Application of a dynamic terrestrial landslide early warning system in a wide high-voltage transmission line coverage area

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The power grid is one of the most important lifeline projects in modern society. However, the complex transmission network was fixed to the ground through millions of transmission towers, which were inevitably being affected by various types of geohazard. The failure of local facilities may further cause large-scale power outages, leading serious social impact and economic loss. From this perspective, this study aims to develop a territorial landslide early warning system (Te-LEWS) for the high-voltage transmission line coverage area by introducing a novel method, combining landslide inventory and susceptibility maps, rainfall thresholds and real time rainfall forecast, transmission tower vulnerability analysis and GIS-based dynamic alert system. To this objective, the power grid system consisting of over 130,000 high-voltage transmission towers and covering an area of 7 provinces in China was selected as study objective to conducted susceptibility mapping with different classification methods (information value, random forest and support vector). The rainfall threshold of each county was calculated through analyzing a 7 consecutive day rainfall data for the major historical landslide event. Instead of an ordinary landslide risk assessment practice within the transmission line coverage area, this study mainly focuses on the landslide risk over transmission towers and tries to generate an risk assessment result over a specific risk bearing element with linear distribution characteristic, in this case the electricity transmission lines. With real-time predicted rainfall value as input variable, a dynamic landslide warning system was established on a pixel basis, to identify the transmission towers that are potentially vulnerable to landslide disasters. The performance of the proposed Te-LEWS system were validated through the historical rainfall data and the landslides events from 2015-2019, to gain a comprehensive evaluation on its warning accuracy. Results suggest that the system has a high warning success rate and the false alarm was significantly reduced. In such case, the proposed To-LEWS would greatly support the grid authorities in reducing disaster risks and retrieving huge economic loss. The study shed a new light on the risk analysis method of a specific linear distributed risk bearing element towards geohazard, to demonstrate its potential over wide areas, an application to a huge area in China was shown and discussed.

Keywords: Landslides; GIS; early warning system; disaster risk reduction; high-voltage transmission line

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