), Ph.D., PG, is President and Principal Scientist at THG Geophysics; Vice President of the Pittsburgh Geological Society; and the General Chair of SAGEEP 2026.

SAGEEP 2025 attendees participate in field demonstration.

Visit the SAGEEP 2026 for the most up-to-date schedule.

SAGEEP 2026: Geophysics in the 21st Century
SCHEDULE AT A GLANCE

Time	SAGEEP 1 (Grand Ballroom 3)	SAGEEP 2 (Grand Ballroom 4)	SAGEEP 3 (King's Garden 2)
Sunday, March 15			
8:00am-12:00pm	**SC-1: Introduction to the Multichannel Analysis of Surface Waves (MASW) Method** *Instructor: Julian Ivanov, Kansas Geological Survey*		
8:00am-12:00pm	**SC-2A: Ground Penetrating Radar (GPR): Principles, Applications, and Fundamental Data Processing** *Instructor: Dr. Jan Francke, Groundradar*		
1:00-5:00pm	**SC-3: TEM Tools** *Instructor: Laura Quigley, Seequent*		
1:00-5:00pm	**SC-4: Borehole Geophysics with Mount Sopris** *Instructors: Hanna Flamme, Mount Sopris*		
1:00-5:00pm	**SC-2B: Advanced GPR Data Processing, Interpretation Strategies, and Common Pitfalls** *Instructor: Dr. Jan Francke, Groundradar*		
Monday, March 16			
8:15-10:40am	**Opening Session: John Nicholl Memorial, Early Career & Institutional Awards and Keynote Presentations** *(Grand Ballroom 3-4)* **Dr. Jonathan E. Nyquist** - *From Rock Hammers to Python Notebooks* **Kristin M. Carter, PG, CPG** - *The Pennsylvania Geological Survey: An Historical Tale of Four Surveys*		
10:40-11:00am	**Refreshment Break** *(Grand Ballroom 3-4)*		
11:00am-12:00pm	**Milestones in Near Surface Geophysics: A Tribute to Pete Haeni** *(Grand Ballroom 3-4)*		
12:00-1:20pm	**Lunch on Own**		
1:20-3:00pm	Applications of Geophysics to Archaeology and CRM	Milestones in Near Surface Geophysics	Geophysical Methods
3:00-5:00pm	**Ice Breaker - Exhibit Hall** *(Grand Ballroom 1-2)*		
6:00-8:00pm	**Student Event: Geophysics is for the Birds - National Aviary of Pittsburgh**		
Tuesday, March 17			
8:00-10:00am	MASW Resolution Issues & Case Histories	Milestones in Near Surface Geophysics	Munitions Response
10:00-10:20am	**Refreshment Break in Exhibit Hall** *(Grand Ballroom 1-2)*		
10:20-12:00pm	Drone Based Geophysics	Applications of Geophysics in Fractured Rock	Mobile Geophysical Surveying
12:00-1:20pm	**Featured Luncheon Speaker: Dr. William Harbert,** Professor of Geology & Planetary Science, University of Pittsburgh *(Commonwealth)*		
1:20-3:20pm	Drone Based Geophysics	Geophysical Exploration & Characterization for Critical Minerals & Mining	HVSR
3:30-5:00pm	**Outdoor Equipment Demonstrations & Refreshments - Location TBA**		
6:00-8:30pm	**Conference Evening Event: Dining with the Dinosaurs - Carnegie Museum of Art & Natural History**		
Wednesday, March 18			
8:00-10:00am	Applications of AI to Geophysics	New Geophysical Instruments and Technologies	Environmental Geophysics
10:00-10:20am	**Refreshment Break in Exhibit Hall** *(Grand Ballroom 1-2)*		
10:20am-12:00pm	Humanitarian Geophysics	Geophysical Guidance for Undergrounding & HDD Applications	Environmental Geophysics
12:00-1:30pm	**Geophysical Applications in Near Surface (GAINS) Luncheon & Capstone Panel** *(Commonwealth)*		
1:30-3:30pm	Induced Polarization / Spectral Induced Polarization	Using Geologic Insight in Geophysical Interpretation	Geophysics Education and Workforce Development
3:30-5:00pm	**SAGEEP Wrap-Up Reception & Poster Session w/Pittsburgh Geological Society - Exhibit Hall** *(Grand Ballroom 1-2)*		
Thursday, March 19			
8:00am-5:00pm	**SC-5: Advanced Multichannel Analysis of Surface Waves (MASW) method, Active and Passive** *Instructor: Julian Ivanov, Kansas Geological Survey*		
8:00am-12:00pm	**Field Trip: Tour-Ed Coal Mine & Museum - Tarentum, PA**		

Signals & Systems: Tools & Trends

Signals & Systems: Tools & Trends is a new recurring FastTIMES column for updates on innovation, challenges, and opportunities in near-surface geophysical equipment, software, and systems.

Advancing Near Surface Geophysics with New Technologies: A Must-Attend Technical Session at SAGEEP 2026

On Wednesday, March 18, 2026, SAGEEP 2026 attendees will have the opportunity to engage with some of the most innovative developments in near surface geophysics during a special technical session focused on emerging tools, integrated methods, and next generation data interpretation. This session brings together leading researchers, manufacturers, and practitioners who are pushing the boundaries of what is possible in site characterization, infrastructure imaging, and environmental and engineering applications.
This session highlights six presentations that showcase cutting-edge instrumentation, novel survey approaches, and advanced data integration strategies. Together, they offer practical insights for professionals seeking more accurate, efficient, and meaningful subsurface investigations.

High-Resolution S-Wave Tomography with DAS
Dr. Thomas Fechner, GeoTomographie
Dr. Thomas Fechner will present a breakthrough approach to shear-wave crosswell tomography using Distributed Acoustic Sensing (DAS). Traditionally limited by sensor deployment challenges and weak sources, S-wave tomography has seen limited field use. By integrating DAS fibers with a borehole-coupled SV-wave source, Dr. Fechner demonstrates how dense, high-resolution datasets can now be acquired quickly and efficiently.

His work shows how this method improves spatial resolution, reduces logistical complexity, and delivers critical information on soil stiffness and dynamic properties, key parameters for seismic hazard assessment and foundation design. Attendees will gain insight into how DAS-based tomography is transforming geotechnical site characterization.

Creating Above-and-Below Ground Digital Twins
Matthew Wolf, Impulse Radar
Matthew Wolf will explore how UAV-based LiDAR and photogrammetry can be fused with advanced GPR array imaging to create comprehensive digital twins of urban and industrial environments. By combining high-resolution surface models with subsurface imagery, this approach provides a unified visualization platform for infrastructure and environmental investigations.

This presentation highlights how integrated datasets can enhance interpretation, improve communication with stakeholders, and support smarter planning and asset management. It represents the next step in fully digital subsurface investigations.

Portable Seismic Imaging with VPEG
Shawn Clark, RT Clark
Shawn Clark introduces the VPEG-8 and VPEG-16, ultra-portable electromagnetic seismic vibrators developed for shallow and mid-depth imaging. Designed to bridge the gap between traditional seismic sources and lightweight methods like GPR, the VPEG platform offers broadband, low noise performance in a compact, flexible system.
His presentation will detail system design, deployment options, and field results, demonstrating how portable vibrators can enable high quality seismic surveys in challenging environments and tight spaces.

Expanding the Use of Advanced GPR Survey Techniques
Greg Johnson, SPX
Greg Johnson addresses an important gap in current GPR practice: the underuse of advanced survey types beyond standard common-offset reflection. He will

discuss the value of CMP, WARR, transillumination, and variable-polarization surveys for velocity estimation and anomaly detection.

This presentation encourages both researchers and practitioners to explore these underutilized methods and highlights their potential for future commercialization and wider adoption.

Multi-Receiver TEM for 3D Subsurface Imaging
Dr. Pradip Maurya, TEMcompany
Dr. Pradip Maurya presents xTEM, a new transient electromagnetic system designed specifically for multi-offset, multi-receiver acquisition and 3D inversion. By enabling independently synchronized transmitter and receiver stations, xTEM significantly improves sensitivity to complex geological structures.

This system supports high-quality, open-access datasets suitable for advanced inversion workflows. Attendees interested in groundwater mapping, mineral exploration, and complex conductivity studies will find this presentation particularly valuable.

High-Frequency GPR for Burial Investigations
Peter Leach, Geophysical Survey Systems, Inc. (GSSI)
Peter Leach will showcase how high-frequency GPR can be applied to archaeological and forensic burial investigations. Drawing on work at the Jamestown Rediscovery site, he demonstrates how "digital bisection" techniques can reveal burial orientation, preservation, and stratigraphy prior to excavation.

This work highlights the importance of non-destructive geophysics in cultural heritage management and forensic investigations, providing both scientific and ethical benefits.

Why You Should Attend
This session represents a rare opportunity to see how emerging technologies and innovative survey designs are reshaping near-surface geophysics. Attendees will learn how to:

- Improve spatial resolution and efficiency using DAS and portable seismic sources
- Integrate UAV, LiDAR, and GPR data into unified digital environments
- Expand GPR practice beyond traditional survey designs
- Acquire TEM datasets optimized for 3D inversion
- Apply advanced geophysics to sensitive archaeological and forensic work

Whether your focus is infrastructure, environmental assessment, archaeology, groundwater, or research and development, this session offers practical takeaways and forward-looking perspectives.

By bringing together industry leaders and researchers, this session embodies the innovative spirit of SAGEEP and demonstrates how collaboration between science and technology continues to drive our field forward.

Attendees seeking to stay at the forefront of applied geophysics will not want to miss it.

Author: Amber Onufer (ambero@exiusa.com) is a geophysicist and President of Exploration Instruments, LLC. Amber is a long-time active EEGS member and currently serves on the EEGS Board of Directors as the Vice-President Elect – Committees. Catch up with Amber as she convenes the SAGEEP 2026 technical session, *New Geophysical Instruments and Technologies*.

Community Connections

Community Connections is a new recurring FastTIMES column providing highlights from recent scientific meetings and conferences of key interest to the near-surface geophysics community.

Near-Surface Geophysics at AGU25

The geoscience community from around the world came together at the American Geophysical Union (AGU25) meeting along the shores of the Mississippi River in New Orleans, December 15–19, 2025, to share the latest science and connect with colleagues. The 20th anniversary of Hurricane Katrina was a recurring theme throughout the week.

Near-Surface Geophysics

The near-surface community, with leadership through the AGU Near-Surface Geophysics Section (NS), convened dynamic and popular near-surface geophysics sessions all week. New Orleans also provided the perfect backdrop for a few lively and jam-packed informal NS social get-togethers, including the now-annual Women of Color NS Social and the popular NS Student & Early Career Social.

The poster hall was abuzz with discussions during more than a dozen near-surface sessions on topics from open-source tools to active remote sensing. The section also convened about 20 oral sessions on topics from groundwater science and management, to application of electrical methods.

Near-surface geophysics research also appeared across multiple sections, underscoring the field's growing adoption in wider applications including the critical zone, water resources, critical minerals, and hazards.

Two methods that seemed to be very popular this year included induced-polarization work and applications for fiber optic distributed sensing. There were at least four dedicated distributed acoustic sensing (DAS) sessions, in addition to other sessions and a workshop focused on fiber optic distributed sensing more broadly.

One NS member commented that they were pleased to see so many discussions this year on advancing our understanding of fundamental geophysical concepts and processes, in addition to continued innovation around tools, data collection, and computing solutions.

Several near-surface geophysics exhibitors were also present, including a few who bravely participated in the first-ever guided tours of the exhibit hall.

MacGyver Sessions

macgyver-sessions.github.io

2025 was a popular year for "MacGyver Sessions," which showcased the myriad ways in which scientists have hacked together instruments, sensors, and methods to further their work. You can browse some of the posters and presentations through their new MacGyver website. Learn more about the history and spirit of the MacGyver sessions in a December 2025 Eos article.

NSF National Geophysical Facility

The new NSF National Geophysical Facility (NGF) presented as part of a small NSF Earth Science Facilities town hall attended by several near-surface scientists. The NGF was officially funded by NSF and launched by

EarthScope Consortium in October 2025 and builds on past SAGE and GAGE activities. NGF priorities include building enhanced support for near-surface geophysics, although details about this aspect appear to be in early planning stages and were not shared.

The NGF also announced a near-surface community survey soliciting input (now closed). It was unclear from discussions whether current plans incorporate the previous near-surface geophysics community recommendations compiled by AGU at the request of NSF and published in 2023. Near-surface geophysics community members interested in potentially volunteering for NGF advisory committees can reach out directly to EarthScope for more information.

Scaled Down Meeting

The meeting was shorter and noticeably smaller than in recent years, with estimated attendance around 20,000, nearly a third lower than 2024 in Washington, D.C. While the exhibit hall was less crowded, some attendees wondered what voices and science were missing across the meeting.

Many attendees attributed lower participation to funding cuts, reduced international travel, and limited or delayed approvals for federal scientists. For example, USGS attendees only received travel approvals a few days before the meeting.

The conference ran only Monday through Friday morning, reportedly to save on meeting costs. The decision to eliminate Friday afternoon sessions seemed popular, but holding all workshops on weekdays put them in competition with technical sessions.

Overall, despite a significantly smaller footprint, AGU25 underscored the value and importance of near-surface geophysics as a field that remains innovative, increasingly interdisciplinary, and integral to addressing environmental challenges. The AGU25 scientific program is available online.

Acknowledgments: Thank you to community members I spoke with in New Orleans who gamely responded to my questions about their experience at this year's meeting.

Author: Cian B. Dawson (he/him) is a hydrogeophysicist and FastTIMES Editor in Chief. He is active in the AGU Near-Surface Geophysics Section and is on the leadership committee of the new interdisciplinary AGU Distributed Sensing Technical Committee. Comments reflect the author's independent perspective and do not represent the views of AGU or any section or committee.

Learning Lab

Learning Lab is a new recurring FastTIMES column focused on EEGS professional development resources, as well as providing updates from the EEGS Education Committee.

EEGS Training & Educational Resources for Everyone

Looking to sharpen your skills, expand your professional network, or stay current in near-surface geophysics? EEGS offers professional development opportunities for members at all career levels. Below are opportunities to get involved.

Geophysical Applications in Near Surface (GAINS): Training You Can Use

Started in 2024, Geophysical Applications in Near Surface (GAINS) is a virtual training course for EEGS members looking for an introduction or refresher on practical applications in engineering and environmental geophysics.

GAINS 2026 is a 10-week course from January to March 2026. Participants explore a wide array of topics, from ground-penetrating radar (GPR) in the Arctic to mapping and detection of voids, karst, and sinkholes. Training modules are recorded; members who registered but were unable to attend the live event can log in to the EEGS website to view recordings on demand. The 2026 program will close with a luncheon and panel discussion including subject matter experts from industry and academia on Wednesday, March 18, 2026, at SAGEEP 2026.

Talk About Geophysics! Webinars Connecting EEGS Members

EEGS's Talk About Geophysics (TAG) webinars create an informal, interactive space where members can engage directly with subject matter experts, ask questions, and explore cutting-edge geophysical research. Webinars range from scientific presentations to a deeper dive into noted authors' published articles. Missed the latest webinar? Members can view recordings — including Esben Auken's February 2026 webinar on "*Exploring the Depths: New Transient Electromagnetic Methods in Groundwater and Mineral Exploration*," — by logging into the website.

EEGS Student Chapters: Supporting Our Future and Early-Career Workforce

Did you know that EEGS has active student chapters around the United States? The community has been growing, and there are now 10 chapters. Is your school on the list? Reach out to them!

- Binghamton University, SUNY
- California State Polytechnic University, Pomona
- Colorado School of Mines
- Dickinson College
- Kutztown University
- New Mexico State University
- Pennsylvania Western University, California
- Rutgers University
- Texas A&M, Corpus Christi
- University of Kansas

Each student chapter receives up to four free student SAGEEP registrations and one free SAGEEP workshop registration. Interested groups can propose forming a chapter on their campus at any time. Current student chapters are also invited to submit updates and photos for future *FastTIMES* issues.

EEGS Education Committee

The Education Committee advances the EEGS educational mission throughout the career pipeline by coordinating student-focused programs, Society training initiatives, and outreach resources. The committee supports Student Chapters, plans student-oriented activities at SAGEEP, curates member learning opportunities, and reports progress and needs to the Board. Current Committee members include Paul Schwering (Chair), Sarah Morton Ranney, Miriam Johnston, and Trever Ensele. Community members are invited to submit suggestions for future TAG webinars or other events. To contact the Committee Chair, email staff@eegs.org.

Near-Surface Geophysics Community Calendar

EEGS Events

***GAINS workshop:* Archeogeophysics and forensic geophysics**, with Blair Schneider, Ph.D., Kansas Geological Survey
https://www.eegs.org/gains-course-information
5 March 2026

***GAINS workshop:* Geophysics for the Pennsylvania PG exam**, with Kate McKinley, PGp, PG, THG Geophysics Ltd.
https://www.eegs.org/gains-course-information
12 March 2026

SAGEEP 2026
https://www.eegs.org/sageep-2026
15–19 March 2026

Other Community Events

New Frontiers for Geothermal Energy: From Hot Rocks to a Future Low-Carbon Grid, Industry-Rice Earth Science Symposium (IRESS) 2026
https://eeps.rice.edu/iress-2026
9–10 April 2026

Seismological Society of America 2026 Annual Meeting
https://meetings.seismosoc.org
14–18 April 2026

European Geosciences Union (EGU) General Assembly 2026
https://www.egu26.eu/
3–8 May 2026

SEG-AGU Hydrogeophysics Workshop
https://seg.org/calendar_events/seg-aguhydrogeophysics-workshop/
20–22 July 2026

International Meeting for Applied Geoscience and Energy (IMAGE)
https://www.imageevent.org/
17–20 August 2026

Meeting the Challenges of Groundwater in Fractured Rock Conference
https://www.ngwa.org/detail/event/2026/09/21/default-calendar/26sep5017
21–22 September 2026

Near Surface Geoscience 26
https://eagensg.org/
20–24 September 2026

2026 SEG Summit on Drone Geophysics
https://seg.org/events/events-calendar/
26–29 October 2026

Evolving Community Needs in Fiber-Optic Distributed Sensing: Insights from CTEMPs Training Programs

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Abstract
Fiber-optic sensing methods, such as Distributed Acoustic Sensing and distributed temperature sensing, which are capable of high-resolution continuous measurement over large dimensions, have gained importance in environmental monitoring and near-surface geophysics. In addition to the simple operation of the instrument, users require extensive support and advice in experiment design, installation, data handling, and interpretation.

Since 2009, the Center for Transformative Environmental Monitoring Programs (CTEMPs) has progressively addressed this need through hands-on training, initially focusing on shared instruments and field test beds, and later incorporating open workflows. Early activities focused on DTS, but recent workshops place greater emphasis on DAS while still relying on temperature observations to interpret environmental signals. Test-bed experiments and real deployments help participants understand how measurement choices influence the data acquisition and the data interpretation.

Training infrastructure like CTEMPs with a focus on fiber optic sensing technology in the near-surface geophysics community is essential to ensure that these geophysics methods are adopted responsibly, to allow researchers to explore measurement strategies, select technologies, and interpret distributed observations within environmental systems.

Introduction
The Center for Transformative Environmental Monitoring Programs (CTEMPs) was launched in 2009 as a community facility supported by the National Science Foundation (NSF) for advanced high-resolution environmental sensing (Tyler and Selker, 2009).

Early CTEMPs activities focused on fiber-based distributed temperature sensing (DTS), which addressed the community's need for spatially continuous temperature measurements in hydrologic and environmental studies. Rather than improving absolute point accuracy compared to conventional sensors, DTS enabled observation of temperature variations along long distances with a single calibrated system, allowing researchers to resolve patterns and dynamics that discrete sensors could not easily capture. As fiber-optic sensing expanded beyond hydrology into geophysics and infrastructure monitoring, CTEMPs' training and user support services responded to community demand by expanding to incorporate distributed acoustic sensing (DAS), reflecting the increasing interest in applications concerning seismic, infrastructure, and environmental sensing.

This demand was driven by user objectives to make repeatable seismic observations of time-lapse processes over long distances. CTEMPs now operates as a multi-institutional community facility that works on adapting its training to meet new scientific and professional needs.

Fiber-optic sensing is increasingly utilized in disciplines such as environmental monitoring, structural health assessment, and geotechnical engineering. While operating the instrument is straightforward, users often find challenges in designing experiments due to complex environmental variables, installing cables in difficult terrains, and interpreting data that requires advanced analytical skills.

In addition, professional societies and funding agencies have placed increasing emphasis on workforce development and training, which has led to a growing need for hands-on learning opportunities. To meet the growing demand for practical training, CTEMPs provides a comprehensive program that offers access to shared instruments, controlled test environments, and open data exploration workflows. CTEMPs ensures broad accessibility by offering two complementary training formats: a one-day hands-on session at the AGU Annual Meeting and a weeklong summer workshop dedicated to experiment planning and data interpretation.

What CTEMPs Training Looks Like in Practice

CTEMPs training emphasizes direct interaction with DAS and DTS systems in realistic field settings, where participants operate interrogators and observe how installation conditions influence recorded measurements. The most recent trainings have incorporated applied exercises addressing field planning, data quality control, and interpretation challenges to better prepare the community for field deployments.

Participants come from diverse backgrounds of the near-surface geophysics community, including graduate students, academic researchers, environmental consultants, government scientists, and industry partners. Some participants start the training with too many questions to know where to begin, so the CTEMPs trainings try to provide a mix of background material and interactive exercises. For example, in a data management planning exercise, participants work in groups to design hypothetical experiments to study some environmental process they are interested in. They need to identify the spatial resolution requirements, the time over which the process is likely to need to be observed (e.g., minutes, days, months), the signal frequencies likely to be observed (if DAS), and the accuracy requirements. As groups engage in this exercise, many other aspects of the hypothetical study come up in the context of a specific scenario, which makes it easier for some trainees to ask questions that may transfer to other scenarios (Fig. 1).

Figure 1. Hands-on training activities during a CTEMPs workshop. (a) Participants operating DAS equipment in a field demonstration. (b) Fiber-optic installation and data exploration exercises during the workshop. (c) Group photo from the 2025 summer workshop at the Nevada Agricultural Experiment Station test bed. *Photo credits:* (a–b) S. Sayyadi and C. Kratt; (c) A. Harpold.

This training-centered approach has allowed CTEMPs to observe how interests and expectations change across disciplines and career phases, revealing where professional development activities are most effective. At early career stages, participants focus on understanding the physics of DAS and DTS, which informs best practices for fiber optic system installation and data collection and processing. Later career stages are often interested in specific application needs that push the requirements and specifications of the interrogators and cable deployments. All participants seem interested in the cutting-edge technologies and their development by commercial companies.

Fiber Optic Training Test Bed at Reno, Nevada

CTEMPs recently established the 'UNR Farm Fiber Optic Test Bed' to demonstrate the impact of fiber-optic installation decisions on DAS and DTS performance in controlled, real-world-like conditions. The test bed is located at the Nevada Agricultural Experiment Station, which is operated by the University of Nevada, Reno (Fig. 2).

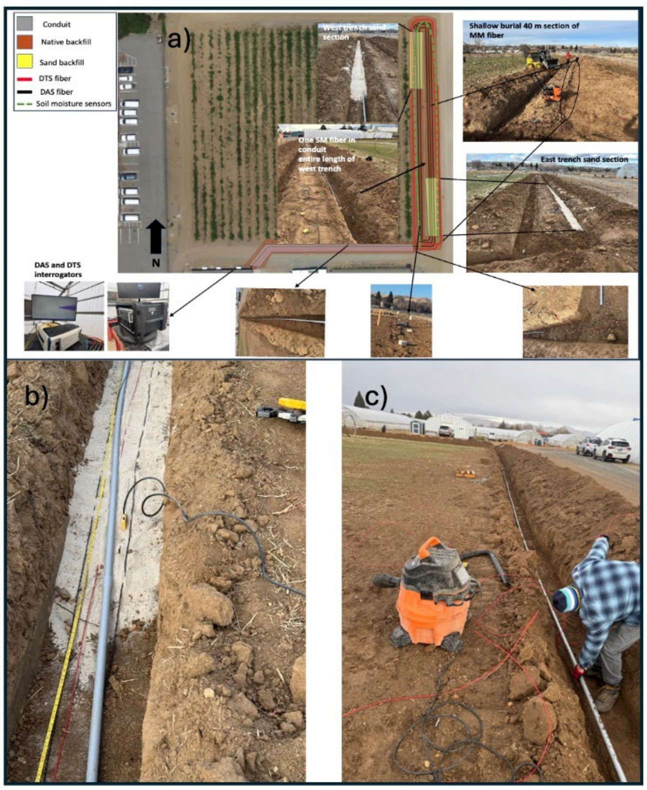

Figure 2. UNR Farm Fiber Optic Test Bed used for CTEMPs training. (a) Overview of the test site showing conduit, sand-backfilled, and native-soil fiber installations. (b) Trench installation examples illustrating different coupling conditions used to evaluate DAS and DTS responses. (c) Field deployment at UNR Farm Fiber Optic Test Bed. ***Photo credits:*** **(b-c) S. Sayyadi.**

This installation was originally built in summer 2025 to investigate coupling effects and compare different DAS units under controlled conditions (Sayyadi and others, 2025a, b). It has been left in place and is available as a test site for CTEMPs instrument users. The site was also used for a hands-on multi-day workshop in 2025 (Werdann, 2025) and served as a learning environment for participants.

At the Farm Fiber Optic Test Bed, fiber-optic cables are installed in a variety of ways: conduit installation, sand backfill, and native soil burial. This setup allows participants to directly explore measurement uncertainty, configuration trade-offs, and failure modes or compare coupling conditions and their impact on a distinct response in both DAS and DTS data (Sayyadi and others, 2025a).

In addition to the test bed-controlled trench installations, a recent CTEMPs workshop incorporated a dark fiber experiment in which a DAS interrogator unit was plugged into the existing telecommunications network in Reno. This new exercise exposed participants to DAS deployment along long, real-world urban infrastructure. These settings demonstrate the steps to collect fiber optic data for urban infrastructure monitoring and earthquake hazards studies (Louie and others, 2026).

Balancing Multiple Types of Instruments in a Single Training

In recent CTEMPs workshops, the interest in DAS has noticeably surpassed that of DTS in near-surface geophysics, where dense sampling or sensitivity to dynamic processes is critical. This difference likely reflects the more recent adoption of DAS within environmental and near-surface research communities, whereas DTS has a longer history of use in hydrologic and environmental studies (Selker and others, 2006). Although interest in DAS has grown rapidly, DTS remains essential in many environmental studies. The low-frequency mechanical signals detected in environmental DAS data are difficult (often impossible) to tease apart from temperature changes that also influence DAS unless temperature data are available simultaneously at the same locations (e.g., Sidenko and others, 2022).

Recent workshops also include sessions with industry representatives, where participants observe different

DAS systems in operation and discuss real-world deployment considerations (Fig. 3). The goal is not to promote specific vendors but to help users understand how instrument characteristics influence experimental design decisions.

Figure 3. a-b) Workshop participants engage with an industry representative at AGU 2025 to compare DAS system behavior and discuss practical deployment choices. *Photo credits:* (a–b) S. Sayyadi

How Training Needs Are Changing—and Where Gaps Remain

As DAS applications expand into new areas, training needs have shifted from instrument operation to experimental decision-making. Participants increasingly focus on questions such as cable selection, burial method, gauge length, and data management choices that strongly influence whether collected data can answer their research questions.

Over time, workshop discussions have focused on experimental decisions and interpretation. Participants now spend more time discussing how measurements should be designed before deployment and how to interpret results afterward.

Implications for Future Fiber Sensing Trainings

To meet the needs of participants with varying backgrounds and levels of experience, the Center for Transformative Environmental Monitoring Programs (CTEMPs) organizes training in modules that combine classroom and field activities. This approach allows participants to work at a basic or more sophisticated level, depending on their own experience and interests, such as advanced experiment design. For example, the majority of environmental scientists do not have formal training in seismology, but the growth of environmental seismology methods (i.e., passive seismic data recording and interpretation of when/where/how signals are occurring) provides a bridge for CTEMPs to meet the needs of participants with and without seismology training. Further, the contemporaneous development of open-source DAS software such as DASCore has lowered the computer programming hurdle to make initial DAS data visualization achievable by a wider range of scientists and engineers (Chambers and others, 2024).

Looking to the future, CTEMP's training will continue to focus on data processing and interpretation together with practical installation of both DAS and DTS systems, with increasing attention to DAS due to its expanding applications in near-surface geophysics. The UNR Farm Fiber Optic Test Bed will remain a central location for training where we can provide a controlled environment where temperature effects, signal behavior, and deployment strategies can be explored before real-world applications. We also aim to strengthen the connections between sensing technologies and hydrogeophysical processes. They also support improved environmental interpretation by utilizing combined DAS and DTS observations. In this way, education shifts from teaching how sensing systems operate to helping researchers understand what their measurements represent, and preparing users to interpret observations may ultimately be as important as providing access to the sensing technology itself.

References

Chambers, D., Jin, G., Tourei, A., Saeed Issah, A. H., Lellouch, A., Martin, E., Zhu, D., Girard, A., Yuan, S., Cullison, T., Snyder, T., Kim, S., Danes, N., Punithan, N., Boltz, M. S., & Mendoza, M. M., 2024, DASCore: a Python Library for Distributed Fiber Optic Sensing. Seismica, 3(2). https://doi.org/10.26443/seismica.v3i2.1184

Louie, J., Barnes, D., Watson, P. J.,and others, 2026, DAS observations of crustal thickness from a 56 km infrastructure fiber: *ESS Open Archive*.

https://doi.org/10.22541/essoar.176745389.93388848/v1

Sayyadi, S., Kratt, C., Hausner, M., Martin, E. R., Wengrove, M., Glover, H. E., and Harpold, A., 2025a, Sensing environmental conditions in fiber-optic DAS and DTS using a field study of varying installation: *SEG International Exposition and Annual Meeting Expanded Abstracts*, 44, 1697–1700. https://pubs.geoscienceworld.org/segeab/proceedings-split/SEGEAB.44/1/1697/725452

Sayyadi, S., Kratt, C. B., Hausner, M. B., Martin, E., Glover, H., and Harpold, A., 2025b, Quantitative comparison of seven DAS interrogators from an active source field experiment at the UNR Farm Fiber Test Area, Reno, Nevada: *AGU Fall Meeting 2025 Abstracts*, Abstract 1922565

Selker, J. S., Thévenaz, L., Huwald, H., Mallet, A., Luxemburg, W., van de Giesen, N., Stejskal, M., Zeman, J., Westhoff, M., and Parlange, M. B., 2006, Distributed fiber-optic temperature sensing for hydrologic systems: Water Resources Research, 42, W12202. https://doi.org/10.1029/2006WR005326

Sidenko, E., Tertyshnikov, K., Lebedev, M., and Pevzner, R., 2022, Experimental study of temperature change effect on distributed acoustic sensing continuous measurements: *Geophysics*, 87, 1–59. https://doi.org/10.1190/geo2021-0524.1

Tyler, S. W., and Selker, J. S., 2009, New user facility for environmental sensing: *Eos, Transactions American Geophysical Union*, 90, 483. https://doi.org/10.1029/2009EO500003

Werdann, M., 2025, CTEMPs hosts hands-on summer workshop and conducts experiment at the Nevada Experiment Station: *Nevada Today, University of Nevada, Reno*, September 26, 2025. https://www.unr.edu/nevada-today/news/2025/ctemps-workshop-and-experiment

Zeman, J., Westhoff, M., and Parlange, M. B., 2006, Distributed fiber-optic temperature sensing for hydrologic systems: *Water Resources Research*, 42, W12202. https://doi.org/10.1029/2006WR005326

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Low Fidelity DTS Based Signal for Thermal Image Prediction of Desiccation Fractured Surface of Levees via Encoder-Decoder Deep Learning Algorithm

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Abstract

Near-surface geophysics aims to understand the physical properties and dynamic behavior of the Earth's shallow subsurface and ground surface, particularly their response to environmental drivers such as atmospheric forcing, moisture variability, and thermal exchange. At the microscale, these processes reflect interactions between soil properties, vegetation cover, and structural heterogeneities, which in earthen flood defenses may lead to localized thermal anomalies associated with surface cracking. Fiber-optic distributed temperature sensing (DTS) provides spatially continuous temperature measurements but remains challenging to interpret in terms of two-dimensional surface behavior. In this study, linearly dense DTS measurements were combined with thermal remote imaging to investigate surface thermal patterns over a cracked, grass-covered peat dike at the Flood Proof Holland test facility. DTS data were interpolated to generate low-fidelity two-dimensional temperature fields, which were used as input to a convolutional encoder–decoder model, while the measured thermal images were used as the desired output. The results show that key surface thermal features can be reconstructed from DTS measurements alone, highlighting the potential of DTS for near-surface geophysical monitoring of earthen flood defenses.

Introduction

Climate change projections indicate an increasing frequency and severity of drought events, which pose a growing challenge to earthen flood defenses constructed from shrinkage-prone soils such as peat and clay (Vardon 2015). Prolonged drying can lead to desiccation cracking, altering near-surface thermal and hydraulic behavior and potentially compromising dike stability. When drought periods are followed by precipitation, cracks may act as preferential flow paths, creating hazardous conditions for flood protection infrastructure (Jamalinia and others, 2019).

Near-surface geophysics provides a framework for investigating such processes by relating observable thermal signals and related them to the physical properties and dynamic behavior of the ground surface. Surface temperature is particularly sensitive to moisture conditions, material heterogeneity, and structural discontinuities. Cracks modify heat exchange mechanisms driven by radiation, convection, and evaporation, resulting in localized thermal anomalies that can serve as indicators of surface degradation (Steele-Dunne and others, 2010). Thermal-based approaches therefore offer a non-invasive means to investigate crack-related processes at the ground surface (Tang and others, 2010).

Fiber-optic distributed temperature sensing (DTS) provides spatially continuous temperature measurements and has been widely applied in near-surface and geotechnical monitoring (Schenato 2017). DTS systems in particular have been used to investigate anomalous water flow, soil saturation, and thermal fluxes in both natural and engineered environments (Dong and others, 2015; Cao and others, 2021). Despite these advances, DTS measurements are inherently limited by their one-dimensional longitudinal sensing geometry, which complicates the interpretation for spatially complex surface phenomena such as desiccation cracking which is inheritably 2D. While temperature anomalies may be detected when a fiber-optic cable traverses a crack, translating these observations into a two-dimensional understanding of surface thermal behavior remains challenging.

Previous work conducted at the Flood Proof Holland experimental facility demonstrated that DTS measurements collected from a cable laid on the surface of a grass-covered peat dike exhibit discrepancies in both magnitude and timing when compared to thermal remote imaging and air temperature observations. Physics-based numerical modeling showed that these discrepancies arise from a combination of environmental forcing and cable-specific effects, including solar radiation, emissivity, and cable–surface interaction. Although such models provide valuable insight into the mechanisms governing the DTS response, their application becomes increasingly complex when attempting to infer spatial surface patterns under variable environmental conditions.

In this study, we explore a complementary data-driven approach to enhance the spatial interpretability of DTS measurements. By combining DTS observations with thermal remote imaging acquired over the same cracked dike surface, a convolutional encoder–decoder model is trained to learn the relationship between low-fidelity DTS-derived temperature fields and high-resolution surface thermal images. Rather than replacing physical interpretation, this approach provides a spatial mapping that links line-based distributed sensing measurements to two-dimensional surface thermal behavior, supporting near-surface geophysical monitoring of earthen flood defenses.

Methodology

Physical setup at the Flood Proof Holland facility

The field experiment was conducted at the Flood Proof Holland (FPH) test facility, an open-air experimental site dedicated to the investigation of soil-based flood defenses under realistic environmental conditions. The monitored dike is approximately 20 m long, 4.5 m wide, and 1.5 m high, and is founded on a peat-based soil layer. The dike was selected due to the presence of a naturally formed surface crack in the grass-covered protection layer, which represents a localized structural heterogeneity commonly observed in earthen flood defenses. The cracked section of the dike was instrumented using a combination of fiber-optic distributed temperature sensing (DTS) and thermal remote imaging. A fiber-optic cable was deployed directly on the dike surface in a meandering pattern, forming multiple parallel transects approximately perpendicular to the crack.

This configuration enabled spatially dense temperature measurements across both cracked and intact grass-covered areas (see Figure 1). A thermal remote imaging camera was mounted on a mast above the instrumented section, providing a fixed field of view covering the crack and surrounding ground surface. Both sensing systems operated continuously and simultaneously over a 20-day monitoring period, ensuring temporally synchronized DTS and thermal observations.

Fiber-optic distributed temperature sensing (DTS)

Distributed temperature sensing (DTS) measurements were acquired along the surface-deployed fiber-optic cable, providing spatially continuous temperature observations along the cable path with a temporal resolution of 15 minutes based on the BOFDS interrogator from Fibristerre (Facchini and others, 2024). These measurements capture near-surface thermal variations driven by atmospheric forcing, surface–atmosphere heat exchange, and subsurface moisture dynamics, which are known to be sensitive to cracking and material heterogeneity in earthen flood defenses. While the DTS measurements are linearly dense along the cable, they represent a one-dimensional sampling of a two-dimensional surface thermal process. As a result, additional processing is required to relate the DTS observations to spatially distributed surface temperature patterns.

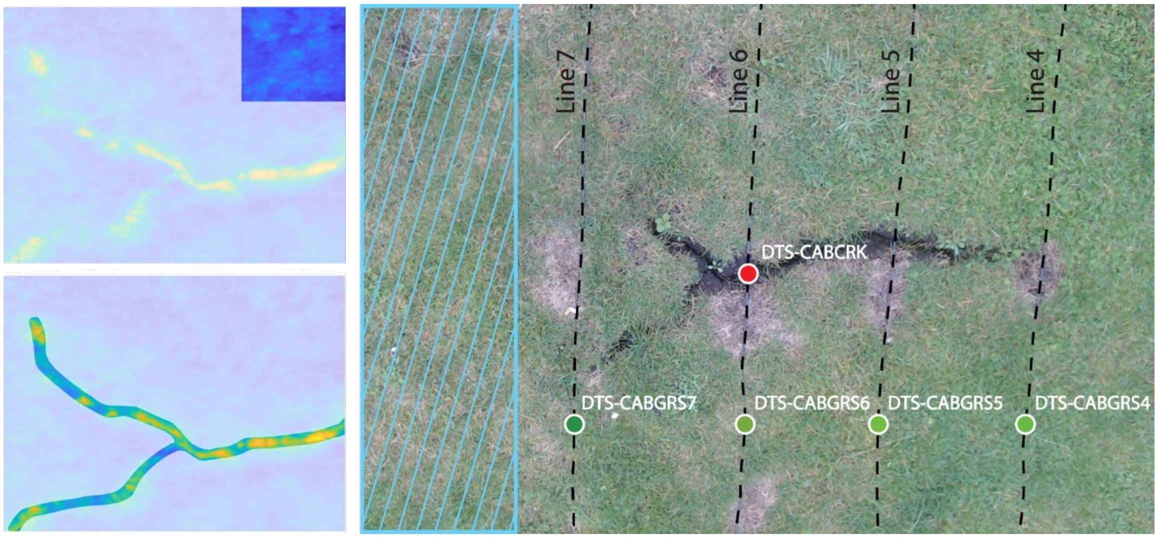

Figure 1. Monitored surface. Image in the left corresponds to thermal camera and in the right to web-cam. Note the lines of fiber cable.

Geostatistical interpolation of DTS with Kriging

To approximate the two-dimensional surface thermal behavior from the one-dimensional DTS measurements, a geostatistical kriging approach was applied (Oliver and Webster, 1990). The DTS temperature observations were interpolated to generate low-fidelity two-dimensional temperature fields over the monitored area. Kriging was selected due to its ability to incorporate spatial correlation and provide physically consistent interpolation of spatially sparse measurements. The interpolated DTS temperature fields preserve the measured thermal information while providing an approximate spatial representation of the surface temperature distribution. These fields were subsequently cropped to match the spatial extent and resolution of the thermal remote camera images, enabling pixel-wise correspondence between the DTS-derived fields and the thermal imagery.

Thermal remote imaging camara (TRC)

Surface thermal behavior was independently observed using a fixed thermal remote imaging camera Flir-a35sc (Malmivirta and others, 2019) positioned above the cracked section of the dike. The camera recorded 16-bit thermal images at a temporal resolution of 30 minutes, providing high-fidelity two-dimensional observations of surface temperature variations across the crack and adjacent grass-covered areas. The thermal images serve as a reference representation of the surface thermal response and were used as the output data for the data-driven modeling. Regions of interest were defined to ensure consistent spatial alignment with the interpolated DTS-derived temperature fields.

Data-driven mapping between DTS and thermal imagery

To map the low-fidelity, interpolated DTS temperature fields to high-resolution surface thermal imagery, a convolutional encoder–decoder U-net type (Isola and others, 2017) of architecture was employed, following established image-to-image learning frameworks based on fully convolutional networks and autoencoders (Long and others, 2015; Ronneberger and others, 2015; Heaton, 2017) The encoder progressively compresses the input DTS-derived two-dimensional temperature fields into a lower-dimensional latent representation by means of stacked convolutional layers with increasing feature depth and spatial down sampling. This process allows the model to extract spatially coherent temperature patterns and gradients that are representative of the underlying surface thermal state. The decoder mirrors the encoder structure and reconstructs a two-dimensional thermal image from the latent representation using transposed convolutions and up sampling operations, consistent with widely used image-to-image translation approaches (Isola and others, 2017). Through this process, spatial information encoded from the DTS measurements is expanded back into image space, producing a reconstructed surface temperature field that is directly comparable to the measured thermal imagery. The network is trained in a supervised manner using the measured thermal images as output targets, enabling the model to learn the nonlinear relationship between the DTS-derived temperature fields and the observed surface thermal response. From a near-surface geophysical perspective, the encoder–decoder does not introduce new physical information but instead acts as a spatial mapping operator that translates line-based distributed temperature measurements into a two-dimensional representation consistent with observed surface behaviour. As such, the model can be interpreted as a data-driven tool for enhancing the spatial interpretability of DTS measurements rather than as a purely predictive black-box model.

Training and evaluation

The dataset was divided into training and testing subsets, with 80 % of the data used for training and 20 % reserved for evaluation. To increase the effective size and diversity of the training dataset, data augmentation was applied to both the DTS-derived temperature fields and the corresponding thermal images. Augmentation consisted of spatial transformations including rotations and horizontal and vertical reflections, which preserve the physical consistency of surface thermal patterns while exposing the model to a broader range of spatial configurations. In addition, multiple spatial crops were extracted from each image to emphasize different surface regions, including areas over the crack and surrounding grass-covered zones. These augmentations were applied identically to the input and output data to maintain spatial correspondence. Model performance was evaluated by comparing predicted thermal images with the measured thermal imagery using visual inspection and pixel-wise error analysis, with particular attention given to the reconstruction of thermal features associated with the surface crack and the surrounding ground surface.

Results

Representative examples of the DTS-derived input fields and their corresponding measured thermal images are presented in Figure 2. Additionally, the reconstructed thermal images obtained from the encoder–decoder model are also presented below each of the subsamples with their associated absolute error maps. Each column corresponds to an independent test sample, illustrating a range of thermal conditions observed during the monitoring period.

The DTS input fields (top row) exhibit smooth spatial gradients that reflect the low-fidelity nature of the interpolated temperature fields derived from linearly distributed fiber-optic measurements. These fields capture large-scale temperature variations across the surface but do not resolve fine spatial features associated with surface heterogeneity, vegetation structure, or cracking. In contrast, the measured thermal images (second row) reveal complex surface thermal patterns characterized by strong spatial variability and localized anomalies. In several cases, elongated high-temperature features aligned with the crack geometry are clearly visible, indicating preferential heat exchange along zones of structural weakness and altered moisture conditions. These observations are consistent with expected near-surface thermal responses of cracked, grass-covered earthen materials under environmental forcing. The reconstructed thermal images (third row) demonstrate that the model is able to recover the dominant spatial organization of surface temperature from the DTS-derived input alone. In particular, the predicted images reproduce the location and orientation of the crack-related thermal anomalies, as well as the overall contrast between cracked and intact areas. While the reconstructed fields are smoother than the measured thermal images, the principal thermal features controlling surface behavior are preserved.

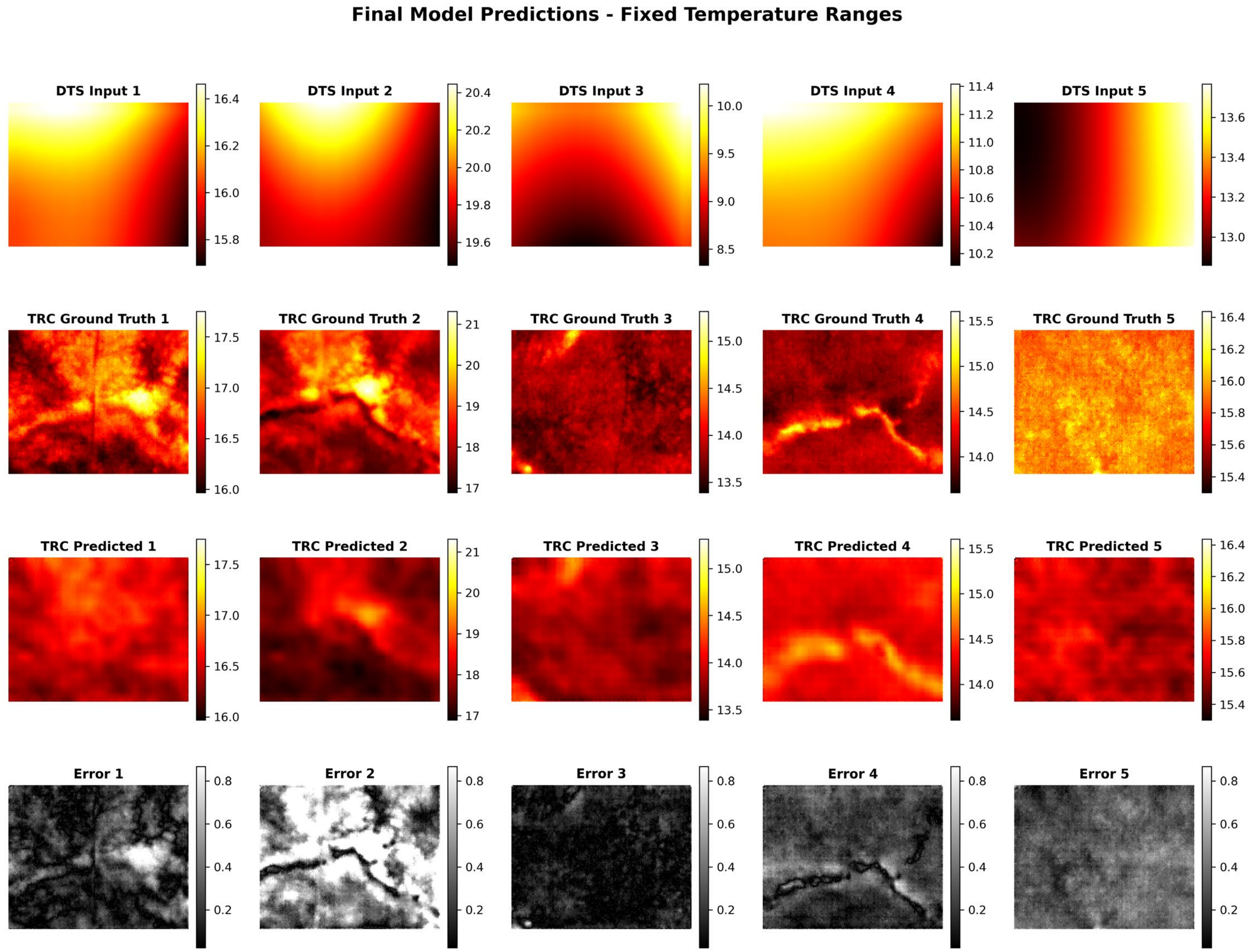

Figure 2. Encoder-decoder input, objective and prediction for different zones over the surface. Error is estimated as the difference in degrees Celsius.

The error maps (bottom row of Figure 2) provide insight into the limitations of the reconstruction. Errors are spatially structured rather than randomly distributed, with higher values typically occurring along sharp thermal gradients and at fine-scale features visible in the thermal imagery. Notably, elevated errors are often observed along the crack itself, where surface temperature variations are most abrupt and influenced by microscale processes that are not fully constrained by the DTS measurements. In contrast, more homogeneous grass-covered regions exhibit lower and more uniform errors.

Conclusions

Overall, the results indicate that the data-driven mapping effectively enhances the spatial interpretability of DTS measurements by recovering physically meaningful two-dimensional surface thermal patterns. From a near-surface geophysical perspective, this demonstrates that DTS observations contain sufficient information to infer key aspects of surface thermal behavior, even though they are intrinsically limited in spatial dimensionality. The reconstructed images therefore represent a spatial enrichment of distributed sensing data rather than a replacement of direct thermal measurements. Still, it is recommended to dive in the optimization of the architecture of the deep learning algorithm and in the influence on the number of connections inside the U-net structure.

References

Cao, Ding-feng, Hong-hu Zhu, Chengchao Guo, Bing Wu, and Jiachen Wang. 2021. “Passive Distributed Temperature Sensing (PDTS)-Based Moisture Content Estimation in Agricultural Soils under Different Vegetative Canopies.” *Paddy and Water Environment* 19 (3): 383–93. https://doi.org/10.1007/s10333-021-00839-6

Dong, Jianzhi, Susan C. Steele-Dunne, Jasmeet Judge, and Nick Van De Giesen. 2015. “A Particle Batch Smoother for Soil Moisture Estimation Using Soil Temperature Observations.” *Advances in Water Resources* 83 (September): 111–22. https://doi.org/10.1016/j.advwatres.2015.05.017

Facchini, Massimo, Nils Nöther, and Léon Neff. 2024. “Distributed Fiber Optic Smart Geosynthetics for Geotechnical Applications in Transportation.” *Procedia Structural Integrity*, SMAR 2024 – 7th International Conference on Smart Monitoring, Assessment and Rehabilitation of Civil Structures, vol. 64 (January): 1597–604. https://doi.org/10.1016/j.prostr.2024.09.414

Heaton, Jeffrey. 2017. “Ian Goodfellow, Yoshua Bengio, and Aaron Courville: Deep Learning: The MIT Press, 2016, 800 Pp, ISBN: 0262035618.” *Genetic Programming and Evolvable Machines* 19 (October). https://doi.org/10.1007/s10710-017-9314-z

Isola, Phillip, Jun-Yan Zhu, Tinghui Zhou, and Alexei A. Efros. 2017. “Image-To-Image Translation With Conditional Adversarial Networks.” 1125–34. https://openaccess.thecvf.com/content_cvpr_2017/html/Isola_Image-To-Image_Translation_With_CVPR_2017_paper.html

Jamalinia, Elahe, Philip J. Vardon, and Susan C. Steele-Dunne. 2019. “The Effect of Soil–Vegetation–Atmosphere Interaction on Slope Stability: A Numerical Study.” *Environmental Geotechnics* 8 (7): 430–41. https://doi.org/10.1680/jenge.18.00201

Long, Jonathan, Evan Shelhamer, and Trevor Darrell. 2015. “Fully Convolutional Networks for Semantic Segmentation.” 3431–40. https://openaccess.thecvf.com/content_cvpr_2015/html/Long_Fully_Convolutional_Networks_2015_CVPR_paper.html

Malmivirta, Titti, Jonatan Hamberg, Eemil Lagerspetz, et al. 2019. “Hot or Not? Robust and Accurate Continuous Thermal Imaging on FLIR Cameras.” *2019 IEEE International Conference on Pervasive Computing and Communications (PerCom*, March, 1–9. https://doi.org/10.1109/PERCOM.2019.8767423

OLIVER, M. A., and R. WEBSTER. 1990. “Kriging: A Method of Interpolation for Geographical Information Systems.” *International Journal of Geographical Information Systems* 4 (3): 313–32. https://doi.org/10.1080/02693799008941549

Ronneberger, Olaf, Philipp Fischer, and Thomas Brox. 2015. “U-Net: Convolutional Networks for Biomedical Image Segmentation.” In *Medical Image Computing and Computer-Assisted Intervention – MICCAI 2015*, edited by Nassir Navab, Joachim Hornegger, William M. Wells, and Alejandro F. Frangi. Springer International Publishing. https://doi.org/10.1007/978-3-319-24574-4_28

Schenato, Luca. 2017. “A Review of Distributed Fibre Optic Sensors for Geo-Hydrological Applications.” *Applied Sciences* 7 (9): 896. https://doi.org/10.3390/app7090896

Steele-Dunne, S. C., M. M. Rutten, D. M. Krzeminska, et al. 2010. “Feasibility of Soil Moisture Estimation Using Passive Distributed Temperature Sensing.” *Water Resources Research* 46 (3). https://doi.org/10.1029/2009WR008272

Tang, Chao-Sheng, Yu-Jun Cui, Anh-Minh Tang, and Bin Shi. 2010. "Experiment Evidence on the Temperature Dependence of Desiccation Cracking Behavior of Clayey Soils." *Engineering Geology* 114 (3): 261–66. https://doi.org/10.1016/j.enggeo.2010.05.003

Vardon, Philip J. 2015. "Climatic Influence on Geotechnical Infrastructure: A Review." *Environmental Geotechnics* 2 (3): 166–74. https://doi.org/10.1680/envgeo.13.00055

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Distributed Fiber Optic Sensing for Monitoring Carbon Sequestration via Nature-Based Solutions (NBS) in Agricultural Settings – Challenges and Opportunities

Albena Mateeva, Shell International Exploration and Production Inc.

Abstract

Nature-based solutions (NBS) in agriculture offer significant potential for soil carbon sequestration and greenhouse gas mitigation but lack scalable monitoring tools. This paper explores the applicability of distributed fiber-optic sensing (DAS, DTS, and DCS) to monitor NBS outcomes—such as soil carbon, greenhouse gas emissions, and biodiversity—as well as key inputs for biogeochemical models, including soil temperature and land-management practices. Technical challenges, deployment considerations, and research priorities are discussed to guide maturation of these technologies for commercial-scale NBS projects.

Introduction

Nature-based solutions (NBS) aim to manipulate ecosystems to sequester more carbon (C) in biomass and soil while reducing greenhouse gas (GHG) emissions. Since soil is the largest terrestrial carbon store—containing more carbon than the biosphere and atmosphere combined—even small percentage changes in soil C can have a very large impact on ecosystem health and atmospheric GHG. Agricultural settings offer one of the best opportunities for increasing soil carbon through optimized land management, addressing climate change and food security simultaneously (e.g., the “4 in 1000” initiative of COP21).

To realize this potential, new tools are needed to monitor the impact of NBS interventions on soil C and GHG emissions at commercial project scales (~10^2–10^3 kha). Existing measurement approaches are typically geared toward either much smaller or much larger scales (Novick and others, 2022). To fill this capability gap, new methods are needed.

Figure 1 groups soil measurement methods by approach, maturity, and speed. The speed of areal coverage is critical because soils are highly heterogeneous, requiring dense spatial sampling and, ideally, time-lapse measurements. “Touch” methods (e.g., soil sampling, probing) are well established but too slow and labor-intensive for commercial-scale projects. “Visit” methods, in which instruments are mounted on vehicles to take point measurements (e.g., electromagnetic or radiation-based tools), are faster but still limited. Even with optimized sampling, coverage at tractor speed can take months for a typical project, during which soil properties may change significantly. Using multiple instruments in parallel could accelerate coverage but would substantially increase cost, a major constraint for NBS.

A step change in speed could be achieved through “remote” methods that use waves or propagating fields to sample large areas. Seismic surface waves, for example, can traverse kilometers in seconds. While seismic—and areal geophysics more generally—has not yet been investigated for soil carbon, it is appealing, particularly when combined with dense, permanent receivers such as Distributed Acoustic Sensing (DAS).

This leads to the final category, “permanently in-situ” methods, in which speed is achieved through continuous monitoring with hundreds or thousands of sensors. Distributed fiber-optic sensing (DxS) belongs to this category. For DTS (temperature) and DCS (chemical), sensing is restricted to the cable trajectory, whereas for DAS, measurements can extend away from the cable when paired with suitable sources, enabling efficient characterization of large areas. In all cases, cable deployment must be compatible with agricultural activities. Continuous monitoring in time is a key advantage of DxS in dynamic ecosystems.

Thus, DxS appears well matched to NBS in principle, though its capabilities must be evaluated against specific applications. This paper reviews potential DxS use cases in two broad categories: monitoring NBS outcomes (soil C, GHG emissions, biodiversity) and measuring inputs for forecasting those outcomes (e.g., field conditions and land management).

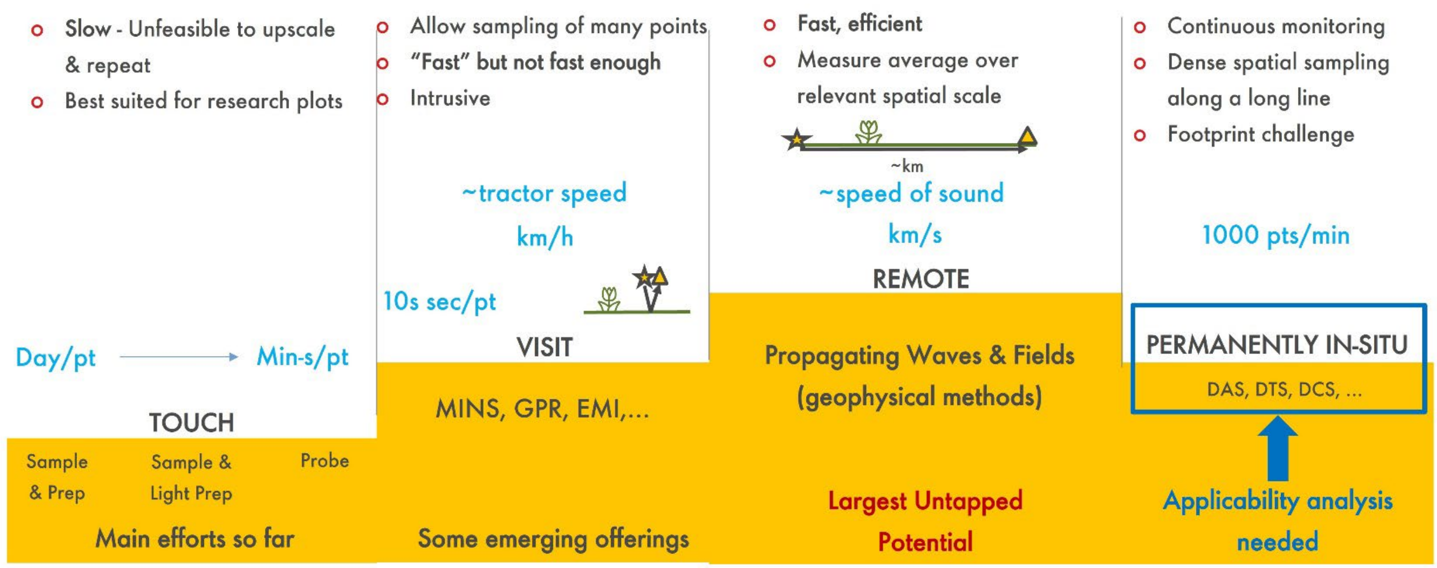

Figure 1. Categories of methods for soil monitoring (some may be overlapping). The methods considered here are mainly ground-based. Satellite and airborne methods can be seen as part of the "visit" or "remote" categories, but soils are not easy to probe from far above. The least mature is the "permanently in-situ" category to which fiber-optic sensing (DxS) belongs. This paper analyses DxS applicability to NBS.

Measuring NBS Outcomes with DAS and DCS

Soil carbon monitoring with DAS

Seismic methods are sensitive to many soil properties relevant to carbon accumulation, including clay content, density, porosity, permeability, water saturation, and some microbial metabolites (Sharma, 2016; Davis and others, 2009). Surface waves probing depths on the order of 1m are well suited for estimating soil carbon stocks that influence ecosystem dynamics in croplands and pastures. However, changes due to land-management interventions are expected to be confined to the top 10–15 cm, making detection more challenging. Very short wavelengths are required, but these attenuate rapidly with distance and reduce the efficiency advantage of remote methods, necessitating increased source effort.

Additional challenges arise when DAS is used as a receiver, since target wavelengths may fall below the typical gauge length of DAS interrogators, leading to loss of amplitude fidelity due to spectral notches. While smaller gauge lengths could mitigate this, they may compromise signal-to-noise ratio. At present, DAS applications for soil C therefore appear limited to velocity measurements, whose correlation with carbon content remains uncertain and must be tested in field studies with dense spatial sampling.

GHG emissions monitoring with DCS

Conventional GHG flux measurements (CO_2, CH_4, N_2O) rely on chambers or eddy-covariance towers (Livingston and Hutchinson, 1995; Zhu and others, 2023) at discrete locations, making upscaling difficult due to strong spatial and temporal variability. Distributed Chemical Sensing (DCS; Totland and others, 2025; Lu and others, 2019) offers a potential alternative by continuously tracking dissolved gas concentrations along a fiber immersed in porewater or shallow surface water. This approach may be particularly relevant for rice paddies, where practices such as Alternate Wetting and Drying aim to reduce methanogenesis (Linquist and others, 2015). A single DCS cable could cross many paddies and track CH_4 concentrations through wetting cycles. However, DCS is still nascent, with cost and technical complexity posing significant challenges, underscoring the need for small-scale feasibility trials.

Bioacoustics with DAS

While soil C and GHG are the primary targets of NBS projects, increased biodiversity is a desirable co-benefit. Its monitoring typically relies on complementary tools such as camera traps, environmental DNA (eDNA), and passive acoustic monitoring (PAM/bioacoustics) to infer the presence and abundance of taxa. Traditional bioacoustics uses discrete microphones, whereas DAS offers extended spatial coverage and, in some cases, access to otherwise difficult environments.

The attractiveness of DAS hinges on low-cost deployment of durable cables. Because onshore bioacoustics targets airborne sounds, trenching may not be required, but shallow burial could be beneficial to protect cables from trampling or chewing animals and to enable synergies with other DAS applications such as soil characterization or grazing monitoring. Optimal burial depth remains uncertain and requires field testing. Fence-mounted deployments, while convenient, are likely to suffer from vibration noise, again pointing to the need for feasibility tests. Above-ground deployment by unspooling cable from a drone is an interesting possibility to consider, but it is likely best suited to temporary installations in difficult terrain rather than typical agricultural settings.

Measuring Inputs for Biogeochemical Models

Biogeochemical models are critical for optimizing land management and quantifying carbon credit generation. Model accuracy depends both on its sophistication and quality of input data that is not always easy to obtain. DxS may help refine some of these inputs.

Soil temperature from DTS

While land-surface temperature is readily available, some models require temperatures at additional depths (e.g., 5 cm and 25 cm). Conventional temperature probes are sparse and sensitive to installation quality. DTS could provide spatially extensive temperature measurements at at least one depth. Cost is likely to preclude a dedicated deployment, but if a cable is deployed for another purpose (e.g., DAS), recording DTS for a period of time could improve model calibration.

Monitoring land management: Tracking cattle with DAS

Optimized grazing (e.g., Adaptive Multi-Paddock; Mosier and others, 2021) is a key pathway to carbon sequestration, as grazing intensity and spatiotemporal patterns can strongly influence soil carbon trajectories. Forecasting the effects of different grazing schemes requires knowing when and where cattle graze—information commonly tracked manually by ranchers, a process that is burdensome and unreliable. Automated tracking would be valuable both for improving management and for verifying that prescribed grazing rotations were implemented prior to issuing carbon credits.

Several satellite- and animal-based tracking approaches have been trialed but are not universally applicable, each with distinct advantages and limitations. DAS may offer an additional alternative by adapting microseismic localization techniques to monitor animal locations through their footsteps recorded along a long DAS array. A proof-of-concept field trial is underway, with data recorded in a shallow trench (Figure 2) in late 2025. The data is yet to be analyzed. Cable installation logistics and cost are the primary foreseeable barriers to wide adoption, pointing to the need for cost studies and optimization.

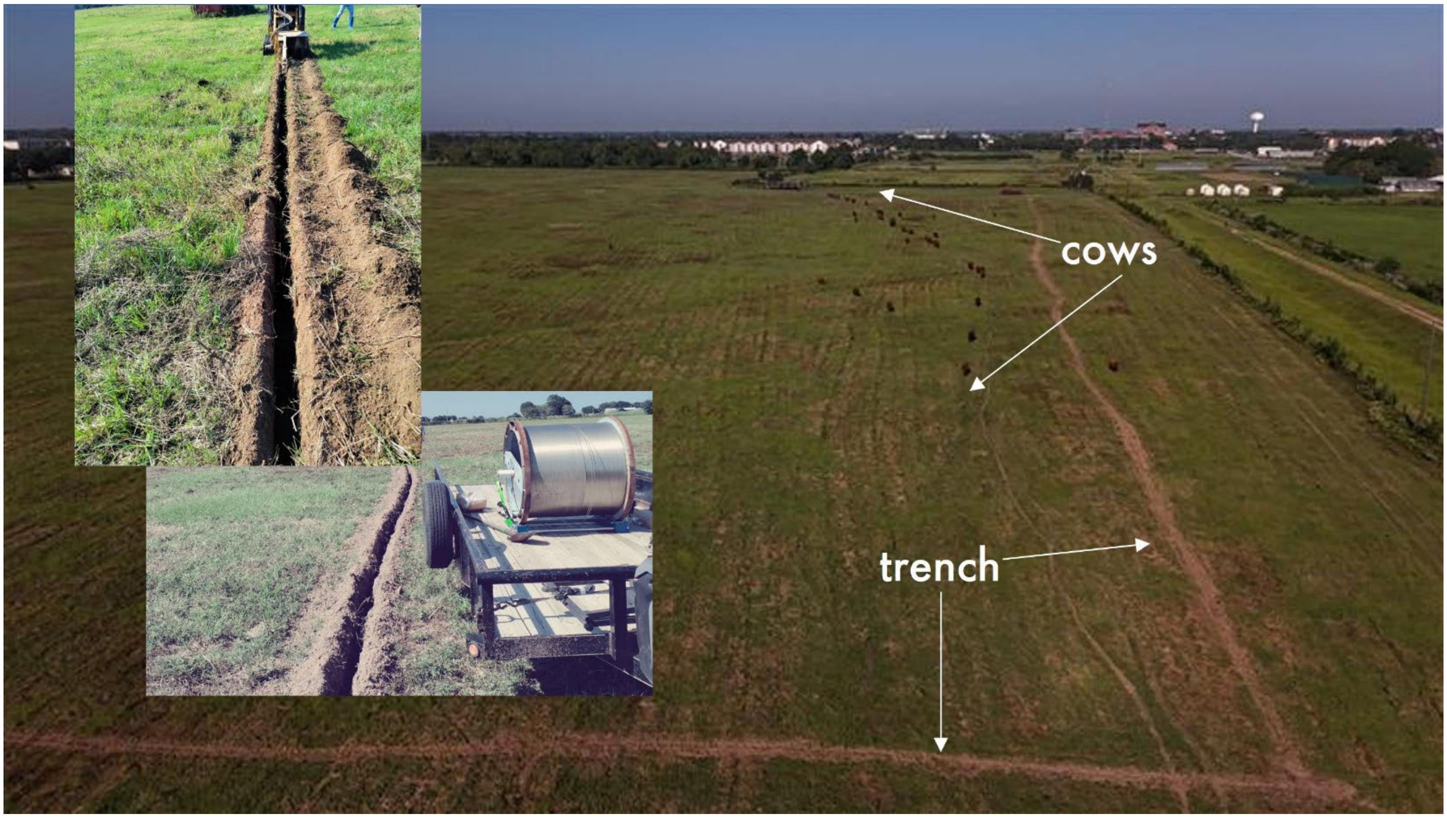

Figure 2. Field-test of DAS for cattle localization through footsteps at Prairie View A&M University, Texas. Areal view of trench and cows – the trench is 2.5km long, only partially in the picture. Inserts: Opening the trench (3" wide x 9" deep) and getting ready to unspool cable.

Conclusion

Distributed fiber-optic sensing offers multiple promising applications for agricultural NBS, but all require further maturation. Key gaps include validating seismic sensitivity to soil carbon, developing ultra-shallow characterization methods, advancing high-frequency source options, extending DAS usability beyond its first spectral notch, maturing DCS for GHG monitoring, and identifying low-cost deployment approaches compatible with farming operations. Techno-economic assessment will be essential, as cost is a decisive factor for NBS adoption. While motivated by agricultural NBS applications, progress in these areas could benefit DxS use across many environmental and engineering domains.

Acknowledgements

I am grateful to colleagues in the NBS R&D team at Shell for valuable discussions on measurements and modelling. Special thanks to K. Kuloyo and collaborators from PVAMU for enabling the cattle test acquisition, with support from G. Gonzalez, C. Dealing, C. Davis, P. Leung, S. Grandi, and E. Jaworek.

References

Davis, C.A., Pyrak-Nolte, L.J., Atekwana, E.A., Werkema, D.D., and Haugen M.E. Microbial-induced heterogeneity in the acoustic properties of porous media. Geophys Res Lett, 36 (2009), pp. 1-5. https://doi.org/10.1029/2009GL039569

Linquist, B. A., Anders, M. A., Adviento-Borbe, M., Chaney, R. L., Nally, L., da Rosa, E., and van Kessel, C., 2015, Reducing greenhouse gas emissions, water use and grain arsenic levels in rice systems: *Global Change Biology*, **21**, 407–417. https://doi.org/10.1111/gcb.12701

Livingston, G. P., and Hutchinson, G.L., 1995, Enclosure-based measurement of trace gas exchange: applications and sources of error: in *Biogenic trace gases: Measuring emissions from soil and water*, P. A.

Matson and R. C. Harriss, eds., Blackwell Science, 14–51.

Lu, X., Thomas, P. J., and Hellevang, J. O., 2019, A review of methods for fibre-optic distributed chemical sensing: *Sensors*, **19**, 2876. https://doi.org/10.3390/s19132876.

Mosier, S., Apfelbaum, S., Byck, P., Calderon, F., Teague, R., Thompson, R., and Cotrufo, M. F., 2021, Adaptive multi-paddock grazing enhances soil carbon and nitrogen stocks and stabilization through mineral association in southeastern U.S. grazing lands: *Journal of Environmental Management*, **288**, 112409. https://doi.org/10.1016/j.jenvman.2021.112409

Novick, K. A., Metzger, S., Anderegg, W. R. L., Barnes, M., Cala, D. S., Guan, K., Hemes, K. S., Hollinger, D. Y., Kumar, J., Litvak, M., Lombardozzi, D., Normile, C. P., Oikawa, P., Runkle, B. R. K., Torn, M., and Wiesner S., 2022, Informing Nature-based Climate Solutions for the United States with the best-available science: *Global Change Biology*, 28, 3778–3794. https://doi.org/10.1111/gcb.16156

Sharma, S., 2016, In-situ field biofilm detection using seismic methods: M.S. thesis, Oklahoma State University.

Totland, C., Mikesell, T. D., and Thomas, P. J., 2025, Distributed chemical sensing: An unexplored frontier in urban, industrial, and environmental monitoring: *The Leading Edge*, **44**, 598–605. https://doi.org/10.1190/tle44080598.1

Zhu, S., L. Olde, K. Lewis, T. Quaife, L. Cardenas, N. Loick, J. Xu, and T. Hill, 2023, Eddy covariance fluxes over managed ecosystems extrapolated to field scales at fine spatial resolutions: *Agricultural and Forest Meteorology*, **342**, 109675. https://doi.org/10.1016/j.agrformet.2023.109675

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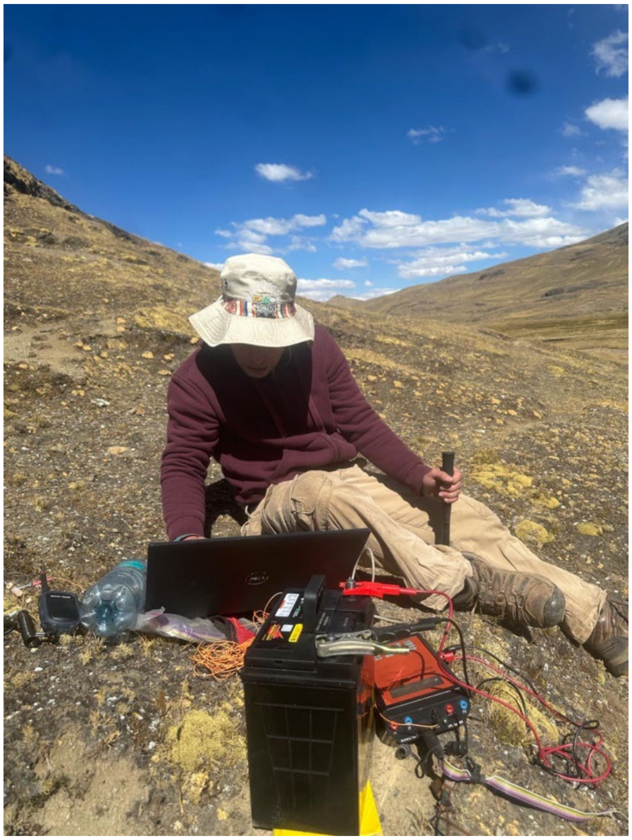
Postcards from the Field

Postcards from the Field is a new recurring FastTIMES feature sharing photos from recent near-surface geophysics work. Community members are invited to submit your photos for future consideration.

The New Resolution Geophysics (NRG) Xcite airborne electromagnetic (AEM) system at Portales Municipal airport, New Mexico, being prepared for deployment during a 2026 aquifer mapping study. Credit: Burke Minsley

Rutgers University Newark Ph.D. students Chris Terra and Donald Pesonen set up a DUALEM-421S EMI sensor to investigate saltwater dynamics at a coastal farm in Virginia. Credit: Raymond Hess.

Rutgers University Newark Ph.D. students Raymond Hess and Donald Pesonen georeference electrodes for an ERT survey conducted at a coastal farm in Delaware to investigate saltwater dynamics. Credit: Chris Terra.



Joaquin (Jack) Cambeiro collects electrical resistivity data in the Peruvian Andes over the Alta Murmurani bofedal (Andean peatland) to determine peat thickness, July 2025. Credit: Julie Loisel/Nataleigh Perez.

U.S. Geological Survey scientists Jackson Sharpe and Scott Ikard make self-potential geophysical measurements in a wetland near Leadville, Colorado, in July 2024. Credit: USGS/Andrea Creighton.

Graduate students Danielle Nering (FIU), Sam Adams (FIU), and Rajeun Islam (FAU) collecting ground-penetrating radar (GPR) measurements along a tree trunk to infer moisture content variability at their Luquillo LTER (Puerto Rico). Credit: Xavier Comas (Critical Zone Geophysics Lab at FIU)

Scientist conducts a transient electromagnetic (TEM) survey to characterize a peatland below a frozen lake in Germany. Credit: Sebastian Uhlemann

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☐ Other	☐ Mining	☐ Seismic	☐ GSA	
	☐ Shallow Oil & Gas	☐ Other	☐ NGWA	
	☐ UXO		☐ NSG	
	☐ Aerial Geophysics		☐ SEG	
	☐ Agriculture		☐ SSA	
	☐ Renewable Energy		☐ SPWLA	
	☐ Other		☐ NAOC	

1391 Speer Boulevard | Suite #450 | Denver, CO 80204
(p) 001.1.303.531.7517 | staff@eegs.org | www.eegs.org

Environmental and Engineering Geophysical Society **2026 Corporate Membership Application**	Renew or Join Online at www.EEGS.org

FOUNDATION CONTRIBUTIONS

FOUNDERS FUND

The Founders Fund has been established to support costs associated with the establishment and maintenance of the EEGS Foundation as we solicit support from larger sponsors. These will support business office expenses, necessary travel, and similar expenses. It is expected that the operating capital for the foundation will eventually be derived from outside sources, but the Founder's Fund will provide an operation budget to "jump start" the work each year. Donations of $50.00 or more are greatly appreciated. For additional information about the EEGS Foundation (an IRS status 501(c)(3) tax exempt public charity), visit the website at http://www.EEGSFoundation.org.

Foundation Fund Total: $ ____________

STUDENT SUPPORT ENDOWMENT

This Endowed Fund will be used to support travel and reduced membership fees so that we can attract greater involvement from our student members. Student members are the lifeblood of our society, and our support can lead to a lifetime of involvement and leadership in the near-surface geophysics community. Donations of $50.00 or more are greatly appreciated. For additional information about the EEGS Foundation (a tax exempt public charity), visit the website at http://www.EEGSFoundation.org.

Student Support Endowment Total: $ ____________

CORPORATE CONTRIBUTIONS

The EEGS Foundation is designed to solicit support from individuals and corporate entities that are not currently corporate members (as listed above). We recognize that most of our corporate members are small businesses with limited resources, and that their contributions to professional societies are distributed among several organizations. The Corporate Founder's Fund has been developed to allow our corporate members to support the establishment of the Foundation as we solicit support from new contributors.

Corporate Contribution: $ ____________

Foundation Total: $ ____________

PAYMENT INFORMATION

☐ Check/Money Order ☐ VISA ☐ AmEx

☐ MasterCard ☐ Discover

Subtotals

Membership: $____________

Total Student Sponsorship @ $20 ea. $____________

Foundation Contributions: $____________

Grand Total: $____________

____

Card Number **Exp. Date** **CVV #:**

____

Name on Card

____

Signature

Make your check or money order in US dollars payable to: EEGS. Checks from Canadian bank accounts must be drawn on banks with US affiliations (example: checks from Canadian Credit Suisse banks are payable through Credit Suisse New York, USA). Checks must be drawn on US banks.

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

Return this form with payment to: EEGS, 1391 Speer Boulevard, Suite #450, Denver, CO 80204 USA Credit card payments can be faxed to EEGS at 001.1.303.820.3844

Corporate dues payments, once paid, are non-refundable. Individual dues are non-refundable except in cases of extreme hardship and will be considered on a case-by-case basis by the EEGS Board of Directors. Requests for refunds must be submitted in writing to the EEGS business office.

QUESTIONS? CALL 001.1.303.531.7517