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Discriminant analysis of shallow landslides potential in the debris flow basins in Taiwan

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The extreme weather caused by climate change often induces heavy rainfall that triggers landslide hazard. The typhoon Morakot in 2009 brought more than 3,000 mm accumulated rainfall to Kaohsiung area in Taiwan, causing wide-spread landslides and debris flows hazard. In this study, the discriminant analysis was conducted to analyze the shallow landslide potential in Namashia and Liuguey Districts, Kaohsiung City, in southern Taiwan. We used aerial photos to identify the shallow landslides, and combined with LiDAR and DEM data to identify the deep-seated landslides. Through the identification process, the shallow landslides included in or coincided with the deep-seated landslide scars were removed. The resulting shallow landslides were typically with areas smaller than 100 square meter and 5 meter resolution was used as analysis unit to be in consistency to DEM. Influence factors were derived from terrain characteristics on the debris flow basin base and through the hypothesis test and cross-correlation analysis. All of the influence factors were normalized to avoid bios and the discriminant analysis was conducted subsequently. The final effective factors for Namashia District included slope, aspect, plan curvature, and profile curvature; for Liuguey District were the slope, aspect, plan curvature, profile curvature, and height. The discriminant analysis was conducted using fifty percent of randomly selected samples of landslide and non-landslide with a ratio of approximately 1. Validation of the analysis model was performed using the other 50 % samples for prediction and comparison. The results of both the discriminant analysis and prediction were consistent with an overall accuracy of more than 60 %. By digitizing the discriminant scores and then plotted versus the distribution of shallow landslides, it appeared that the shallow landslides scars fitted the high score location well. The analysis method proposed in this study provided consistent and satisfactory results, and could be applied to other areas for estimation and prediction of the shallow landslide potential.

Keyword: shallow landslide, landslide potential, discriminant analysis, DEM