Geophysical Research Abstracts
Vol. 20, EGU2018-14915, 2018
EGU General Assembly 2018

Detection of landslide-dammed lakes and triggering landslides in Taiwan using Landsat imagery

Barbara Friedl (1), Daniel Hölbling (1), Günther Prasicek (2,3), Anne-Laure Argentin (2), and Tsai-Tsung Tsai (4)

(1) Department of Geoinformatics - Z_GIS, University of Salzburg, Salzburg, Austria (barbara.friedl@sbg.ac.at), (2) Department of Geography and Geology, University of Salzburg, Salzburg, Austria, (3) Department of Earth Surface Dynamics, University of Lausanne, Lausanne, Switzerland, (4) Disaster Prevention Research Center, National Cheng Kung University, Tainan, Taiwan

Taiwan is frequently affected by severe landslide events, most notably caused by high-magnitude earthquakes or heavy rainfalls brought by typhoons. The large amount of mobilized debris significantly affects the drainage system, representing a downstream threat. The Taiwanese mountains are, at least in part, densely populated and human lives and infrastructure are frequently affected by large landslides and landslide-river interference, such as the formation of landslide dams and lakes, dam breaching and river course changes. Especially in hardly accessible mountain regions the use of remote sensing data can help to investigate landslide-river interference.

In the present study, we aim to semi-automatically detect landslide-dammed lakes as well as the triggering landslides by object-based image analysis (OBIA). OBIA offers a methodological framework for the efficient identification and change analysis of natural phenomena such as landslide-induced lake formation, because of its ability to consider spectral, spatial, textural, morphometric, as well as hierarchical properties of segmentation-derived image objects. Three sub-regions of different river catchments in Southern Taiwan, where landslide-induced lake formation was observed after major typhoons or earthquakes, are considered in this study. Pre- and post-event Landsat imagery (particularly Landsat 5-8) and digital elevation data (SRTM at 30m resolution) serve as primary data basis. Pre-processing of Landsat data comprises the Top of Atmosphere (TOA) correction of Digital Numbers (DN) values and co-registration of datasets to ensure the correct alignment of images; DEM (digital elevation model) data processing includes the calculation of various DEM derivatives, i.e. surface characteristics such as slope, and hydrological parameters as for instance flow accumulation, or flow direction. Landslide-dammed lakes are initially detected by applying approved spectral indices for water detection, i.e. the Normalized Difference Water Index (NDWI), the Modified Normalized Difference Water Index (MNDWI) or the Automated Water Extraction Index (AWEI). The dam-causing landslides are identified by comparing the best available pre- and post-event Landsat images and delineated mainly based on changes in spectral contrast between landslides and their surroundings caused by changes in vegetation. A combined use of NDVI (Normalized Difference Vegetation Index), surface morphology characteristics and contextual information is considered here. For differentiating between river beds (i.e. sediment/debris deposition area) and landslides (i.e. debris source area), shape-based characteristics (e.g. length/width ratio) and morphological properties are used. Classification accuracy is assessed by comparing outcomes to results from visual image interpretation (i.e. manually digitized reference polygons) as well as to existing data sets, e.g. landslide and lake inventories.

The developed classification routine can be adapted for time-series analysis of historical and recent optical remote sensing data from different sensors (Landsat, Sentinel-2, FORMOSAT, etc.) to monitor the evolution of landslide-dammed lakes over time. An inventory of landslide-induced lakes and triggering landslides and a better understanding of landslide-river interaction are crucial to assess and predict natural hazards and hazard cascades.