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Advancing rainfall-induced landslide detection using homogeneous slope units and distributed rainfall thresholds

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A better detection of landslide occurrence is critical for disaster prevention and mitigation, and a standing pursuit owing to increasing and widespread impact of slope failures on human activities and natural environment in a changing world. However, the detection of rainfall-induced landslide is limited in some areas by data scarcity and method applicability. In this study, we proposed distributed rainfall thresholds within homogeneous slope units, by considering the interaction of landslide-influencing geo-environmental conditions and landslide-triggering rainfall variables. Homogeneous slope units are extracted based on detailed terrain analysis. Various landforms are identified and used to obtain slope units with homogeneous slope traits. The concept behind the distributed rainfall threshold models is that rainfall threshold for landslide occurrence varies with geo-environmental conditions such as slope gradient. Thus, a link can be established between landslide-influencing geo-environmental conditions and landslide-triggering rainfall variables. We used elevation, slope, plan and profile curvature, mean annual precipitation and temperature, soil texture and land cover as independent variables. Rainfall duration and cumulated rainfall of landslide-triggering rainfall events are automatically calculated and used, the former as one of independent variables, and the latter as the dependent variable. A support vector regression (SVR) and a multiple linear regression (MLR) method are used. The error and correlation coefficient measurement indicate a better performance of SVR method. Compared with grid units, the model scores high accuracy for slope units. The models are implemented at a regional scale (Guangdong, China). The SVR model in slope units ran with error of 0.16 mm and correlation coefficient of 0.93.