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Automated identification and mapping of landslides, after two tropical cyclones struck Taiwan, by using Free and Open Source GRASS GIS

Two large tropical cyclones also called typhoons struck Taiwan in the summer of 2004. Subsequent landslides caused not only casualties and housing damages but also produced large volumes of sediment that entered a drinking water reservoir. For reservoir and watershed management it is important to quickly identify the location and areal extent of new landslides for coordinating mitigation efforts. In this study, two automated methods, supervised and unsupervised classification of 10 m multi-spectral SPOT-5 imagery, were tested for their ability to identify and map landslide areas that were triggered by the two typhoons. A slope map was applied to mask roads, riverbeds and agricultural fields erroneously commissioned as landslides. The automated classification results were then compared with manually delineated landslides using SPOT-5 super mode satellite imagery with a resolution of 2.5 m. Finally, the results from all three methods were validated by using 0.35 m ortho-photos. This paper reports the results and discusses the salient differences between the automated and manual methods.

Taiwan is an island, about 380 km long and 140 km wide, separated by the Strait of Formosa from southeastern China. The island is prone to an average of four to five tropical cyclones, also called typhoons, each year. These intense storms bring torrential rains that can trigger landslides in the wide mountain belt that runs north-south, occupying almost two thirds of the island. In the second half of the 20th century, a great number of hydro-electric dams was constructed in the across the island. Natural occurring landslides and landslides induced by road construction or farming have scoured hill slopes and act as the major sources of both coarse and fine sediments that enters the channels and rivers. The sediments are transported and deposited in dams and reservoirs, reducing their storage capacity for drinking water and electricity production. A local assessment has indicated that between 8.8 and 9.7% of all fine sediment is trapped in Taiwan by reservoirs annually (Hwang 1994). Studies have further shown that landslides contribute over 80% of all sediment that enters the reservoir annually, especially in well-forested watersheds where natural

soil erosion rates are relatively low (e.g. Borghuis and Chiu 2005). This is why rapid and accurate identification of new landslides is of great importance to support watershed management. A quick response can enable the timely removal of landslide deposits or application of protective measures preventing further rock and soil transport. Aerial photographs have long been used to interpret and delineate landslides. But mapping landslides using aerial photographs is a tedious and time-consuming process. In recent years, researchers have turned to satellite images as a data source for mapping landslides using methods that range from visual interpretations to semi- or fully-automatic procedures such as change-detection and (un-)supervised classification. The main objective of this study was to test whether automatic methods are feasible for accurately and efficiently identifying landslides from 10 m SPOT-5 satellite imagery in mixed forested and cultivated mountain areas. This study consisted of three main parts.
First, the supervised and unsupervised classification methods were used to identify landslides in satellite imagery. Second, the automated classification results were compared with landslides that were manually delineated from supermode 2.5 m satellite imagery. Third, the study uses 0.35 m resolution orthophotos to validate landslides mapped by the automated and manual methods and to help explain the differences between the three methods. Findings from this study should be of interest to landslide researchers as well as watershed management agencies.

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