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Landslide movement pattern revealed by temporal and spatial monitoring: A dip slope case in northern Taiwan

Chia-Han Tseng[1], Yu-Chang Chan[2], Ching-Jiang Jeng[3], Ruei-Juin Rau[4], and Yu-Chung Hsieh[5]
[1]Department of Geology, Chinese Culture University, Taipei, Taiwan (zjh17@ulive.pccu.edu.tw)
[2]Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan (yuchang@earth.sinica.edu.tw)
[3]Environmental and Hazards-Resistant Design Department, Huafan University, New Taipei, Taiwan (jcjhf@cc.hfu.edu.tw)
[4]Department of Earth Sciences, National Cheng-Kung University, Tainan, Taiwan (raurj@mail.ncku.edu.tw)
[5]Central Geological Survey, Ministry of Economic Affair, New Taipei, Taiwan (hsiehyc@moeacgs.gov.tw)

A natural hillslope developing into a landslide shows ground cracks and topographic deformation. Geomorphological and subsurface investigations using appropriate methodology are essential to understand the failure mechanisms and stability of a hillslope. A dip slope in sedimentary rock in northern Taiwan has been observed to have a potential landslide hazard for the development of ground cracks and persistent deformation of local buildings and facilities on the slope. To monitor the movement of the dip slope and then understand its movement pattern, 144 ground monitoring points was set in 2001, and its coordinates were measured using conventional traverse surveying twice a year until 2017. In addition, 6-year surficial surveying results as time series of displacements and velocity field are revealed by each GPS station on the slope surface. The long-term surveying results point out different displacement patterns of the dip slope depending on rainfall duration and amount. The surficial surveying results are presented as a time series of displacements with constraints of geometry and distribution of ground cracks and underground observations. The long-term surveying results reveal multiple potential sliding blocks within the Huafan University campus. A model of landslide movement with a listric sliding surface is proposed. Finally, the continuous GPS stations show the average velocity of 0.396~0.528 x 10^{-7} mm/sec, being classified as “Extremely slow” in the global “velocity scale of landslides” proposed by Cruden and Varnes in 1996. The long-term surface monitoring of a potential landslide slope in this study provides a reliable and economical way to understand the mechanism of movement behavior of the slope and evaluate slope stability.