Post-Print: Early Identification and Monitoring of Landslide Hazards in Danba County Based on the "Three Checks" System

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Abstract

To address the challenge that traditional ground survey methods are difficult to identify high-position concealed landslide hazards, the authors' team proposed a "space-air-ground" collaborative "Three-Survey" system for landslide hazard identification and monitoring, which has been applied in engineering projects nationwide with good results, though limited academic documentation exists on this work. Taking the Danba County section of the Dadu River Basin, where landslide disasters occur frequently, as the study area, this study carries out practical application of landslide hazard identification and monitoring based on the "Three-Survey" system. First, two InSAR techniques—stacking-interferometric synthetic aperture radar (Stacking-InSAR) and small baseline subsets-InSAR (SBAS-InSAR)—combined with high-resolution optical remote sensing are employed to achieve broad-area screening of active landslide hazards throughout the experimental area, with comparative analysis of the identification results between Stacking-InSAR and SBAS-InSAR. Subsequently, airborne LiDAR measurement technology and UAV aerial photogrammetry technology are utilized to conduct detailed investigation of landslide hazards in high-risk sections around Danba County town, followed by verification of major landslide hazards through field surveys. Finally, SBAS-InSAR technology is used to monitor and analyze deformation of typical landslide hazards. Through collaborative utilization of space-air-ground observation means, a total of 41 landslide hazards were detected in the study area, primarily local reactivations of large ancient landslide deposits under disturbances from long-term gravitational action, river erosion, and human engineering activities, with deformation evolution trends of most landslide hazards showing good correlation with seasonal rainfall.

Full Text

Early Identification and Monitoring of Potential Landslides in Danba County Using a Space-Air-Ground "Three-Investigation" System

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Abstract

Traditional ground-based survey methods face significant challenges in identifying high-altitude, concealed landslide hazards. To address this issue, our research team has developed a Space-Air-Ground cooperative "Three-Investigation" system for landslide hazard identification and monitoring, which has been successfully implemented in engineering applications nationwide, although few academic publications have documented this work. This study presents a practical application of the "Three-Investigation" system in Danba County, a region along the Dadu River basin prone to frequent landslide disasters. We first employed two InSAR techniques—stacking interferometric synthetic aperture radar (Stacking-InSAR) and small baseline subsets InSAR (SBAS-InSAR)—combined with high-resolution optical remote sensing to conduct a broad-area survey of active landslide hazards across the entire study area, and comparatively analyzed the identification results from both methods. Subsequently, we utilized airborne LiDAR and UAV aerial photogrammetry technologies to perform detailed investigations of landslide hazards in high-risk zones surrounding Danba County. Field surveys were then conducted to verify major landslide hazards. Finally, SBAS-InSAR technology was applied to monitor and analyze deformation of typical landslide hazards. Through the synergistic use of Space-Air-Ground observation methods, we detected 41 potential landslide hazards in the study area. These hazards primarily represent local reactivation of large ancient landslide deposits due to disturbances from long-term gravitational forces, river erosion, and human engineering activities. Most of the identified landslide hazards exhibit deformation evolution trends that correlate well with seasonal rainfall patterns.

Keywords

Landslide hazards; identification and monitoring; "Three-Investigation" system; InSAR; airborne LiDAR; Danba County