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Catastrophic Hsiaolin landslide in southern Taiwan triggered by Morakot Typhoon: Insights from 3-D discrete element simulation

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The Typhoon Morakot on August 8th 2009 bought a heavy rainfall in southern Taiwan and caused a catastrophic landslide which buried Hsiaolin Village of Kaohsiung County in southern Taiwan and caused a mortality of more than 400 people. The landslide initiated at Shamdushan from a slope of about 500 m to 900 m above the riverbed and huge amount of slide materials moved quickly downward and became a debris flow. A part of debris topped over the highland of 590 m and spread on the hillslope. The slide materials finally destroyed the Hsiaolin village. Most debris kept downward movement along the gully and reached the Chishan River, and blocked the main stream forming a dammed lake. In this study, we used 3D discrete element method with granular particle assemblage (PFC3D) to simulate kinematic process and mechanics of this catastrophic landslide. According to the 3-D numerical simulation, Hsiaolin village might be buried in 60 seconds after the triggering of landslide in Shamdushan. The predicted maximum velocity is about 50 m/sec and the debris could reach to the other side of the Chishan River. Consequently a dammed lake was formed in the Chishan River. From the viewpoint of the assessment of catastrophic landslides, the analysis of sensibility of landslide potential is a crucial topics, furthermore the 3-D discrete element method is a powerful tool to elucidate the mechanics and kinematics of landslide process and impact area induced by gigantic landslide event.