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Editorial: Monitoring, early warning and mitigation of natural and engineered slopes—Volume II

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Editorial on the Research Topic
Monitoring, early warning and mitigation of natural and engineered slopes—Volume II

Introduction

Natural and engineered slopes are widely distributed all over the world (He et al., 2021; Qiu et al., 2022). Due to natural factors or human activity, many slopes are becoming unstable and showing a very high exposure to landslides (Zhou et al., 2022; Pei et al., 2023). Thus, it is necessary to monitor these unstable slopes and conduct early warning accordingly (Zhu et al., 2021; Yang et al., 2022). Recently, with the development of science and technology and the theory of multidisciplinary interaction, they provide new opportunities for the research on early detection, dynamic monitoring and risk reduction of unstable slopes (Liu et al., 2022; Wang et al., 2022). However, efficient detection, low-cost monitoring, accurate early warning, and reliable risk assessment still require further breakthroughs (Qu et al., 2021; Ma et al., 2023). Volume I of this Research Topic received 14 manuscripts last year (Nie et al., 2023). Now Volume II brings together 16 papers designed to present the latest research advances and methods for monitoring, early warning and mitigation of natural and engineered slopes.

Slope hazards mechanism and reduction technology

The stability prediction of soil-rock slopes with complex physical and mechanical properties is an important topic in the field of geological engineering. To study the stability of mine slope under deep bench blasting vibration, Su et al. analyzed mechanical parameters of a mine slope under uniaxial and triaxial instruments by field vibration monitoring and numerical simulation methods. The results show that the overall displacement of the slope is small under the action of dynamic blasting load, and the change of displacement decreases with the decrease of the vibration wave.

Fu et al. predicted the stability of soil-rock slope by machine learning algorithm coupled with intelligent optimization algorithm-weighted mean of vectors algorithm (INFO).

Dynamic process and formation mechanisms of landslides are essential to hazard assessment, three different related researches proposed this issue. Yang et al. studied the characteristics and formation mechanism of a debris flow that occurred in Zhangjiayuan gully through field investigation and remote sensing interpretation. Dai et al. used the Xigou debris flow in the Three Gorges Reservoir Region (TGRR) as a case study, the development characteristics and initiation pattern of which were analyzed based on field investigation. Song et al. made a critical area identification and dynamic process simulation for landslide hazard chain formation in the upstream Jinsha River. In another study, the impact pressure and flow velocity in the flow field were measured synchronously using the impact detection system and a particle image velocimetry system in a water channel and the effects of the turbulence structure on the impact process of flash flood were investigated (Gu et al.).

Wang et al. studied the hydrological effects of macropore flow and proposed a mechanistic model of the formation of shallow landslides by introducing the macropore coefficient of granite residual soil. The study results showed that the macropores of vegetation roots had a significant effect by increasing the permeability of granite residual soil. The accuracy of data-driven model is closely affected by the quality of negative samples, Ye et al. proposed a method combining a self-organizing-map (SOM) and a one-class SVM (SOM-OCSVM) to generate more reasonable non-landslide samples. The aforementioned results prove that the proposed method can enhance the performance of ML models to produce more reliable LSM.

In addition, two studies on actual engineering projects are of interest, as they provide experience and techniques from field investigations. Liu et al. studied the development characteristics, distribution, and communication law of ground fissures along the highway using the comprehensive investigation method and technology. The Daofu landslide, Xianshui River Earthquake Zone is a typical landslide directly threatening the road below and forming a debris flow channel. Zhang et al. combined traditional methods (drilling and field investigation) with two geophysical techniques, multichannel analysis of surface waves (MASW) and electrical resistivity tomography (ERT) to effectively determine the electrical characteristics, velocity characteristics and spatial structure of the landslide. Their study indicates the use of MASW and ERT can quickly and effectively characterize the subsurface of landslides to assess landslide risk and prevent debris flow hazards.

The ecology and land use of the disaster area

The effects of geohazards on the ecological environment and ecological spatial pattern have received wide attention from scholars. In this issue, three studies focus on ecological, environmental and land use change in areas affected by geological hazards. Yang et al. explored the land-use evaluation and utilization advice on a debris flow disaster deposit area-The upstream Fujiang River. The author believes that the agriculture scenario can be used in the high soil fertility area, and the potential construction scenario is best suited for infrastructure because of its low soil fertility. Vegetation coverage is an important indicator for evaluating regional environmental. Liu et al. found the vegetation coverage in the Ganjiang River Basin showed a fluctuating increasing trend 2000–2020, and an increasing trend with increasing elevation, the result show that the anti-sustainability effect of vegetation change was stronger than that of sustainability, and weak anti-sustainability was dominant. The findings could provide a scientific basis for the management of regional ecosystems. Sui et al. utilized a quantitative analysis of the ecological recoverability of Jiuzhaigou in cases of artificial restoration and spontaneous restoration under different types of geohazards. Results showed that forests play a vital role in maintaining and controlling habitat quality; artificial restoration can significantly ameliorate the impact of geohazards on the scenic area. The above studies show that geological hazards have a negative effect on local ecosystems, there is a need to quantify this effect, moreover, human restoration contributes to ecosystem recovery.

Engineering properties and microcosmic mechanism of landslide materials

The other two studies focus on the engineering properties and microcosmic mechanism of different materials. In the first study, Liu et al. explored the mechanical effect of clay under acidic and basic conditions, they thought that the cohesive force and internal friction angle of clay decreases under acidic conditions, whereas in basic conditions the opposite is true. In this study of Cui et al., the engineering properties of remolded diatomite and the effects of cement on the compression characteristic, strength properties and microstructures of cement-stabilized diatomite were investigated. Results show that compared with undisturbed diatomite, the compressibility of the remolded diatomite increases while the strength characteristics decrease. Xu et al. considered the key physical factors of Yunan laterite by laboratory tests, and the dielectric constant model was finally proposed to evaluate the natural water state of the laterite. The results show that the relative dielectric constant of laterite increases gradually with the increasing volumetric water content, dry density and temperature respectively. Their findings provide new prevention and control ideas for soil landslides.

Perspectives

The new volume of this Research Topic is dedicated to the use of modern technologies, data-based approaches and techniques incorporating multiple disciplines for monitoring, warning and mitigation of natural and engineered slopes. However, under the influence of extreme weather and the construction of large-scale

projects, slope failure needs new attention. On this basis, it provides reference for mitigating damage from the following aspects. I) Multi-scale and multi-disciplinary integration to analyze the physical mechanism and dynamic process inside the slope; II) Early warning and analysis of slope instability based on big data information and field refined detection system; III) Innovate green, efficient and sustainable slope post-disaster restoration projects.

Author contributions

Three authors co-organized the album, with WN on Slope hazards mechanism and reduction technology, HQ on ecology and land use of the disaster area, and AA on Engineering properties and microcosmic mechanism of landslide materials.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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