Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

HDS27-P01 Room:Convention Hall Time:May 24 16:15-17:30

Relationship between slope failures and height and density of trees brought by LIDAR data

Takaki Okatani[1*], Otoi Kosei[1], Takayuki Nakano[1], Mamoru Koarai[1]

[1]GSI of Japan

Authors showed that tree height can be supposed from LIDAR data and number of trees and area of tree timber at breast height can be presumed in case of plantation of ceders by previous study in Izumozaki district, Niitaga prefecture. Authors analyzed relationship between form of trees and probability of slope failure occurrence. Less probability of slope failure occurrence is pointed in case of higher tree areas from study in Izumozaki district. Authors will show results of further analysis about the relationship.

Keywords: LIDAR Data, Height and Density of Trees, slope failures

Slope angle at each 30m x 30m cell (2004)

Maximum tree height at each 30m x 30m cell

	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-(m)	average
0-5 (m)	0.4%	7.8%	10.5%	-	-	-	-	-	-	-	2.1%
5-10	0.8%	7.6%	14.1%	19.0%	-	-	41.7%	-		-	8.2%
10-15	0.9%	1.7%	6.2%	16.2%	23.5%	33.8%	51.3%	26.3%	-	-	12.1%
15-20	2.1%	3.3%	4.6%	11.8%	13.0%	22.3%	24.7%	22.7%	31.0%	-	11.8%
20-25	2.2%	2.3%	4.8%	6.0%	10.6%	12.5%	18.0%	13.7%	15.6%	-	9.8%
25-30	0.0%	2.0%	3.6%	6.8%	8.9%	11.8%	14.3%	15.0%	8.3%	-	10.1%
30-35	-	0.0%	4.9%	6.3%	9.0%	12.1%	11.1%	16.3%	16.3%	-	10.3%
35-	-	-	12.5%	6.1%	12.1%	8.6%	16.3%	10.3%	-	-	11.2%

(%) : ratio of slope failure area in each cell

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HDS27-P02 Room:Convention Hall Time:May 24 16:15-17:30

Automated Delineation of Slope Unit using Airborne LiDAR derived Digital Elevation Models

Nagazumi TAKEZAWA[1], Makoto MATSUZAWA[1], Tadanori ISHIZUKA[1], Hidetomo TATSUMI[2*], Fumi TAKEMURA[2], Ryoichi OHNO[2]

[1]Public Works Research Institutes, [2]JAPAN CONSERVATION ENGINEERS & CO.LTD

Digital elevation models can provide us with wide variety of information about the land surface using existing GIS softwares and programs. When analyzing the susceptibility of hillslopes to displacement as well as landsliding, stability is usually determined on a watershed basis. However, basic evaluation is conducted on individual hillslope bounded by ridges and streamlines with which combinations of slope units comprise a watershed. Here, watershed boundaries can be extracted by automated GIS programs. Nonetheless, hillslopes are often manually digitized from scanned contour maps which are then made into geographic data.

For an attempt to develop an objective method for automated delineating of slope unit, the authors applied Zhou's approach (2004) of reversed elevation model and extracted hillslopes through raster processing. The dataset used in this study was an airborne LiDAR derived elevation models collected in Hofu City, Yamaguchi Prefecture in 2009. Identified slopes were then combined with normally obtained watersheds to obtain slope units bounded by ridges as well as streamlines. For analyzing sensitivity of outcomes, five-different window size and three-repeat counts were tried to when calculating summit planes while five-different minimum contributing areas were tried when dividing watersheds.

Keywords: Airborne LiDAR, digital elevation model, slope unit, automated delineation, slope failure

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HDS27-P03 Room:Convention Hall Time:May 24 16:15-17:30

Extracting small scarps to predict potential sites of deep-seated landslides

Masahiro Chigira[1*], Tsou ChingYing[1], Ryuzo Yokoyama[2], Michio Shirasawa[2], Tatsuro Chiba[3], Kazuya Funakoshi[3], Yukiko Sakurai[4]

[1]Disaster Prevention Research Institute Kyoto University, [2]Yokoyama Geo-Spatial Information Laboratory Co. Ltd., [3]Asia Air Survey Co. Ltd., [4]Aero Asahi Corporation

Typhoon Talas 2011 induced many deep-seated landslides in the Kii Mountains. Ten landslides had been surveyed by airborne laser altimetry before the landslide events by the Ministry of Land, Infrastructure, Transportation, and Tourism and Nara prefectural government, which made it possible to analyze detailed topography. There were few landslides that had detailed topographic data beforehand. Topographic analysis clarified that these deep-seated landslides had been preceded by eyebrow-shaped small scarps along their future crowns, which suggests that such small scarps are the clues to predict potential landslide sites. Most of these scarps are too small to be easily identified on aerial photographs.

We made several types of images from high-resolution DEMs and compared their possibility to identify precursory small scarps for three landslides in Otoh in Gojo, Nara (Shimizu, Akatani, and Nagatono). The images were a slope image, a 3-D slope image, a 3-D red image, and a curvature image.

The precursory scarps were 35-43 degrees with a horizontal length of 7-57 m along slope lines. Horizonta length and vertical height are close because the slope angle is near 45 degrees. These scarps are identified by the change in slope angles, and are not easily recognized because of larger sizes. The Shimizu landslide had one small scarp and the Akatani and the Nagatono landslides had more than one scarps.

We found no big difference among the images we made to detect precursory scarps. The slope image and the 3-D red image could not tell us the slope direction in some cases. The 3-D slope image had no such troubles, but must be observed with stereoscopic glasses so could not be annotated on it. It could not be used with other images on GIS. Identifying precursory small scarps could not be made automatically, but could be made manually in a practical sense. Appropriate images help this process.

Keywords: Deep-seated landslide, Air-borne laser altimetry, Gravitational slope deformation

Japan Geoscience Union Meeting 2013
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HDS27-P04 Room:Convention Hall Time:May 24 16:15-17:30

Large landslide in the northwestern face of Mount Mitou, west Tokyo

Yoshihiko Kariya[1*], SHIMIZU, Chousei[2], Koichiro Sawabe[3], Kuniyasu Mokudai[4], Go Sato[5]

[1]Senshu University, [2]Komazawa University, [3]Graduate School of Senshu University, [4]Pronatura Japan, [5]Teikyo Heisei University

Rugged mountains consisting of inclined sedimentary rocks are present in the upper part of the Tama River, 70 km west of downtown Tokyo. It is generally assumed that these mountains are subjected to geologic and geomorphic conditions that are conducive to the occurrence of gravitational mass rock deformation and large landslides. Therefore, we clarified the geomorphic and geologic features of a large landslide on the northwestern face of Mount Mitou, which lies within this area. We found a thick angular gravel bed with a volume of approximately 2 x 10^6 m^3; this layer contained jigsaw brecciated rock clasts, and hummocks were present on the ground surface. This gravel bed originated from a large landslide, the material for which was likely supplied from the amphitheater located 1 km south of the area where the gravel bed is primarily distributed. This gravel bed filled and dammed the small valley of a tributary of the Tama River, resulting in the production of a small lake or floodplain. The age of primary landsliding is estimated to be 1292-1399 cal AD or older, based on the ^{14}C ages of lacustrine-floodplain deposits, although younger ages in the range 1469-1794 cal AD are obtained from the gravel bed itself. This suggests that at least two independent landslides occurred at the study site. Interview with the local residents clarified traditional literature describing the break of a small lake and the apparition of a great serpent on the northwestern face of Mount Mitou; such features could be a metaphor for collapse of the landslide lake and the subsequent debris flow.

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Relationships between sagging geomorphologies and geological structure of Nogo-hakusan Granodiorite along the Gifu-Fukui

Naoya Iwamoto[1*], Satoru Kojima[1], Heitaro Kaneda[2], Tomoyuki Ohtani[1]

[1]Department of Civil Engineering Gifu University, [2]Department of Earth Sciences Chiba University

Many landslides have occurred in Japan with steep landform, and have damaged people and properties. Therefore, it is very important to understand the site characteristics and warning signs of the landslides. Sagging geomorphologies are considered to be one of the warning signs of landslides. However, relationships between development of sagging geomorphologies and landslides are unclear. This study aims to claarify the relationships between the formation process of sagging geomorphologies and landslides by to examine sagging geomorphologies and geological structures of igneous rock.

Many sagging geomorphologies occur in Nogo-hakusan Granodiorite distributed around Mt. Nogo-hakusan on the Gifu-Fukui prefecture boundary. The sagging geomorphologic features were extractred from the detailed contour maps based on DEM data offered by Etsumi Sankei Sabo Office and Fukui River and National Highway Office. Geological structures such as joint systems and faults of the granodiorite were studied in the field. As the result, 189 places of sagging geomorphologies were recognized, and their dominant directions are parallel to the dominant strikes of the joint system. When the strikes of joints are subvertical to the strikes of the ridges, the sagging geomorphologies are poorly developed. The sagging geomorphologies are developed on the flat surface or gentle slope on the top of the mountains and the ridges, and many of them are mainly located behind post-glacial dissection fronts. Repetition of the following process and close relationships between the sagging geomorphologies and landslides can be supposed by these observations: 1) unstabilization of the flat surface behind the dissection front by landslide, 2) formation of sagging geomorphologies by the unstabilization, and 3) occurrence of landslide at the sagging.

Keywords: sagging, Mt.Nogohakusan, landslide, joint

Japan Geoscience Union Meeting 2013
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HDS27-P06 Room:Convention Hall Time:May 24 16:15-17:30

Reconstruction of processes of gravitational slope deformation around Mt. Eboshi using terrestrial cosmogenic nuclide

Ryoko Nishii[1*], MATSUSHI, Yuki[2], MATSUZAKI, Hiroyuki[3]

[1]University of Tsukuba, [2]Kyoto University, [3]The University of Tokyo

A number of linear depressions are widely distributed around Mt. Eboshi, Northern Japanese Alps. This study addressed the reconstruction of formation processes of gravitational slope deformation using terrestrial cosmogenic nuclide. The rock samples for exposure dating were taken from three scarp faces, which are estimated as slip planes related to gravitational slope deformation, corresponding to three linear depressions; two depressions are located at the upper part of the slope and the other is at the middle part of the slope. The concentration of cosmogenic nuclide (^{10}Be) at the two scarp faces at the upper slope was higher than that at the middle slope. Assuming that initial nuclide concentration is zero and no shielding by seasonal snow cover, we estimated minimum exposure ages of these scarp faces. The minimum exposure ages of upper two scarps were estimated as 2.9 ka and 1.2 ka, while it was calculated to be 0.9 ka for the middle one. These data suggest that slope deformation had advanced downward in Holocene.

Keywords: Terrestrial cosmogenic nuclide, Holocene, granitic rocks, Northern Japanese Alps

Japan Geoscience Union Meeting 2013
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HDS27-P07 Room:Convention Hall Time:May 24 16:15-17:30

Preparation of seamless landslide GIS data

Shoichiro Uchiyama[1*], Shoji Doshida[1]

[1]National Research Institute for Earth Science and Disaster Prevention

Since 1982, 1:50,000 landslide maps have been produced at the Japanese National Research Institute for Earth Science and Disaster Prevention. Since October 2000, the institute has been publishing a landslide GIS database and making these data available over the web. In 2012, we began a major project to revise these data. This project targeted three problems: 1) Division of landslides extending over the boundaries of the map into separate elements, 2) Inaccurate positions and shapes in landslide GIS data produced since 2005, and 3) Presence of obvious errors in the attribute data. To address these problems, we released an updated seamless landslide GIS database. The data are continuously maintained and updated once a month.

Keywords: Landslide GIS data, Seamless data, Major revise, Data release

Japan Geoscience Union Meeting 2013
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HDS27-P08 Room:Convention Hall Time:May 24 16:15-17:30

The research in regarding with electrical resistivity tomography at landslide area in Nishi-ikawa,Tokushima,Japan

Tomohiro Ymazaki[1*]

[1]Graduation Science of Chiba Unuversity, [2]Disaster Prevation Research Insititute Kyoto University

Landslide is one of the severe disasters triggered by rainfalls or earthquakes. Recently, landslides tend to increase by global-warming. This research pays an attention to the rainfall-induced landslide. So far, we are trying to develop the early warning system for the landslide using self-potential (SP) measurements. The previous our indoor experiments provide some important facts in landslide process for hydrological, geotechnical, and electromagnetic senses; (1) expansion of saturated area under the ground, (2) changes of underground water flow from vertical to lateral directions, (3) apparent soil displacement 2-30 minutes before the main landslide, (4) good agreement between saturated area and area with low SP value, and (5) appearance of transient signals 2-30 minutes before the main landslide. These facts should be validated in in-site measurements. In general, to monitor underground water condition, pore-pressure meters are used but they are likely to disturb hydraulic system underground due to drilling. On the other hand, electrodes for SP measurements do not disturb it because they are installed near the surface. So there is an advantage in SP approach to monitor actual slopes. In this study, we perform electrical resistivity tomography and core sampling by borehole drilling as preliminary tests.

The test area is the slope at Nishiikawa, Tokushima, Japan. The Disaster Prevention Research Institute Kyoto University installed sensors such as extention meters to monitor the slope. We perform electrical resistivity tomography for this slope. We set up 6 lines in this study. 2 lines set to lateral to the landslide segment, and 4 lines cross segment. The inter-electrode distance of the experiment are 1m and/or 2m for each line. Then we have drawn 2 dimensional resistivity map for cross-sections and a quasi-3 dimensional map from the observed data. The results show that there are low resistivity region at shallower depth ($<$ 3 m). In order to evaluate the resistivity tomographic results, we drilled 2 boreholes to investigate core sample and found an impermeable layer with lay material around 3m depth. This is the very consistent with the electrical resistivity tomographic results. Through these facts, it is safe to say that the estimation on slip surface of the landslide segment seems adequate. In next step, an in-situ test system for monitoring practical slope will be constructed at the slope. The details will be given at our presentation.

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HDS27-P09 Room:Convention Hall Time:May 24 16:15-17:30

Measurement of the anisotropic pore water diffusion in clay samples by NMR diffusometry

Yoshito Nakashima[1*]

[1]AIST

Clays are important minerals for the geohazards such as landslides. The platy grain structure of clays yields strong anisotropy in the transport properties of clay samples. Proton nuclear magnetic resonance (NMR) is a promising tool to measure the diffusion anisotropy of pore water in clay samples non-destructively and non-invasively. The applicability of NMR diffusometry to clay samples is discussed mainly in terms of the preliminary computer simulations (e.g., Fig. 1) using the random walk technique (Nakashima et al., 2008).

Ref: Nakashima et al. (2008) Water Resources Research, vol. 44. http://onlinelibrary.wiley.com/doi/10.1029/2008WR006853/pdf

Keywords: clay, nuclear magnetic resonance, computer simulation, pore structure, anisotropy, diffusion tensor

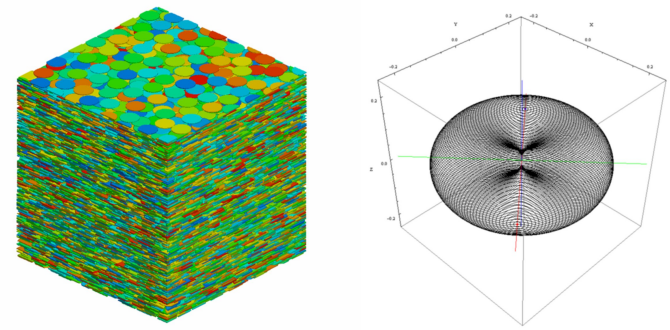

Fig. 1 Left: synthetic image of a sediment of completely parallel clay platelets (porosity 47 vol%). Right: corresponding direction-dependent normalized self-diffusivity of pore water as a wireframe shell having a constriction (not convex ellipsoid).

Japan Geoscience Union Meeting 2013
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Why does a landslide accelerate? - Estimation of dynamic friction process associated with the sliding -

Masumi Yamada[1*], Hiroyuki Kumagai[2], Yuki Matsushi[1], Takanori Matsuzawa[3]

[1]DPRI, Kyoto University, [2]Nagoya University, [3]NIED

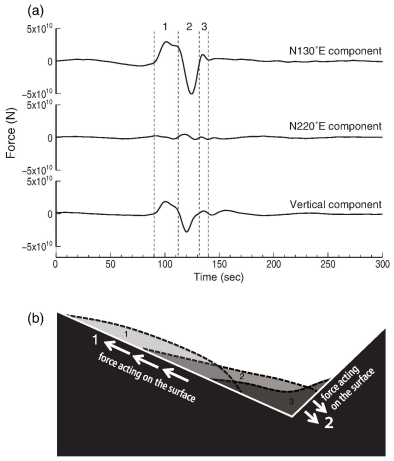
Assessing and managing the risks posed by deep-seated catastrophic landslides requires a quantitative understanding of the dynamics of sliding rock masses. Previously, landslide motion has been inferred qualitatively from topographic changes caused by the event, and occasionally from eyewitness reports. However, these conventional approaches are unable to evaluate source processes and dynamic parameters.

In this study, we apply a different approach for reconstructing the dynamic landslide processes using ground shaking data recorded away from the landslide. The deep-seated catastrophic landslide sequence induced by heavy rainfall in 2011 in the Kii Peninsula, Japan, was the first instance in which 1) seismic signals radiated by landslides were recorded by densely distributed near-source seismometers, and 2) the precise volume of the landslide material was able to be measured by comparing pre- and post-landslide topographic data obtained using airborne laser scanning. We performed a source inversion with the long-period seismic records of one of the largest events, and from this obtained a force history of the landslide.

Here we reveal the dynamic processes of the landslide: smooth initiation of sliding, acceleration accompanied by a substantial decrease in frictional force, and deceleration due to collision. Of particular importance is the determination of the dynamic friction during the landslide. The coefficient of friction is estimated to be 0.56 at the beginning of the event and drops to 0.38 for most of the sliding. The change in the frictional level on the sliding surface may be due to liquefaction or breaking of rough patches, and contributes to the extended propagation of the large landslide. The approach demonstrated here offers an innovative method for understanding the sliding processes associated with catastrophic landslides, enabling us to simulate the motion of such events.

Figure caption: Dynamic process of the Akatani landslide. (a) Estimated single-force source time functions for the two horizontal components (sliding direction and its perpendicular direction) and the vertical component. (b) Schematic diagram of the mass sliding model. The numbers correspond to the three stages indicated in (a).

Keywords: landslide, deep-seated landslide, seismic data, coefficient of dynamic friction



Japan Geoscience Union Meeting 2013
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The evaluation of denudation form in the mountain streams, use of the analyze shallow landslide susceptibility

Makoto Matsuzawa[1*], Nagazumi Takezawa[1], Takao Yamakoshi[1], Tadanori Ishiduka[1], Hidetomo TATSUMI[2], Fumi Takemura[2]

[1]Public Works Research Institutes, [2]JAPAN CONSERVATION ENGINEERS & CO.,LTD

In this study, we applied the analyze shallow landslide susceptibility (called C-SLIDER) to Hofu city and we examined the validity of a C-SLIDER result and an actual shallow landslides area, and verified about the applicability of the C-SLIDER.

At result, does not progressed denudation areas which were soil layer is thick area were validity of the analysis result by the C-SLIDER and an actual shallow landslide area is high. In other words, the degree of risk shallow landslide by the C-SLIDER method is applicable. On the other hand, progressed denudation areas which were soil layer is thin were validity of the analysis result by the C-SLIDER and an actual shallow landslide area is low, in other words, the degree of risk shallow landslide by the C-SLIDER method is inapplicable.

Keywords: debris flow, Shallow landslide, C-SLIDER method, Slope form of denudation grade

Japan Geoscience Union Meeting 2013
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HDS27-P12 Room:Convention Hall Time:May 24 16:15-17:30

Sea cliff landslides caused by the 2011 Tohoku earthquake and the 2011 Fukushima-Hamadori earthquake in the Joban coast

Hiroshi Kurosawa[1*], Yoshihiko Kariya[2]

[1]Graduate School of Senshu University, [2]Senshu University

Many of sea cliff landslides caused by large earthquakes in March and April 2011 occurred along the Joban coast facing the Pacific Ocean. We measured geomorphic parameters (e.g., length, width, volume) of 177 sea cliff landslides from the north Ibaraki to the north Fukushima. Then, we clarified the morphological characteristics of landslides by using airphoto analysis and field investigation, and examined the relationship between landslide morphology, local geology and seismic acceleration parameters (QuiQuake by AIST).

Landslides were mainly classified into the following 2 types. [Type 1, n=89] The upper part of sea cliff (unconsolidated marine or terrestrial sands and gravels, or aeolian tephras) collapsed, but lower part (marine sedimentary rocks) remained stable. [Type 2, n=79] The whole of sea cliff collapsed regardless of local geology. Nine landslides could not be classified due to the resolution problems of airphoto. Average volume of landslide block was 2.2 x 10^3 m^3 for Type 1 and 7.6 x 10^3 m^3 for Type 2. A middle scale landslide with almost 10^5 m^5 volume of a landslide block was included in an unclassified type. Landslides of Type 1 were frequently found in the southern and the northern Joban coast such as Hitachi, Kita-ibaraki and Sohma. Landslides of Type 2 were present in the middle part of Joban coast such as Kita-ibaraki and Futaba. The landslides tended to concentrate in the areas where high seismic acceleration was estimated on March 11 2011 such as Hitachi, Futaba and Tomioka.

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Effect of temperature on shear strength of slip surface clay taken from a slow-moving landslide activated in cold season

Tatsuya Shibasaki[1*], Takanari Yamasaki[1], Sumio Matsuura[2]

[1]Japan Conservation Engineers & Co., Ltd., [2]Disaster Prevention Research Institute, Kyoto University

Landslides in Japan are often associated with occurrence of swelling clay minerals such as smectite that are frequently found in Tertiary deposit rocks or layers altered by hydrothermal processes in volcanic region. Because residual friction angle of smectite is very low, landslides with slip surfaces that are rich in smectite can become easily unstable in very gentle slopes. Such landslides tend to move very slowly for a long time. Velocity of such landslides are approximately 0.01-0.1mm/min statistically. In addition, those which became active during winter revealed various behavioral patterns when monitored. Their activities start from late autumn to snow-melting season. Some landslides stop moving during heavy snow period. It is not fully understood what kinds of factors control such various behaviors. Shallow and small-size landslides generally start moving from early winter (late autumn to early snowy season) which led us to suspect seasonal fluctuation of underground temperature affecting the slope stability. In the recent years, the authors have conducted experiments focusing on the temperature dependency of shear strength of soils, and revealed that residual strength of soils rich in smectite is strongly affected by temperature condition (Shibasaki and Yamasaki, 2010). In this paper, we carried out an additional experiment in order to investigate the mechanism of slow-moving landslides activated in winter.

We directly tested the effect of temperature on shear strength of slip surface, using an undisturbed sample taken from a landslide in Joetsu district, Niigata prefecture found in Neogene sedimentary rocks. X-ray diffractometer analysis of slip surface clay showed that dominant clay mineral is smectite. Direct shear test was performed on the drilled core sample containing slickensided slip surface at the depth of GL-4.5m. A test was carried out under normal stress of 50kN/m2 to reproduce the effective normal stress in the field. Shear rate of 0.005mm/min was applied. Temperature of the specimen was controlled by a shear box bath filled with water which circulated from temperature-controlled bath installed outside which changed from 14 to 27 degrees centigrade during the test. When temperature dropped, shear strength coincidentally decreased. This result matches with ring shear experiments performed on reconstituted samples of smectite-rich clayey soils (Shibasaki and Yamasaki, 2010). Furthermore, the results support the hypothesis that seasonal fluctuation of underground temperature lower shear strength of slip surface and can trigger landslide movement.

Keywords: slow-moving landslide, swelling clay mineral, smectite, residual strength, temperature dependency, cold season

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Changes in the risk of sediment-related disasters under climate change due to global warming

Satoshi Nakamachi[1*], Sumio MATSUURA[2], Takashi OKAMOTO[3]

[1]Division of Earth and Planetary Science, Graduate School of Science, Kyoto University, [2]Disaster Prevention Research Institute, Kyoto University, [3]Forestry and Forest Products Research Institute, Forestry Agency

In snow-covered areas, sediment-related disasters are caused by meltwater as well as rainfall. Therefore, the risk of sediment-related disasters increases during the snow melting period, when snow melts almost every day with the progress of season. In addition, a large amount of meltwater generated by extreme weather events such as strong winds makes the risk high.

According to the latest studies, variation in precipitation, air temperature, winds and other meteorological elements in the winter time of Japan has been getting larger for the last few decades. Thus we believe that the timing, type, scale and hazard area of sediment-related disasters may change drastically in future winter seasons.

However the relationship between sediment-related disasters and climate change in snowy regions has not been fully investigated. This is because of the infrequency of extreme events and the sparseness of local meteorological stations.

Therefore, we intend to clarify the long term trends and probability of extreme weather events in a snow environment in district of heavy snow in warm-temperate zones of mountainous areas, using the meteorological data sets acquired by both the Forestry Agency and the Meteorological Agency.

Keywords: sediment-related disaster, global warming, extreme weather event

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Distribution, ages, and deformation of the Holocene dammed-up-lake sediments along the Ane River, central Japan

Kazuki Haba[1*], Heitaro Kaneda[1]

[1]Department of Earth Sciences, Chiba University

The middle reaches of the Ane River, Shiga Prefecture, central Japan, are known to have been dammed by large-scale slope failure of Mt. Ibukiyama at least twice in the geologic past. Older and younger dammed-up lakes reportedly existed 30-40 ka and ˜5 ka, respectively, but precise ages and triggers of their formation and disappearance have been poorly known. Our short drilling at two sites on the modern riverbed of the Ane river recovered the lowermost part of the younger dammed-up lake sediment down to a depth of ˜4.0 m and ˜6.8 m from the riverbed. Base on radiocarbon ages of leafs and fragile plant fragments from the sediment cores as well as those from outcrops nearby, the younger dammed-up lake is most likely to have been formed ˜5.5 ka. The age of disappearance, however, is poorly constrained because the upper part of the lacustrine sediment has been mostly eroded away. On the basis of the radiocarbon dates obtained so far, the younger dammed-up lake is inferred to have existed at least until ˜4.5 ka, indicating that the lake retained for at least 1000 years. The long lake life is probably the result of very large volume of the landslide body that blocked the river, but the material of the body might be another reason for its long life: limestone gravels that lithify very quickly. We also found that the younger dammed-up-lake sediments have tilted up to as large as ˜20 degrees with small displacements at some places. Although the tilt may be partially ascribed to differential sediment compaction, we infer that active faulting has some relation to those deformations, given that the area is located in a compressional stepover between two active left-lateral faults: the Kajiya and Sekigahara faults.

Keywords: Ane River, large-scale slope failure, dammed-up lake, active fault, compaction