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On the Correlation of Landslides and Sedimentation in Western Taiwan after the 1999 Chi-Chi Earthquake

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The hilly Western Foothill of Taiwan Island is highly prone to landslides, especially during typhoon season in the summer. The 1999 Chi-Chi earthquake (MW=7.6) resulted in tremendous amount of landslides in western Taiwan area. The impact of this earthquake not only makes the geomaterial more fractured but also changes the river morphology in the Western Foothill area. This study investigated the correlation of landslides and catchment sedimentation after the 1999 Chi-Chi earthquake. As the major river in western Taiwan, the Wu-River and Ta-Chia River are adopted and studied. The study comprises two major parts, i.e. the investigation of landslides and catchment sedimentation, and the study of their correlation. The former part includes field, satellite image and DTM calculation results, and the later part includes analysis on the correlation between the landslides and catchment sedimentation. Following the 1999 Chi-Chi earthquake, three typhoon events, i.e. Toraji (2001), Mindulle(2004), and Sinlaku (2008) were adopted for this study.

Although the impact of Chi-Chi earthquake is significant, the impacts of Chi-Chi earthquake on different sub-catchments are different. The results show strong correlation between the catchment sedimentation and landslides. The landslides are more prone to reactivation during Toraji, especially in the upstreams and the area near the epicenter of Chi-Chi earthquake. Compared with Typhoon Toraji, fewer and fewer reactivated landslides were induced by subsequent typhoons. This finding reveals a self-healing effect after the 1999 Chi-Chi earthquake. In other words, except for extremely high concentrations of rainfall, the landslides were more and more prone to new generation. Our findings indicate, comparing with typhoon Mindulle, more sediments were generated by typhoon Toraji in Wu-River and Ta-Chia River catchments. And those sediments were transported to the downstream by typhoon Mindulle. The results also reveal a sedimentation trend in the upstreams during Toraji and an incision trend in the upstreams during Mindulle.

A conceptual model is also developed to investigate the control factors on the correlation of sedimentation and landslides. This case study could provide experiences of the sustained landslide investigation and sediment estimation to regard as the reference of catchment management and landslide hazard risk assessment.