



Study on the impact of regional rainfall-induced landslide hazard due to global environmental change

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This paper presents the study on the impact of regional rainfall-induced landslide hazards due to global environmental change using Remote Sensing (RS) and Geographic Information System (GIS). Since the global climate change has significant influence on the changes in precipitation in Taiwan recently, several record-breaking rainfalls with sequential rainfall-induced geological hazards were occurred in the past few years. Especially in August 8, 2009, a high rainfall intensity and long-duration rainfall brought by Typhoon Morakot has broken all rainfall records in Taiwan and caused severe and large-scale landslide hazards. It stimulates the study to explore the coupling between rainfall and impact of regional rainfall-induced landslide hazards.

To study the spatial distribution of rainfall, analysis of rainfall characteristics was first conducted in this study. Precipitation data from rainfall stations operated by Water Resources Agency of the Taiwan Ministry of Economic Affairs and other government agencies in the study area were adopted for conducting the rainfall frequency analysis. The results of the frequency analysis were represented as the contour of the return period of rainfall using the GIS. Then, the assessment of regional rainfall-induced landslides using hydro-geological model incorporating with RS/GIS is conducted to investigate the most common shallow landslide in Taipei County of north Taiwan. The deterministic approach that couples an infinite-slope stability analysis with a one-dimensional analytical solution for rainfall infiltration is adopted to assess the time-varying slope safety of each slope unit with transient pore-water pressure during a rainfall event. The infinite-slope stability analysis is based on the limit equilibrium method, in which slope angles, unit weights of soil and water, shear strength parameters, and transient pore-water pressures are combined to estimate the safety factor for each grid. The physical, mechanical, geological and hydraulic properties are established using the GIS and RS data. The response of transient pore-water pressure during a rainfall event can then be analyzed.

Our findings indicate that the shallow landslide hazards in the study area are strong related to the spatial distribution of rainfalls. Because the impacts from the global environmental change usually belong to the regional scale, the use of GIS and RS plays a crucial role for the analysis. In addition, the predictions of the landslides induced by different return periods of rainfall with the consideration of the possible influence from the global climate change can also be used to provide precaution for future hazard mitigation.