Landslide probability model established based on long-term landslide inventory and rainfall factor

Chun-Yi Wu and Yen-Chu Yeh

Department of Soil and Water Conservation, National Chung Hsing University, Taichung, Taiwan (cywu@nchu.edu.tw)

Landslides in a large area have considerable uncertainties in the prediction and forecasting. Thus, more and more researches used probability models to predict and forecast the landslide probabilities. In this study, the study area was divided into different rain gauge control areas according to Thiessen's polygon method, and further divided into slope units on the basis of topography for the purpose of higher spatial resolution in the landslide probability model. The long-term landslide inventory spanned from 2000 to 2015, daily rainfall and effective accumulated rainfall were used to estimate rainfall thresholds for triggering landslides. Then, the exceeding probabilities of the rainfall event that exceeded the thresholds were calculated based on the historical rainfall data spanned from 1987 to 2016 using Poisson probability model. Besides, the event counts triggering landslides under the conditions of the events exceeded the rainfall thresholds were summed up in the slope units to calculate the landslide occurrence probability of events. Finally, this probability was multiplied by the exceeding probabilities of the rainfall event that exceeded the thresholds to predict the annual exceedance probabilities of landslide occurrence in each slope unit based on the concept of conditional probability. The results showed the annual exceedance probabilities of landslide occurrence within the slope units occupied in the southwest part of Taipei Water Source Domain were higher than the others, and the highest probability value reached 0.151. These slope units located the area characterized by weaker lithology, higher elevation and steeper slope. Comparing with the landslide probability model only based on the long-term landslide inventory, the landslide probability model established based on the landslide inventory and rainfall factor can avoid the problem resulting from the incompleteness of the landslide inventory, and also predict the annual landslide occurrence probabilities corresponding to the changes in rainfall condition in the future.