Mapping Progressive Erosion and Void Formation in A Slope along the Pearl Riverbank in Mississippi

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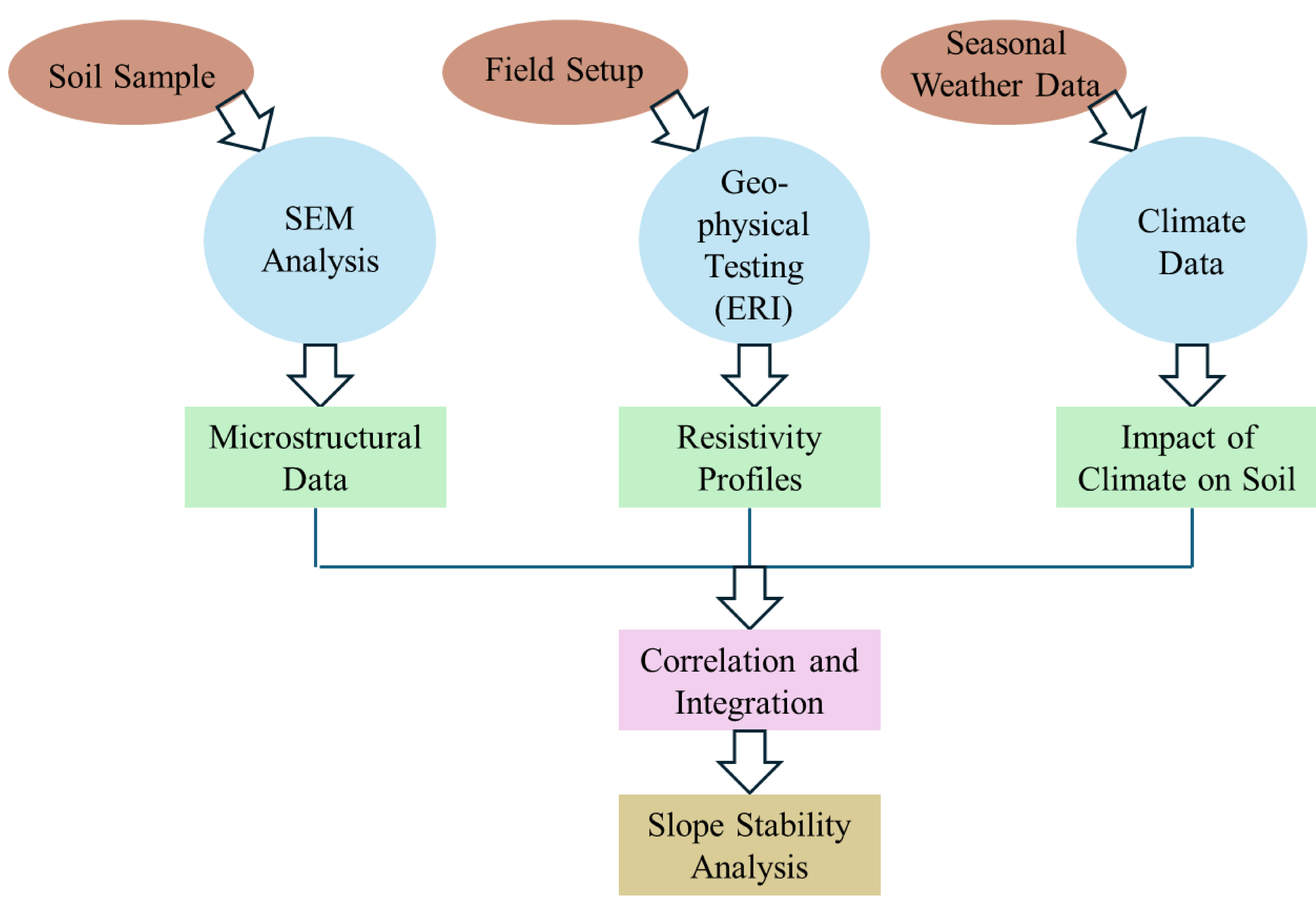
Abstract

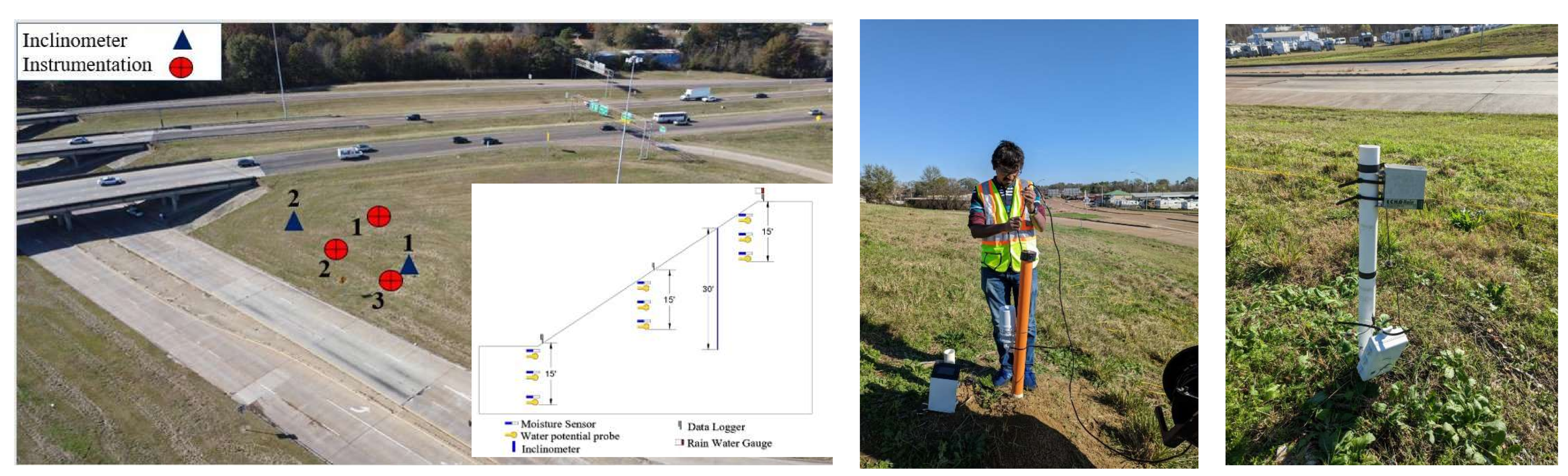
Erosion control in highway embankment systems is critical for maintaining their structural integrity and preventing catastrophic failures. The highway embankment of Terry Road located in the Jackson area, is experiencing movement in slope that threaten its structural integrity and environmental stability. This research aims to implement a thorough investigation to systematically analyze and mitigate these problems. A dispersive test is a soil analysis method used to determine the soil's tendency to break down and disperse when exposed to water. This test helps identify soils that are prone to erosion and instability, which is crucial for effective soil management and erosion control. Beginning with the dispersive tests, the different kinds of ions like Si, Al, Mg, Fe, which significantly influences soil dispersion, is quantified through Scanning Electron Microscopy (SEM) to provide a detailed chemical profile of the soil. To map potential voids and identify areas prone to erosion, advanced geophysical techniques are used, including Resistivity and Induced Polarization surveys. These methods allow for a non-invasive assessment of the subsurface conditions, highlighting regions that may require targeted intervention. After determining the critical zones, hydrological data, particularly focusing on seasonal water fluctuations and rainfall patterns of Terry Road area is collected. Seasonal variation of weather data is incorporated to model their impact on erosion dynamics over time. This comprehensive approach not only addresses the immediate concerns at Terry Road but also contributes to the broader field of soil erosion management in similar environmental settings.

Introduction



The objective of this study is to control erosion problem in soil embankment system. To obtain the desired result, a thorough investigation of the study location is required. To obtain the surface morphology and texture of a sample with microstructural analysis SEM (Scanning Electron Microscopy) is conducted. This provides high-resolution images of a material's surface morphology that shows how aggregates, particles and fillers are distributed within a matrix. SEM and dispersion tests reveal soil microstructure and particle behavior, aiding in understanding material strength and erosion risks critical for slope stability. Electrical Resistivity Imaging (ERI) is a geophysical method that maps subsurface resistivity variations by injecting electrical currents into the ground. It helps in slope stability by identifying weak zones, groundwater flow, and variations in soil or rock properties, which are critical for stability assessment.

Study Area



Methodology

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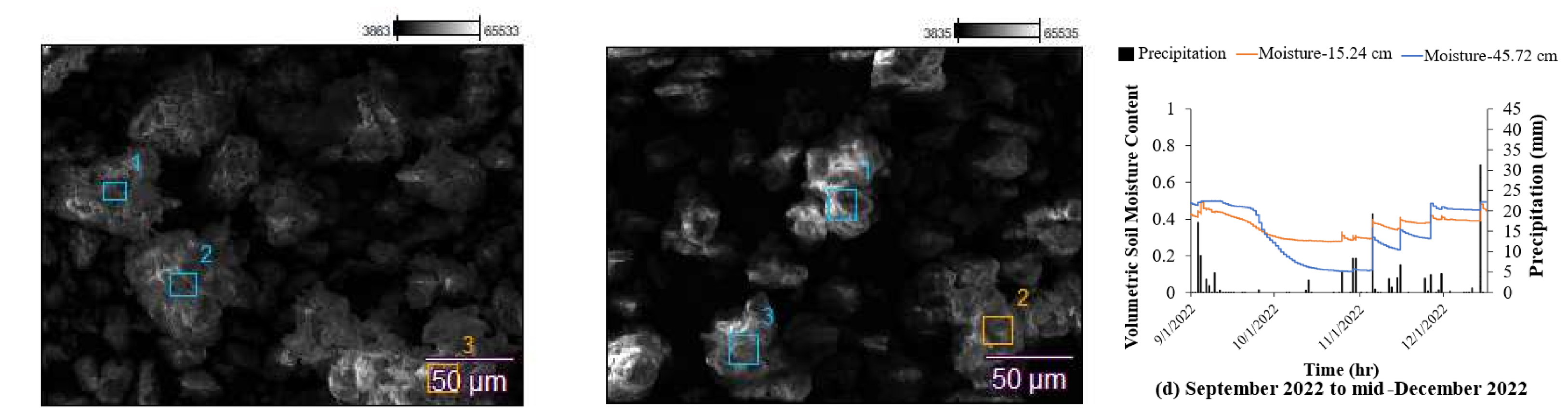
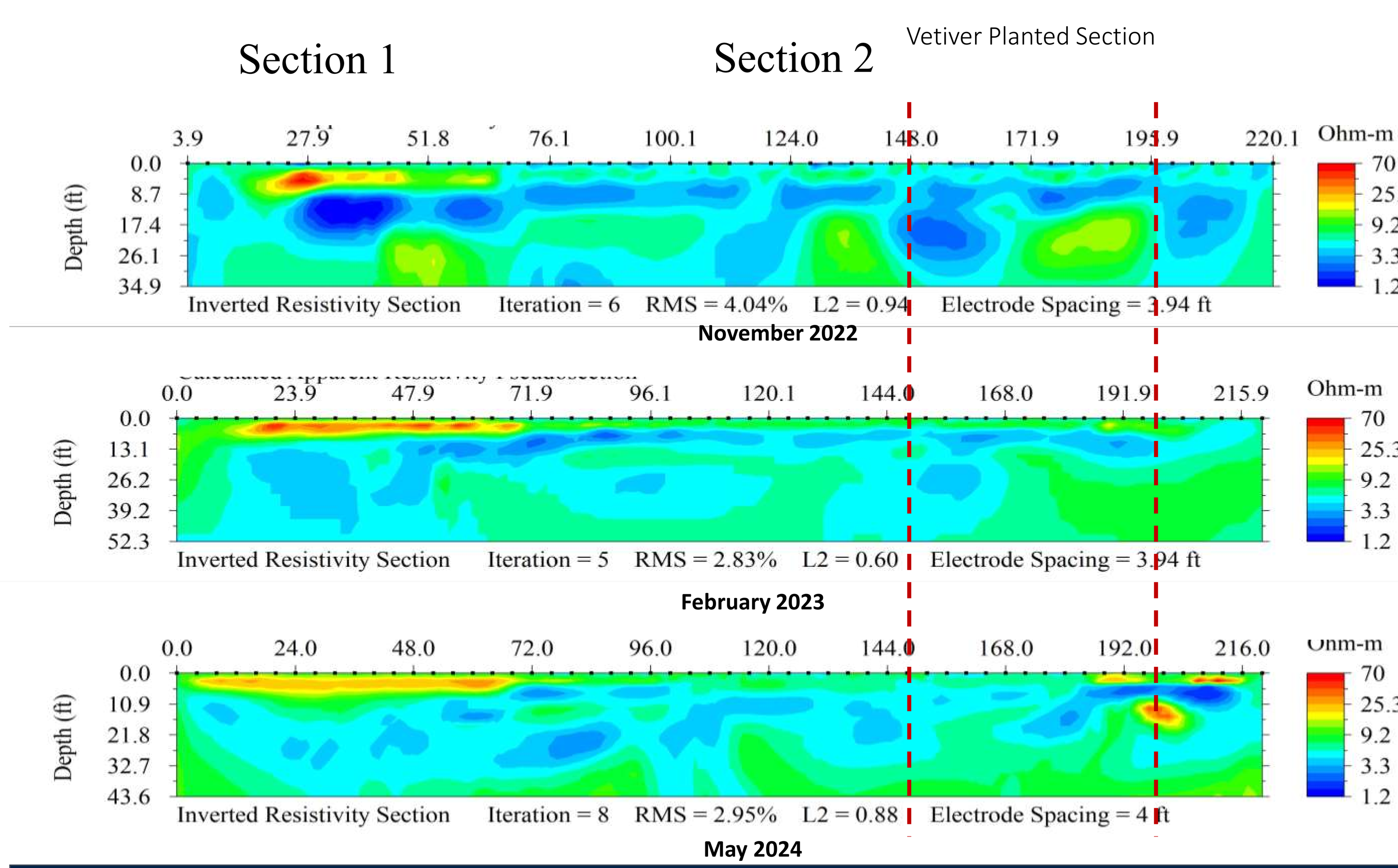
Result





Conclusion

This study employs an integrated approach combining SEM analysis, ERI testing, and seasonal weather data to comprehensively assess slope stability. By analyzing soil microstructure, subsurface resistivity variations, and the impact of seasonal climatic fluctuations, the research elucidates the complex interactions between material properties and environmental conditions affecting slope integrity. The results provide a scientifically robust framework for identifying vulnerable zones, understanding erosion mechanisms, and implementing data-driven strategies for risk mitigation, contributing significantly to advancements in geotechnical and environmental engineering.

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