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Variation of Slope-Area Relationship Caused by a Catastrophic Landslide

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In August 2009, in Taiwan, Typhoon Morakot with a maximum rainfall of over 2,900 mm, induced over 23,000 landslides in mountainous area throughout southern Taiwan. One large scale deep-seated landslide, the Hsiaolin landslide, with an area of about 250 ha, buried the entire village causing 397 casualties, the disappearance of 53 people, and the destruction of over 100 houses (Lin et al., 2011; Tsou et al., 2011). The LiDAR-derived 2 m resolution DEMs before and after Typhoon Morakot was utilized in this study to perform the relation between slope and contributing area. Montgomery and Foufoula-Georgiou (1993), among other authors (eg. Tarolli and Dalla Fontana, 2009) suggested a partitioning of the landscape into drainage and slope regimes that include hillslopes, unchanneled valleys, debris flow-dominated channels, and alluvial channels. These regimes are based on the different patterns of slope-area relation in a loglog diagram. In the analyzed study area a significantly variation of slope-area diagram after the deep-seated landslide has been observed. Sediment mass produced by deep-seated landslide with approximately 2.7x107 m3 (Wu et al., 2011) depleted from hillslope, nearly 90 m deepest failure depth resulted in outward extend of upstream catchment boundary. Huge amount of sediment mass was transported downward also formed significant deposition in debris flow channel and alluvial channel, respectively. These phenomenon also reflects patterns in slope-area diagram. The contributing area related to hillslope-to-valley transition tends to migrate from 20 m2 to 50 m2, that means hillslope length become longer due to outward development of upstream catchment boundary. The local slope of debris flow channel, and alluvial channel section of the diagram, become gentler due to sediment depositions after the landslide. These high resolution analysis pre and post a major event, represent a strategic tool for a directly quantification of the processes that affected and significantly changed the earth surface.

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