Geophysical Research Abstracts
Vol. 16, EGU2014-5725, 2014
EGU General Assembly 2014

Detection and Volume Estimation of Large Landslides by Using Multi-temporal Remote Sensing Data

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Large landslides are frequently triggered by strong earthquakes and heavy rainfalls in the mountainous areas of Taiwan. The heavy rainfall brought by the Typhoon Morakot has triggered a large amount of landslides. The most unfortunate case occurred in the Xiaolin village, which was totally demolished by a catastrophic landslide in less than a minute. Continued and detailed study of the characteristics of large landslides is urgently needed to mitigate loss of lives and properties in the future. Traditionally known techniques cannot effectively extract landslide parameters, such as depth, amount and volume, which are essential in all the phases of landslide assessment. In addition, it is very important to record the changes of landslide deposits after the landslide events as accurately as possible to better understand the landslide erosion process. The acquisition of digital elevation models (DEMs) is considered necessary for achieving accurate, effective and quantitative landslide assessments. A new technique is presented in this study for quickly assessing extensive areas of large landslides. The technique uses DEMs extracted from several remote sensing approaches, including aerial photogrammetry, airborne LiDAR and UAV photogrammetry. We chose a large landslide event that occurred after Typhoon Sinlaku in Meiyuan the mount, central Taiwan in 2008. We collected and processed six data sets, including aerial photos, airborne LiDAR data and UAVphotos, at different times from 2005 to 2013. Our analyses show the landslide volume being 17.14×10^6 cubic meters, deposition volume being 12.75×10^6 cubic meters, and about 4.38×10^6 cubic meters being washed out of the region. Residual deposition ratio of this area is about 74% in 2008; while, after a few years, the residual deposition ratio is down below 50%. We also analyzed riverbed changes and sediment transfer patterns from 2005 to 2013 by multi-temporal remote sensing data with desirable accuracy. The developed technique will support damage and risk assessments of large landslides because the volume difference, riverbed change, and sediment migration can be quantitatively and accurately determined by a combination of multi-temporal remote sensing approaches.