Japan Geoscience Union Meeting 2014
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HDS05-P01 Room:Poster Time:April 29 18:15-19:30

The Assessment of Landslide Displacements Using Digital Photogrammetry and Numerical Analysis

CHANG, Kuang-tsung[1] ; LIN, Chun-te[1*] ; SU, Miau-bin[2] ; CHENG, Min-chieh[1]

[1]Department of Soil and Water Conservation, National Chung Hsing University, Taichung 402, Taiwan., [2]Department of Civil Engineering , National Chung Hsing University, Taichung 402, Taiwan

Instead of comparing remote sensing images between before and after a landslide event, this study compares aerial photographs over the years with the velocities of surface movements of landslide to evaluate the feasibility of aerial photographs as a monitoring tool. Before the total collapse of the slope of Freeway No.3, there were signs showing sliding of the slope, but no equipment was set up for monitoring. We use GIS to discriminate aerial photographs of different years to evaluate the displacements of specific objects or marks. From 2002 to 2004, the average displacement was 49.5cm, and the average displacement rate was 23.7cm/yr; from 2004 to 2007, the average displacement was 22.5cm, and the average displacement rate was 7.3cm/yr.

According to time-dependent creep behavior, the primary creep might have occurred from the beginning of the excavation in 1998 to 2004. And the secondary creep was from 2004 to 2007, so the velocity was comparatively lower than the previous stage. As for the tertiary creep, the displacement rate might rise since 2007 till the total collapse in 2010. The software Plaxis 2D based on the finite element method will be used to analyze the displacement process of the slope. The numerical model is set up according to the digital terrain model (DTM) of the slope. The numerical results will be calibrated with the results of the digital photogrammetry. We expect to obtain the creep behavior of the slope such as the slope strength reduction with time and the changes of surface displacement rate with time.

Keywords: digital photogrammetry, Freeway No.3 landslide, displacement rate, creep

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Deformation Analysis of the Pliocene-Pleistocene Sedimentary Rocks Mountain using Lidar Data

ASAHINA, Toshihiro[1*]

[1]PASCO CORPORATION

1.Introduction

Be a topic for the deformation of the Shimanto Supergroup in the Oigawa River basin and in the Kii Peninsula in many cases. How deformation of sedimentary rocks of the Pliocene to Pleistocene age strata earlier age and lower strength than the Shimanto Supergroup is in progress, I report on the basis of the analysis result of airborne Lidar data. The study area is the mountain in Tsunan of Niigata Prefecture around located on the border between Nagano and Niigata Prefecture. Geologically, the study area is located in the south side of the Matsunoyama dome and the Uonuma formation of Pliocene to Pleistocene age is widely distributed.

2.Mountain block geology and geomorphology

The northwestern part of Tsunan is a steep mountain of 1100m altitude from 200m, where the Uonuma formation, being of sand, silt, alternating beds of silt and sand, massive silt and volcanic rocks, is distributed. The investigation mountain has a monoclinic structure facing the Shinanogawa River on geological structure, which the Uonuma formation dips 40 degrees from 15 degrees SE generally and shows a monotonic spread to the whole.

In this area, a number of landslides have occurred, but at the time of the earthquake in northern Nagano Prefecture (March 12 2011, M6.7, depth: 8km, epicenter: Sakae village in Nagano Prefecture), the large plane slip presumed to be caused by this earthquake has occurred.

3.Lidar data

An airborne Lidar survey was conducted on May 14, 2013 for the morphological analysis of the northwest mountain of Tunan. Lidar measurement was carried out in the range of about 30km2 by ALS60 system. The Lidar point data were interpolated using a natural neighbor method on a grid with 1.0m spacing.

In order to understand the characteristics of the mountain deformation, I analyzed the mountain terrain in the following procedure.

1)Analysis 1

a.Classification of slope gradient (a grid with 5.0m spacing),b.Extraction of the cells of 40 degrees from 15 degrees slope gradient,c.Analysis of surface structure,d.Extraction of bedding surface slopes that is likely to cause a slip

2)Analysis 2

a.Image analysis,b.Extraction of linear deformation terrain , such as a lineation or an edge,c.Extraction of deformation terrain surface, such as a depression zone,d.Integrated analysis of analysis 1 and 2

4.Discussion

The GIS analysis of the cells obtained by the process of Lidar data and GIS processing has revealed that the slopes which are considered to bedding plane are found very widely in the mountain. Furthermore, based on the morphological features obtained, the two mountain blocks with a trace of a slip plane as the bedding planes were extracted. These mountain slopes have a characteristic of both showing a bedding plane sliding surface morphology on the terrain surface and the irregular linear trough. The largest linear trough is running diagonally across the hillside slope, and its extension reaches 600m from 550m. The thickness of the terrain block forming a linear trough is about 10m from 6m maximum. These morphological features suggest that the bedding surface played a major role in events that may have caused the extensive deformation and collapse of the edifice. The above is a morphological characteristic that is not found in such the Shimanto Supergroup.

These are important key points in extracting mountain deformation due to the bedding slip.

5.Conclusions

By the analysis of Lidar data, it has been confirmed the distribution of distinctive slopes to suggest that the edifice extensive deformation has occurred in the past in this area.

6.References

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Keywords: Lidar, surface morphology, bedding plane slip, line trough, edifice deformation

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Interaction between river bed condition and debris flow in Ichino-sawa subwatershed of Ohya-kuzure landslide, Japan

TSUNETAKA, Haruka[1*] ; HOTTA, Norifumi[1] ; IMAIZUMI, Fumitoshi[2] ; HAYAKAWA, Yuichi S.[3]

[1]Life and Environmental Sciences, University of Tsukuba, [2]Graduate School of Agriculture, Shizuoka University, [3]Center for Spatial Information Science, The University of Tokyo

In recent years, there has been significant concern about large-scale sediment movements, such as deep-seated landslides, that are expected to occur more intensively due to changes in rainfall patterns. These landslides not only induce immediate sediment disasters downstream but also produce a large amount of unstable sediment that is transported gradually following the landslide. Most of the unstable sediment residing in a deep-seated landslide area is first discharged as debris-flow forms. Thus, after the occurrence of landslides, debris flows have a long-term affect on the watershed regime through their impact power, riverbed aggradation, and the production of turbid water, among other effects.

To facilitate better prediction of debris flows from landslide areas, this study investigated the interactions among topographic conditions, bed-material conditions, and debris flow events in a headwater catchment where a deep-seated landslide had occurred.

The study site was the Ichino-sawa subwatershed in the Ohya-kuzure basin, Shizuoka Prefecture, Japan. The basin experienced a deep-seated landslide about 300 years ago and is currently actively yielding sediment with a clear annual cycle. During the winter season, sediment moves from the hillslope to the channel bed because of freeze?thaw activity and weathering. In the summer season, the deposited sediment is discharged incrementally by debris flows related to storm events.

Topographical surveying and grain-size analysis were carried out several times between November 2011 and November 2013. Point cloud data were acquired during the topographical surveying, using a ground-based laser scanner, and used to create a high-resolution digital elevation model. Grain-size analysis was conducted in the upper, middle, and lower parts of the study site. A line-grid method was employed for the in situ analysis, and the fine particle fraction was determined by sieving the sampled materials. Debris flow occurrences were also being monitored in the same period by a sensor-triggered video camera. Rainfall was observed during the summer season for comparison with debris flow occurrence and magnitude.

Several debris flows with different magnitudes were observed during the study period. Although rainfall events in the early spring season altered bed inclination, the thickness of deposited sediment, and the grain-size distribution of the bed material, more significant changes were detected after the debris flows. While the initial grain-size distribution in early spring was roughly identical over the study site, the subsequent grain-size distribution changed differently, according to location. The source, transport, and deposition areas of the debris flows were different among different rainfall events, resulting in different transitions in geomorphic conditions at different locations. The lower part of the study site changed from a source area to a deposition area through the summer season.

A comparison of the topographic conditions, bed-material conditions, and debris flow events indicated that, in addition to the conditions of the triggering rainfall, topographic and bed-material conditions affected debris flow occurrence and magnitude. These interactions could be observed in the deep-seated landslide area, where a substantial and continuous supply of sediment prevents stabilization of the channel bed through exposure of bedrock or by armoring of bed materials.

Thus, to predict the long-term impact of large landslides, it is necessary to assess the subsequent debris-flow discharge considering the sediment dynamics and changes in topographic and bed-material conditions in the landslide area.

Keywords: debris flow, deep-seated landslide, topographic condition, grain size distribution

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Deep seated landslides along the geological structure in Chishan River Watershed,southern Taiwan

LIAO, Chi-yueh[1*] ; LIN, Ching-weei[2]

[1]) Disaster Prevention Research Center National Cheng Kung University, [2]Department of Earth Sciences National Cheng Kung University Tainan Taiwan

Landslide is the common nature hazard in Taiwan. The Typhoon Morakot in 2009 brought huge precipitation and induced severe hazards in south-central and eastern Taiwan. Except the landslides, debris flow and flooding hazards induced by Typhoon Morakot, the large scaled deep seated landslides deserve more attention because they may cause the destructive disaster.

The Chishan River watershed which covered 750 km2 is selected as study area. The study area is mainly compose of meta-morphic and sedimentary rocks. Within the study area, 313 sites greater than 10 ha with sliding topographic features of deep seated landslide such as crown main escarpment, down slope scarp ,and lateral cracks are recognized from LiDAR derived 1 m resolution DEM, and we noticed the distribution of these sites is close to the structure in our study area. In order to know the influence of structure in the development of deep seated landslides, landslide density are calculated. The landslide density decreases with increasing distance and there are 79% of. deep seated landslides developed along the structure with a 1km buffer zone. The Result indicates that deformation zone associated structure is crucial in the development of deep seated landslides in the study area.

Keywords: Chishan River watershed, deep seated landslides, geological structure