



## Enhancing landslide predictability: Validating geophysical surveys for soil moisture detection in 2D and 3D scenarios

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### ARTICLE INFO

**Keywords:**  
 DC method  
 Soil moisture  
 Infiltration experiments  
 Rain simulation  
 Brazil

### ABSTRACT

Every year, Brazil grapples with the destructive impact of landslides, typically during the summer season. The National Centre for Monitoring and Alerts of Natural Disasters (Cemaden) places significant emphasis on studying these phenomena to understand their processes and causes more deeply. One key challenge faced in this endeavour is the procurement of geotechnical properties of the soil in high-risk areas, with soil moisture being a crucial factor.

Collecting point samples for acquiring these geotechnical parameters is not only costly but also limited in providing a comprehensive two-dimensional or three-dimensional coverage. Therefore, the primary aim of the proposed project is to validate the method of acquiring soil moisture data through geophysical surveys in both 2D and 3D scenarios.

Data was gathered from soil moisture stations within Cemaden's network and various collected samples to confirm the results. To generate more controlled yet realistic conditions, a sequence of field infiltration experiments was conducted. The findings, related to the ability of the geoelectric method to define soil moisture, derived from this project form an invaluable foundation for future investigations spearheaded by the Geodynamics Group and its collaborating institutions.

### 1. Introduction

Annually, Brazil experiences severe floods and landslides, particularly during the summer months. These natural disasters are frequent occurrences in the country. With the unregulated expansion of urban areas and risky settlements, predominantly inhabited by low-income communities, there's an escalating trend of slope landslides. These landslides result in numerous fatalities and extensive material damage, significantly affecting local communities. According to a study by [UFSC-CEPED \(2012, cited in OPAS, 2014\)](#), landslides accounted for 1403 deaths and affected 173,259 people in Brazil between 1991 and

2010. [PAHO - Pan American Health Organization/World Health Organization \(2014\)](#) noted the high mortality rate of landslides, recording an average of two deaths per event.

The National Centre for Monitoring and Natural Disaster Alerts (Cemaden) aims to monitor environmental parameters that trigger such mass movements, as part of its natural disaster alert system. Cemaden endeavours to advance research and technological innovations to enhance early warning systems and consequently reduce casualties and material losses. However, tracking these mass movements is extremely challenging due to the complex nature of landslide-generating processes and the wide variety of variables involved ([Lissak et al., 2020](#); [Pereira](#)

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<https://doi.org/10.1016/j.jsames.2023.104664>

Received 8 August 2023; Received in revised form 22 September 2023; Accepted 19 October 2023

Available online 20 October 2023

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