Preliminary Analysis of Extreme Rainfall-Induced Cluster Landslides in Jiangwan Town, Shaoguan, Guangdong, April 2024: Postprint

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Abstract

In mid-to-late April 2024, an extreme precipitation event occurred in Shaoguan City, Guangdong Province, triggering numerous landslide disasters in the Jiangwan Town area of Shaoguan, causing some regions to experience continuous communication disruption for nearly 36 hours and drawing extensive social concern. Rapid and accurate investigation of the basic characteristics, spatial distribution patterns, and formation conditions of landslides is crucial for disaster emergency decision-making and risk hazard mitigation. Utilizing post-disaster optical remote sensing imagery combined with deep learning models, rapid intelligent identification and manual verification of rainfall-induced landslides in Jiangwan Town, Shaoguan were conducted, interpreting a total of 1,192 landslides with a total area of approximately 3.14 km^2. The landslides were predominantly small-to-medium in scale, primarily distributed in clustered bands along rivers in a NE-SW direction, with pronounced clustering effects. Spatial statistical analysis reveals that landslides are mainly distributed on concave slopes within the elevation range of 200-300 m and with slope gradients of 10°-30°. Furthermore, Random Forest model and SHAP theory were employed to conduct quantitative analysis of the dominant geomorphological controlling factors of landslides, discovering that different topographic and geomorphological factors exert varying degrees of nonlinear influence on landslide formation, and that the coupled effects of multiple factors including elevation, slope gradient, and water convergence conditions jointly control landslide formation. This study highlights the significant advantages of deep learning-based intelligent identification and analysis technologies in emergency investigation of landslide disasters and analysis of formation conditions, providing important technical support for rapid disaster loss assessment and risk hazard investigation.

Full Text

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Abstract

In mid-to-late April 2024, an extreme rainfall event in Shaoguan City, Guangdong Province, triggered numerous landslides in Jiangwan Township, disrupting some areas for nearly 36 hours and attracting widespread public attention. Rapid and accurate characterization of landslide features, distribution patterns, and controlling factors is essential for emergency response and risk mitigation. Using post-event optical remote sensing imagery and deep learning models, we rapidly identified and manually verified rainfall-induced landslides in Jiangwan Township, mapping 1,192 landslides covering approximately 3.14 km^2. The landslides were predominantly small-to-medium sized and exhibited pronounced clustering, distributed in NE-SW oriented bands along river corridors. Spatial statistical analysis indicates they occurred primarily on concave slopes between 200-300 m elevation with gradients of 10°-30°. Furthermore, Random Forest modeling combined with SHAP theory quantified the dominant geomorphological controls, revealing nonlinear influences of various topographic factors and demonstrating that landslide formation was controlled by the coupled interaction of multiple factors including elevation, slope gradient, and water convergence conditions. This study underscores the substantial advantages of deep learning-based intelligent identification and analysis for emergency landslide investigations and condition analysis, offering critical technical support for rapid loss assessment and hazard screening.

Keywords: Extreme rainfall; Cluster landslides; Intelligent identification; Distribution patterns; Formation conditions

Note: Figure translations are in progress. See original paper for figures.