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Dissipation of Landslide Debris Within a Single Drainage Basin as Revealed by Multi-period ALS DEMs

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How the landslide debris is transported and redistributed remains an important topic for understanding erosion processes and evaluating post-landslide hazards along downstream areas. Here we investigated landslide debris redistribution using three periods of Airborne Laser Scanning Digital Elevation Models (ALS DEMs) from 2005, 2010 and 2016 within a single drainage basin that was affected by several landslides after the heavy rainfall event brought by Typhoon Morakot in 2009. We purposely selected the single drainage basin to better constrain the source of landslide debris. The multi-period high-resolution ALS DEMs give the necessary accuracy to calculate small but significant volume changes that were not easily detectable from previous measuring techniques. Our results show that the landslide debris redistributed most effectively during a large rainfall event. In contrast, areas without existing landslides were minimally affected in terms of volume change. We applied a simple surface roughness index, the standard deviation of heights in the drainage basin, to show how the topography was changed due to heavy rainfall within the drainage basin. The concept of surface roughness is useful and efficient in describing the changes of topography in a drainage basin, particularly when multi-period ALS DEMs are available for a long period time. The surface roughness may effectively characterize the dissipation of landslide debris because the surface roughness values become lower during the debris redistribution process. The redistribution of landslide debris over the observed years suggest that the dissipation of landslide debris is dominated by episodic heavy rainfall events within the active Taiwan mountain belt.