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Editorial: Near-surface geophysics in Latin American contexts: its applications, education, and societal perspectives as a whole

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Editorial on the Research Topic
Near-surface geophysics in Latin American contexts: its applications, education, and societal perspectives as a whole

Key challenges in Latin America

Latin America faces significant environmental and infrastructural challenges that demand innovative solutions. Among the most urgent issues is the risk of tailing dam collapses, particularly in mining-heavy regions like Brazil, Colombia, and Mexico. These collapses pose severe environmental and economic threats, making advanced, non-invasive geophysical techniques essential for monitoring dam stability and preventing disasters.

Moreover, none of the countries in Latin America are exempt from significant earthquake risks, particularly along the Pacific Ring of Fire. Having experienced some of the most powerful earthquakes globally, Chile has demonstrated the severe impact of earthquake-induced liquefaction, one of the most critical hazards to infrastructure. Therefore, incorporating detailed velocity profiles into seismic hazard assessments is crucial for accurately predicting ground motions and mitigating earthquake risks in Chile and other seismically active regions worldwide.

Water resource management also remains a pressing issue, especially in vulnerable karst systems and regions with fluctuating soil moisture. Seasonal variations in rainfall directly impact agriculture and flood risks, highlighting the need for effective monitoring tools to ensure sustainability.

The role of near-surface geophysics (NSGeo)

Near-surface geophysics (NSGeo) is emerging as a vital tool for addressing these challenges. This Research Topic, *"Near-Surface Geophysics in Latin American Contexts: Its Applications, Education, and Societal Perspectives as a Whole,"* focuses on how NSGeo techniques can be adapted to local conditions to provide practical, non-invasive solutions for environmental hazards and infrastructure needs.

Goals of the special issue

The primary aim of this Research Topic is to showcase how NSGeo methods combined with complementary tools like UAVs, geological surveys, and computational modeling are being applied to tackle natural disasters, pollution, and infrastructure risks. The research highlights both the technical advancements and societal impact of these techniques in addressing Latin America's unique challenges.

Overview of contributions

The papers in this Research Topic are not simply technical studies; they represent a deeper exploration of how geophysics can be used to address pressing concerns in Latin America. Below is a summary of the contributions (accepted and rejected):

1. Imaging Tree Root Systems Using Ground-Penetrating Radar (GPR) Data in Brazil. This study applies GPR technology to the ecological investigation of tree root systems in Brazil. By imaging root structures non-invasively, the authors contribute to the understanding of root biomass and its role in carbon sequestration, emphasizing GPR's potential in advancing ecological and environmental studies (Rocha et al.).
2. Influence of the Sand-Clay Ratio of the Burial Material of Forensic Targets on Ground-Penetrating Radar (GPR) Responses: Comparison of Dry and Rainy Season Data. Building on earlier forensic GPR studies, this research compares GPR responses under dry and rainy conditions, focusing on the sand-clay ratio. The study demonstrates how soil composition and moisture content significantly affect the detection of buried objects, offering critical guidance for forensic investigations in regions with pronounced seasonal variations (Castro et al.).
3. Spectral Analysis Applied to Filter Electrical Resistivity Tomography Data This manuscript presents advancements in spectral analysis techniques to improve the resolution of electrical resistivity tomography (ERT) data. Enhancing data quality increases the accuracy of subsurface investigations, making it a valuable tool for environmental monitoring and geotechnical projects throughout Latin America (rejected manuscript).
4. Smoothing Savitzky-Golay Adaptive Filter with Legendre Polynomials for Electrical Resistivity Tomography 2D The authors introduce a new approach to smoothing ERT data using adaptive filtering techniques. This method improves the clarity and interpretability of resistivity models, enabling more precise imaging of subsurface features, particularly in geologically complex regions (rejected manuscript).
5. How Much Does Spatial Variability of Shear-Wave Velocity Influence Liquefaction Response? A Case Study from the 2010 Maule, Chile Mw 8.8 Earthquake Examining the effects of spatial variability in shear-wave velocity, this manuscript provides critical insights into how such variability influences liquefaction response during earthquakes. The findings from the 2010 Maule earthquake highlight the importance of incorporating detailed velocity profiles into seismic hazard assessments, offering a valuable tool for mitigating earthquake risks in other regions prone to seismic activity (Núñez-Jara et al.).
6. Investigation of Fractured Rock Beneath a Uranium-Tailing Storage Dam Through UAV Digital Photogrammetry and Seismic Refraction Tomography. This research integrates UAV digital photogrammetry with seismic refraction tomography to investigate fractured rock beneath a uranium tailings storage dam. The combination of these methods offers a detailed analysis of subsurface fractures, which is essential for assessing the stability of critical infrastructure, particularly in regions where mining activities are prevalent (Netto et al.).
7. Efficient 3D Time-Domain Electromagnetic Modeling in Anisotropic Media by Spectral Elements. This manuscript introduces a computationally efficient method for 3D time-domain electromagnetic modeling in anisotropic media. This innovative approach enables more accurate geophysical surveys, contributing to resource exploration and environmental monitoring across Latin America (rejected manuscript).
8. Geoelectrical and Seismoelectric Mapping of Subsurface Pollution in a Closed Landfill Near the Tongo Bassa and Ngongue River, Douala, Cameroon. While based in Cameroon, this study's exploration of subsurface pollution mapping using geoelectrical and seismoelectric techniques resonates with environmental challenges seen across Latin America. The integration of these methods provides a detailed understanding of subsurface contamination, with direct applications to waste management and pollution monitoring in Latin American urban centers (Kevin et al.).

Conclusion

The studies in this Research Topic highlight the diverse applications of near-surface geophysical methods across Latin America. Each paper addresses a unique challenge, whether related to environmental protection, disaster risk reduction, or resource management, demonstrating the value of NSGeo techniques in improving our understanding of subsurface conditions.

The integration of advanced computational tools and field techniques with traditional geophysical methods enhances the effectiveness of NSGeo applications. As Latin America continues to face environmental and infrastructural challenges, these techniques will become even more critical for informed decision-making and sustainable development. We hope this Research Topic inspires further research and innovation, fostering collaborations that will lead to continued advancements in near-surface geophysics across the region.

The special issue has broadly covered the topic of near-surface geophysical applications; however, discussions on geophysical education and its societal perspectives remain open for future issues.

Author contributions

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Conflict of interest

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