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Improve Drone Survey Hazard Mapping technology to decipher landslide activity and geomorphological evolution

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The Tsaoling Landslide is one of the largest landslides in Taiwan caused by the Chi-Chi Earthquake in 1999. More than 130 million cubic meters of rocks and debris blocked the Chingshui Stream channel and formed a landslide dammed lake. In July 2004, Typhoon Mindulle completely filled the dam by the debris of the landslides initially situated on the higher upstream regions. Since then, the river channel in the region of the filled dam lake and the seismogenic Tsaoling landslide accumulation began to cut down by fluvial erosion and transportation, eventually forming multiple river terraces and deep valley. In 2009, extreme heavy rain fall hit the area again by the typhoon Morakot, causing deformation of the eastern flank of the landslide area and major river channel migration. However, relative environmental changes and geomorphical evolution in Tsaoling landslide area have received less attention. In recent years, the remote sensing technology improves rapidly, providing a wide range of image, essential and precise geoinformation. The Small unmanned aircraft system (sUAS) has been widely used in landslide monitoring and geomorphic change detection. On the basis of self-made drones, we have established a multi-temporal high-resolution DTMs, so as to access and to monitoring the post-landslide activities and topographic changes the Tsaoling area regularly and continuously. The result shows that, especially during the monsoon (spring rainy season) in June 2017, the small cliff of minor scarp on the main sliding surface has an important cliff line retreat. The maximum retreat distance exceeds 150 meters, and the volume of the landslide situated on the original sliding surface exceeds 1.5 million cubic meters. Over the next few years, the data set indicated that the topography of the area change continued. In this study, on the one hand, we are actively exploring new algorithms to minimize the relative error of the terrain in each period to accurately calculate the morphological changes in each period. On the other hand, the geomorphic changes indicate the landslide activity, and the characteristics of the river processes in the Tsaoling landslide area. Since 2016, through 8 multi-temporal UAS missions in Tsaoling area, the results indicate that the area is continues to deform and remain active. As a result, it is still worthwhile to monitor continuously.