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Kinematic simulations of the rainfall-triggered Shiaolin debris avalanche, southern Taiwan

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The Taiwan Island, caused of situated on an active orogenic belt possesses high seismicity and high relief, and situated on the most common trajectory of typhoons in northwest Pacific Ocean, is then frequent been struck by the natural hazards. Among the natural hazards, landslides in one of the most frequent disasters in Taiwan.
Typhoon Morakot attacked Taiwan on August 7-9, 2009. During these days, the rainfall near Shiaolin village in southern Taiwan exceeded 1800mm almost equals to the annual precipitation, and caused serious disasters. The hills behind Shiaolin village were collapsed, buried the village, and create a landslide dam. Moreover, more than four hundred villagers were buried alive. In this study, both the Digital Terrain Model (DTMs) before and after landslide is been integrates to estimate the volume of the slid materials, the zone of initiation, the zone of accumulation, the shape of the deposit and the impact area. Meanwhile, the seismometer record at neighboring regions is also been included. Finally, by using 3D Distinct Element Method (DEM) Partical Flow Code (PFC3D) software, taking into account different material property, different parameters and the pore water pressure, etc., the kinematic processes of the debris flow in Shiaolin is been analyzed.
In order to taking into account the effect of the pore water pressure, the ball elements are thus subject to gradient-perpendicular buoyancy. Each group of parameters both tested with and without pore water pressure. The consequence shows that the pore water pressure plays an essential factor to triggered landslides. Several groups of parameters reveals the best-fit result, by comparing the shape of the accumulation with the reality, indicating the friction coefficient should as low as 0.1. The friction coefficient of the surface of separation determines the shape and the region of the deposits.
According to the numerical simulation, the process of the landslide is been explored. The total duration of the landslide process is about 160 seconds. 27 seconds after landslide been triggered, the flow front hits the 590 Highland behind the Shiaolin village, and then changes the direction of motion and split into two runout courses. About 57 seconds after initiation, the debris flow struck the Shiaolin village. Within 10 seconds, part of the Shiaolin village was been buried and swept. 70 seconds after the landslide, the debris surge flows across the Chishan River, reach the opposite side of the river and forming the landslide dam. The results of the snapshots coincide with the broad band seismometer record and the near surface magnetic survey data. The analysis provides not only the kinematic process but also the mechanics of the landslide, and may serve to landslide hazard mitigation as well.