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Numerical simulation of the inundation area for landslides induced debris flow –a case study of Hong-shui-xian gully in southern Taiwan

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Typhoon Morakot (2009) caused serious landslides and debris flows in southern Taiwan due to intensive rainfall with long duration. The case study area of the Hong-shui-xian gully, located in Liouguei District, Kaohsiung city, is one of the debris flows caused by this typhoon. The watershed of the Hong-shui-xian gully has area of 34.1 ha. The majority of the landslide debris (landslides covered 33.7% of the watershed area) entered the main stream of the gully, where it mixed with water and became a debris flow. Eroding the sidewalls of the stream, the debris flow entrained additional material and traveled downstream into village and Laonong River. In this study, a two-dimensional commercial model FLO-2D was used to simulate debris-flow inundated area. Because the debris-flow event is highly related to landslides, how to consider the sediment concentration due to landslides in inflow hydrograph, and to select resistant parameters is important in the simulation work. The inflow hydrograph that considered sediment concentration caused by flood, landslide, and debris flow were proposed in this study. Rheological property of the debris-flow deposited sediment was analyzed by laboratory experiment, and the rheological equations were determined. The influence of inflow hydrograph, sediment concentration, and roughness coefficient on the simulated results was discussed. The sediment concentration and the roughness coefficient were calibrated by the comparison with the debris-flow inundated area and deposited depth in field survey. The simulated results showed that the average sediment concentration by volume of debris flow was 0.50. The maximum deposited depth in the debris-flow inundated area was up to 6 m, maximum velocity 5 m/s, and the deposited volume 780,000 m^3. The simulated deposited depth and inundation area showed a reasonable match to field investigation.