Postprint: Fine Identification Methods for Debris Flow Source Materials in Heavily Vegetated Mountainous Areas Using LiDAR Remote Sensing

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Abstract

Identification and calculation of debris flow material sources constitute the foundation for scientific assessment of debris flow scale, hazard level, and comprehensive management. However, traditional ground surveys and optical remote sensing methods are ineffective for identifying debris flow material sources under dense vegetation cover in mountainous areas. Airborne Light Detection and Ranging (LiDAR) technology can effectively penetrate vegetation to obtain true surface morphology, providing a novel solution for debris flow material source identification. Taking the debris flow in Rize Gully, Jiuzhaigou earthquake-affected area as an example, this study conducts research on debris flow material source identification based on high-resolution airborne LiDAR data combined with pre-earthquake satellite imagery. According to the location of material sources and their color and texture differences on hillshade images, the sources are classified into collapse-slide material sources, slope surface material sources, and channel material sources, and identification markers and remote sensing interpretation methods for each type of material source using airborne LiDAR are established. A total of 155 debris flow material sources in Rize Gully were interpreted, with a total area of 1.06 km^2, accounting for 31.56% of the total watershed area. Based on this, the development and distribution patterns of each type of material source are analyzed. This provides theoretical reference and data support for accurate calculation of debris flow material sources, further serving the prevention and risk assessment of debris flows in the Jiuzhaigou earthquake-affected area.

Full Text

Airborne LiDAR-based Debris Flow Material Sources Remote Sensing Recognition in Lush Mountainous Area

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Abstract

Identification and quantification of debris flow material sources are fundamental to scientifically assessing debris flow scale, hazard level, and comprehensive mitigation. However, traditional ground surveys and optical remote sensing methods struggle to effectively identify debris flow material sources beneath dense vegetation cover in mountainous areas. Airborne Light Detection and Ranging (LiDAR) technology can effectively remove vegetation to obtain true ground surface morphology, providing a new solution for debris flow material source identification. Taking the Rize Gully debris flow in the Jiuzhaigou earthquake area as a case study, this research conducts debris flow material source identification based on high-resolution airborne LiDAR data combined with pre-earthquake satellite imagery. Material sources are classified into collapse-slide sources, slope sources, and channel sources according to their location and color/texture differences on hillshade images, and identification criteria and remote sensing interpretation methods are established for each type. A total of 155 debris flow material sources were interpreted in Rize Gully, covering a total area of 1.06 km^2 and accounting for 31.56% of the total watershed area. Based on this, the development and distribution patterns of each material source type were analyzed. This study provides theoretical reference and data support for accurate calculation of debris flow material sources, further serving debris flow prevention and risk assessment in the Jiuzhaigou earthquake area.

Keywords: airborne LiDAR; debris flow; material source identification; remote sensing interpretation; Jiuzhaigou earthquake

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

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