Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

HDS25-01 Room:102B Time:May 20 13:45-14:00

Rockslide and debris flow at Mochiyamadani, Miyagawa River, Mie Prefecture induced by heavy rain of the Typhoon No.1112

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Typhoon Talas (No.1112) in September, 2011 brought heavy rain into many landslides mainly to Kii Peninsula. A case of the rockslide and debris flow at Mochiyamadani, Miyagawa River is described.

The rockslide occurred near the ridge, two kilometers upper course from the confluence of the Miyagawa main stream. Volume of the landslide is estimated at 200 thousand cubic meters, which is relatively small in the landslides collapsed in this rainfall. Geology of the source area is weathered sandstone which belongs to Chichibu belt. While the slope is dip slope, the structure contributes little to the landslide. It is characteristic that the debris flow involved the landslide dam deposit formed in 2004 Typhoon Meari (No.0419). Volume of transported sediment increased at least 10 thousand cubic meters by this dragging. Debris flowed down with destroying check dam and bridge along the watercourse, reached the confluence, and dammed up the Miyagawa main stream. Estimated flow velocity at the upper course of the confluence is 18 m/s, based on the measurement of superelevation.

Keywords: Typhoon No.1112, Miyagawa, sediment removal, landslide dam

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HDS25-02 Room:102B Time:May 20 14:00-14:15

Validation of landslides caused by Typhoon No. 12, 2011 using Normalized Soil Water Index in the Kii Peninsula, Japan

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In September 2011, catastrophic landslide disasters triggered by record-breaking rainfall due to Typhoon No. 12 (Talas) caused numerous casualties and property damage in the Kii Peninsula, Japan. This study analyzed the relation among the cumulative event rainfall, the maximum hourly rainfall intensity, and the maximum Normalized Soil Water Index (NSWI) for 30 large landslide occurrences. Cumulative event rainfall and maximum hourly rainfall intensity are basic rainfall variables for landslide hazard assessment, and NSWI represents the conceptual soil water content calculated by a hydrological model normalized by the past ten years' largest value. The results show that the distribution of cumulative event rainfall and maximum hourly rainfall intensity do not correspond to landslide locations. However, the maximum NSWI well explains the landslides' locations; landslides occurred in the area where the NSWI was extremely higher than that in the past decade. Heavy rainfalls frequently occur in the Kii Peninsula where mean annual precipitation is higher than in other regions in Japan. Our results indicate that the relative value of NSWI (compared with historical records) is more effective for landslide hazard assessment than the absolute rainfall variables in regions with frequent rainfall. Additionally, NSWI can be validated in other regions where heavy rainfall frequently occurs, and can be used, along with the results of other studies, to assess regional landslide hazards.

Keywords: Landslide, Typhoon No. 12, 2011, Kii Peninsula, NSWI, Cumulative event rainfall, Maximum hourly rainfall intensity

Japan Geoscience Union Meeting 2012
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HDS25-03 Room:102B Time:May 20 14:15-14:30

Deep catastrophic landslide occurrence and heavy rainfalls

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Deep catastrophic landslide triggered serious damages. So, early-warning systems, as well as construction of countermeasures, for deep catastrophic landslide are important tools for disaster risk reduction. For development early-warning systems, it is important to clarify a critical rainfall amounts for deep catastrophic landslide occurrence. We analyses characteristics of recent deep catastrophic landslide triggered rainfalls. Using AMeDAS dataset, we showed that the number of rainfall exceeded 600 mm/48 h was around 250 in Japan.

Keywords: deep catastrophic landslide, rainfall amount, AMeDAS

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HDS25-04 Room:102B Time:May 20 14:30-14:45

Numerical Simulation for Run-out Process of Debris Flow Triggered by Deep Catastrophic Landslides

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Deep catastrophic landsides have triggered large-scale debris flows that have had serious impacts on humans. Therefore, it is important to predict the run-out process of debris flows and to identify debris flow hazard areas. However, previous studies have shown that the commonly used debris flow numerical simulation models may not be applicable for debris flow triggered by deep catastrophic landslide.

Most models used to describe run-out process of stony debris flows assume that they consist of solid and fluid phases. Some researchers have suggested that the motion of fine sediment in large-scale debris flows is similar to that of the interstitial water, which means the fine sediment in large-scale debris flows might be considered to fluid phase rather than solid phase.

In this study, we tested the hypothesis for behaviors of fine sediment and developed a technique for simulation of deep catastrophic landslide-triggered debris flows. We developed new methods to evaluate key parameters to simulate deep catastrophic landslide-triggered debris flows, such as sediment concentration, fluid density, and representative particle diameter and modified the continuity equation for sediment.

To test our model, we conducted detailed field surveys of the past debris flows triggered by deep catastrophic landslides by using topographic data from LiDAR imagery, porosity measurements of soil and weathered bedrock and the grain size distributions of the debris flow sediments.

Using these new data and methods, we conducted numerical simulations of five recent debris flows occurred in Japan in the unified method which we developed. Although the volume of these landslides and travel distances of these debris flows were various, their simulated results reproduced well the observed erosional and depositional patterns if when the concept of fine sediment behaving like fluids was included in the numerical simulation. It showed that the proposed method for debris flow numerical simulation in this study could be applied to predict run-out process of deep catastrophic landslide-triggered debris flow.

Keywords: debris flow, deep datastrophic landslide, numerical simulation, fine sediment

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HDS25-05 Room:102B Time:May 20 14:45-15:00

Landslide Sites Controlled by the Denudation Front and Weathering Intensity: Shallow Landslides by Izumi Group

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Many landslides were induced by the heavy rainfall of Typhoons 0415 and 0421 in Niihama city, east Ehime prefecture. Detailed geomorphic analysis by using airborne laser scanner and geologic investigation revealed the geomorphic and geologic features of landslide sites. The affected area is underlain by the Cretaceous Izumi Group consisting of alternating beds of sandstone, mudstone, and granule conglomerate; the Izumi Group had been supposed to be not susceptible to shallow landslides by rainstorms. Landslide sites were not controlled by lithology but were controlled by the intensity of weathering: the most common landslides were shallow slides of a soil layer derived from heavily weathered rocks. Airborne laser scanner detected landslides of 2004 and of previous years and convex slope breaks. Landslide crowns are aligned laterally to form convex slope breaks, which are ”denudation front”: Slopes just above these denudation fronts and on heavily weathered rocks are the most susceptible slopes to rainstorms.

Keywords: shallow landslide, denudation front, Izumi Group, airborne laser scanner

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HDS25-06 Room:102B Time:May 20 15:30-15:45

Age determination of Dondokosawa Debris Avalanche Deposits in Southern Japanese Alps using dendro wiggle matching

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Dondokosawa Debris Avalanche Deposit (DDAD, 1.9∗10^7 m3) is found in east foot of Mount Houou (2764m ASL), Southern Japanese Alps. The initial failure of DDAD occurred on slopes ca. 2300 m ASL. Then DDAD travelled 3.6 km and was deposited around the valley floor ca. 1100 m ASL. Based on previously obtained 14C ages, DDAD was considered to occur during the period from 780-890 cal AD, and the trigger of failure was assumed to be historical earthquakes or heavy rain. However, conventional single age calibration to calendar time scale usually causes certain errors around 100 years. This prevents us from more accurate correlation between a sudden geologic event like debris avalanche and historical records. To overcome this problem, dendro wiggle matching (WM) is valuable when an appropriate dating material such as fossil log with many tree rings more than several decades can be obtained. In this presentation, I describe a precise age determination of DDAD by WM with OxCal4 and IntCal09. New estimation is 778-792 AD. No large earthquakes were written in any historical document during this period. Meanwhile, a description regarding major losses resulting from floods in ancient Shizuoka Prefecture south of the study area in September 779 AD (Julian calendar scale) is found in an old document SHOKU-NIHONGI. Heavy rain in this time was a possible trigger of the debris avalanche.

Keywords: debris avalanche, wiggle matching, ^{14}C age, high precision dating, tree ring

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HDS25-07 Room:102B Time:May 20 15:45-16:00

Characteristics and ages of sediments accumulated in the ridge-top depression northwest of Mt. Kanmuriyama, Gifu, Japan

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Many numbers and styles of small-scale sagging geomorphic features have been found along the ridges between Gifu and Fukui prefecture by the analyses of 1 m-mesh DEM and detailed topographic maps (provided by the Etsumi Sankei Sabo Office, Chubu Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism) made by using the airborne laser mapping technology (Kojima et al., 2011), although such small-scale landforms could not be recognized by the analyses of 1:25,000 scale topographic maps and air photos. Sediments accumulated in one of such sagging geomorphic features, ridge-top depression (altitude: 1,131 m), northwest of Mt. Kanmuriyama were drilled by hand auger equipments in order to characterize the deposits, determine their ages, and discuss the development history of the sagging geomorphic feature.

The sediments are composed of 1) conglomeratic orange mud, 2) light-yellow mud, and 3) alternating beds of dark-gray mud and carbonaceous mud/leaf litter mixture, in ascending order. The thickness of the sediments increases from east to west for the four boring cores: about 280, 225, 150 and 90 cm from west to east. This results from the increase of the thickness of the formation 3), as 245, 220, 110 and 70 cm. The westernmost and longest core intercalates 3 cm-thick tephra at 148 cm depth composed mainly of glass fragments (refractive index: 1.510-1.513), which is correlated with the Kikai-Akahoya tephra (K-Ah) of 7.3 ka. Plant fragments at 82, 138 and 195 cm depth yield AMS 14C ages of 1210+-25 BP (1234-1060 cal BP), 5320+-30 BP (6191-5996 cal BP) and 6990+-30 BP (7931-7731 cal BP), respectively. These age data indicate that the average sediment accumulation rate is about 0.25 mm/year.

On the basis of the facts described above, the depression is estimated to have formed by slumping of the ridge-top to the east. This estimation is consistent with the geomorphic features observed around the depression. The basement, sandstone of the Mino terrane, of the sediments is estimated to be located just below the conglomeratic orange mud. The accumulation of the sediments and the slumping started about 10,000 years ago, assuming the average sedimentation rate calculated above could be applicable to whole of the sediments. This age estimation suggests that the mountain range of this area became unstable during the worm and wet climate after the last glaciation.

Keywords: sagging geomorphology, landslide, Gifu

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HDS25-08 Room:102B Time:May 20 16:00-16:15

InSAR-image observation of landslide surface deformation triggered by the 2011 off the Pacific coast of Tohoku Earthquak

SATO, Hiroshi P[1*], OKATANI, Takaki[1], YAMANAKA, Masayuki[1], SUZUKI, Akira[1], Tatsuo Sekiguchi[1], KOARAI, Mamoru[1], MIYAHARA, Basara[1], KAMIYA, Izumi[1], Tetsuya Hara[2], YAGI, Hiroshi[3]

[1]GSI of Japan, [2]Advanced Engineering Service, [3]Yamagata Univ.

SAR (synthetic aperture radar) is the measurement technology of ground surface condition by transmitted and received micro wave between a satellite or airplane antenna and the ground. The Web page of Geospatial Information Authority of Japan has already published images of SAR interferometry using ALOS/PALSAR data that reflects crustal deformation by the 2011 off the Pacific coast of Tohoku Earthquake (M9.0). This image also shows local surface deformation apart from the crustal deformation, and we will report the possibility that this local deformation detects landslide surface deformation triggered by the earthquake, for example, at the locations in SW area of Kurihara city, Iwate Prefecture and Tsuchiyu Hot Spring in Fukushima Prefecture as shown in Murakami et al.(2011).

Reference

Murakami M, Okuyama S, Furuya M, Abe T, 2011, Analysis on ground deformation analysis triggered by the 2011 off the Pacific coast of Tohoku Earthquake using ALOS/PALSAR, Proceedings of the Volcanological Society of Japan 2011 Fall Meeting, p.55.

Keywords: landslide, earthquake, InSAR, ALOS, PALSAR

Japan Geoscience Union Meeting 2012
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HDS25-09 Room:102B Time:May 20 16:15-16:30

Estimation of landslide deformation process based on comparison of inclination rate and displacement rate

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At the Shionokawa Landslide, the Research Association for Development of Observation Devices used in Special Landslide Environments installed the IT Ground Tiltmeter System developed through joint research (PWRI et. al. 2009) at 6 locations from behind the main landslide scarp of the landslide to its bottom, and used them to perform observations at 1 hour intervals. Both the backward rotation and forward rotation had been confirmed by instruments, and the largest tilt was recorded by IT-4, where the slide rotated backwards towards the landslide scarp side at a speed of 0.87degree per year. A method to utilize the observation data of the ground inclination at the landslide site has been studied. The landslide mass deformation process from the time of occurrence until now was consistently estimated by combining the inclination and the displacement vectors obtained by the the moving stake observations (Uto et al., 2011). Translation sliding and rotation sliding combined to leave the internal structure unchanged without conspicuous abrupt displacement, as gradual deformation occurred. But some problems have been clarified. For example, (1) analysis including the behavior at the time of an earthquake is necessary to estimate the deformation process of a landslide at a longer time scale, and (2) verification is necessary based on the comparison of landslide cases where the rotary motion is predominant.

In our research, (1) we analyzed the deformation of the Shionokawa Landslide, that occurred following the Great East Japan Earthquake, and (2) analyzed the data of the Toi Landslide together with the Shionokawa Landslide data and proposed a widely applicable utilization method.

For the behavior of the Shionokawa Landslide before and after the outbreak of the Earthquake, although clear tilting was observed during the earthquake, the amount of inclination was only greater by about one-year's increment than the rate in the ordinary time, and the inclination rate decreased in either of them after the earthquake. The moving stake observation results also indicate the similar tendency (below figure), suggesting the possibility that the Shionokawa Landslide temporarily lulled rather than accelerated by the earthquake.

In addition to the Shionokawa Landslide, we focused on the Toi Landslide, which is an about 40 m wide colluvial landslide with an inclination rate a digit greater than the former and conducted comparison and analysis of the inclination rate measured with IT ground tiltmeter (PWRI et al. 2009) and the displacement rate measured with extensometers installed on the landslide scarp to make comprehensive evaluation. It then allowed us to arrive at the correlation of $y=kx$ for the inclination rate, x (rad/day), by the backward rotary motion measured with ground tiltmeters installed in the landslide and the displacement rate, y (m/day), obtained from ground extensometers or moving stakes placed at the landslide head. Assuming these correlation are produced by the rotary motion of the radius, r_2'(m), on the ground surface, it then leads to $r_2'=k$=14.2 - 18.0 for the Toi Landslide and $r_2'=k$=35.4 - 42.2 for the Shionokawa Landslide. On the other hand, the rotary motion of the radius, r_2(m), estimated based on the estimation from the landslide geometry, r_2 = about 16 and r_2=36 respectively, leading to almost the same results with r_2'. For a landslide with rotary motion predominantly observed, it is suggested that the comparison and analysis of the displacement rate and inclination rate contributes to clarification of the deformation mechanism of the landslide. Further improvement in precision of estimation of the deformation process of a landslide that has an arc-shaped slip surface or of the shape of the slip surface is expected by those analyses and the method to estimate slip surfaces obtained from moving stake observation (Ishida et al, 2011).

Acknowledgement: We appreciated the cooperation of the Fukushima River and Highway Office.

Keywords: landslide, IT Ground Tiltmeter System, rotational slide, displacement vector, deformation process, Great East Japan Earthquake

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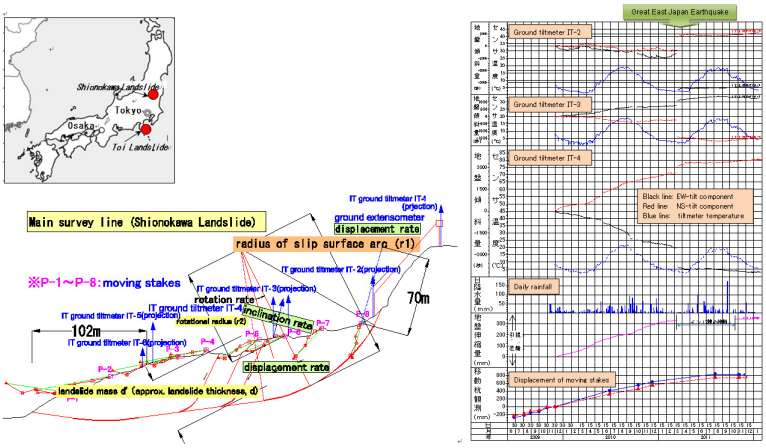

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HDS25-P01 Room:Convention Hall Time:May 20 17:45-18:30

Improvements to the degree-hour method for the warning system for sediment-related disasters during strong winds

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In the snow zone, solid precipitation accumulates temporarily on the surface as the snow pack during the winter season, and when it melts in spring, the risk of landslides increases. Therefore, to evaluate the risk of landslide, it is important to predict the timing and intensity of meltwater volume. The degree-hour method is a simple way of doing this, but under strong wind conditions such as Foehn phenomena or rain on snowpack, much snow melts, and landslides occur much more frequently. Furthermore, the degree-hour method uses a degree -hour factor which is calculated by a statistical method, and so it can not predict the meltwater volume accurately under unusual weather conditions such as strong wind. By using the observational data in a heavy- snow district of warm-temperate zone, this paper shows the calculated relationship between the amount of latent heat transport and sensible heat transport and the meltwater volume during strong winds. Also, by comparing the result with the meltwater volume calculated by the degree- hour method , a better expression for the degree-hour method is shown. In addition, by examining the response of pore pressure data to the meltwater volume, parameters for the warning and evacuation system for sediment-related disasters are shown.

Keywords: warning and evacuation system for sediment-related disaster, meltwater, degree-hour method, strong wind

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HDS25-P02 Room:Convention Hall Time:May 20 17:45-18:30

Inventory mapping of gigantic landslides that might dam up the Hunza River using ALOS/PRISM images, Karakoram, Pakistan

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Gigantic landslides usually dammed up the rivers and subsequent debris flows affected in the watersheds along the lower course. A landslide of 1000m in width and relative height and 1500m in slope length occurred near Atta Abad on a right bank of the Hunza River, northern Pakistan in Jan., 2010. Detritus with a volume of ca 40million cubic meters dammed up the Hunza River. They mainly consist of boulders in a maximum scale of 10m long with fine sand to silt as matrix. Such fine materials were squeezed up and flew on the mound as mudflow. The mudflow killed 19 peoples in the down stream. 3D interpretation of space images of ALOS/PRISM clarified development of scarplets deforming valley slope as pre-cautious signs of a landslide on a gigantic scale.

Based on a result of the study, 3D interpretation of ALOS/PRISM images along the Hunza River was carried out and that found a newly activated gigantic landslide near Khana Abad that is at high risk of landslide damming. This study will report the case of Atta Abad landslide and Khana Abad landslide. And it will present an inventory map of gigantic landslides that might cause natural damming in the Hunza area.

Keywords: ALOS/PRISM images, 3D interpretation, Hunza River_Karakoram, gigantice landslides, landslide dams

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HDS25-P03 Room:Convention Hall Time:May 20 17:45-18:30

Distribution of Landslides Induced by Two Large-scale Earthquakes in 2011, in Iwaki City, Japan

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Iwaki City located in the coastal area of Fukushima Prefecture experienced two large-scale earthquakes, the M9.0 Tohoku earthquake on March 11 and the M7.0 aftershock on April 11, 2011. In terms of the Japanese earthquake scale, both earthquakes experienced in this area registered in the lower 6 level. These earthquakes caused many landslides. We made a landslide distribution map using aerial photographs and Google Earth images and on the basis of the interpretation of these images using field survey data and clarify the characteristics of the landslide distribution.

The results of our study are summarized here.

1) The landslides can be classified into two types, namely, slide type and slope-failure type. The number of slide-type and slope-failure-type landslides are 52 and 1143, respectively.

2) The number of landslides induced by the April 11 aftershock alone accounts for 70% of all landslides.

3) The two surface active faults that caused the April 11 aftershock appeared on the western part of Iwaki City. The distribution of landslides was relatively concentrated around these faults.

4) Most of the slide-type landslides were triggered by the April 11 earthquake. These slides broke out at the convex slope. This is the characteristic difference between slide-type and rain-caused landslides.

Keywords: Landslide, 2011 Tohoku earthquake, Iwaki City

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HDS25-P04 Room:Convention Hall Time:May 20 17:45-18:30

Characteristics of earthquake-induced landslides in granitic mountains of Northern Ibaraki, Japan

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The 2011 earthquake off the Pacific coast of Tohoku and a series of aftershocks triggered continually landslides in granitic mountains of Northern Ibaraki. We confirmed total 41 new landslides with satellite images of Google Earth taken immediately after the main shock and with field surveys from May to November 2011. We inferred that 30 landslides were triggered by main and aftershocks from March 11 to April 11, and the rest 11 landslides were induced by the combination of heavy rainfall by typhoon and an aftershock on September 21. Distribution of slope for the earthquake-induced landslides (March 11 to April 11) was bimodal, reflecting the difference of the slid material between rock and soil. The half of the landslides induced by the main shock (March 11) slid toward SSW to WSW. Although the direction of maximum acceleration was not strongly concentrated to SW at the KiK-net station of Takahagi, characteristics of the seismic wave of the main shock may influence the uneven distribution of direction.

Keywords: The 2011 earthquake off the Pacific coast of Tohoku, landslide, granitic mountains, Ibaraki

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HDS25-P05 Room:Convention Hall Time:May 20 17:45-18:30

Features of gravitational rock deformation in Mizunesawa Basin, the upper reach of the Tama River, west Tokyo

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We describe the geology and geomorphology related to gravitational rock deformation (mass rock creep) in Mizunesawa Basin (MB), the upper reach of Tama River. MB is surrounded by several peaks ranging from ca.1000 m to ca.1600 m ASL, and the azimuth of the main course of MB displays NW-SE direction. The bedrock geology of MB mainly consists of Cretaceous sedimentary rocks of Shimanto Group that generally show NW-SE strike and east dip at 60 to 80 degrees.

Ridge-top linear depressions and antiscarps parallel to the main ridge are present. Depth and length of depressions are usually less than 10 m and up to 450 m, respectively. Features of valley bulging with minor antiscarps and gentle slopes are also found from valley side slopes immediately below ridge-top depressions and antiscarps. On the valley side slopes where bulging features occur, rock deformation caused by toppling can be observed. Although the features of gravitational rock deformation are well developed in MB, accumulation terraces or natural dams are not found at all. This fact requires further consideration about long-term geomorphic development in MB related to middle to large landslides affected by rock deformation.

Keywords: linear depression, antiscarp, mass rock creep, toppling, dip slope vs. scarp slope

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HDS25-P06 Room:Convention Hall Time:May 20 17:45-18:30

Subsurface fracture of sackung features quantified with electrical resistivity tomography

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Deep landslides often occur in mountain slopes which have sackung features resulting from deep-seated gravitational slope deformation. This study addressed the visualization of the internal structure below sackung features using electrical resistivity tomography, to evaluate development of shear zones below sackung features. From August to October 2012, two-dimensional DC resistivity surveys were performed on 12 sackung features consisting of sedimentary rocks which were located above 2600 m a.s.l. in the Japanese Alps (Mt. Chogatake, Mt. Ainodake, Mt. Senmaidake, Mt. Kamikouchi and Hyakkendaira). The setting of the electrodes followed the Wenner array, which was a 46.5 m long profile roughly perpendicular to the focused sackung feature in each line. Computed DC resistivity value ranged from 1 kohmm to 128 kohmm. Some sackung features had a subsurface layer of relatively low resistivity probably resulting from fractured and weathered rock mass. These layers were distributed at the position of shear zones inferred from the geological structure and topographical feature. Such a consistency suggests that the layers of lower resistivity correspond with the shear zones below sackung features. In contrast, the tomographical images of the other sackung features showed no distinct difference in resistivity following the feature. Difference in resistivity between sackung features is supposed to reflect development of shear zones.

Keywords: sackung feature, electrical resistivity tomography, sedimentary rocks, Japanese Alps

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HDS25-P07 Room:Convention Hall Time:May 20 17:45-18:30

Extraction of mass rock creep using airborne LiDAR

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[1]Public Works Research Institutes, [2]National Institute for Land and Infrastructure Management

The prediction of location of deep catastrophic landslide is important to reduce such sediment disasters. Long-lasting, small-scale mass movements called gravitational mass rock creeps sometimes lead to deep catastrophic sliding. However, surface geometry of mass rock creep is not easy to clarify. Here we used LiDAR data to clarify the surface geometry of both the mass rock creep slope and non-mass rock creep slope quantitatively. We used slope angle and eigenvalue ratio for quantifying surface geometry. Moreover, we examined roles of window size to calculate slope angle and eigenvalue ratio. We showed effectiveness of the relationship of window size with slope angle and eigenvalue ratio to characterize difference of surface geometry between mass rock creep and non-mass rock creep slope. At the mass rock creep, even if window size changed, the median value of slope gradient did not change. On the contrary, at the non-mass rock creep slope, the median value of slope gradient was small, as larger window size. The hollows and steep slope around the mass rock creep is clear only when window size was smaller than 10m. Moreover, the eigenvalue ratio was the smallest, when the window size set as one-fourth to half of the intervals of convex at the mass rock creep. Using these characteristics of mass rock creep, we proposed a new method for extraction of mass rock creep using LiDAR data.

Keywords: LiDAR, mass rock creep, deep catastrophic landslide, slope gradient, eigenvalue ratio

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HDS25-P08 Room:Convention Hall Time:May 20 17:45-18:30

An internal structure of deep-seated gravitational slope deformation in the area from Mt. Okuhotaka to Mt. Nishihotaka

YAMASAKI, Shintaro[1*]

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Deep-Seated Gravitational Slope Deformation (DSGSD) is a premonitory phenomenon getting to landsliding, their process is important to consider the mechanism of hazards. However, there are few chances to observe internal structures of large DSGSDs in Japan, because heavy vegetations and thick weathering rinds cover outcrops in many cases. In this presentation, I will introduce an internal structure of DSGSD being exposed on the area from Mt. Okuhotaka to Mt. Nishihotaka, Northern Alps. I could observe processes related to landsliding with characteristic structures. Now, I do not have detailed hazard history and geologic information in this area, but I think many geologists have useful information, because of popular mountaineering area, so I am expecting further discussing and exchanging information about them in front of my poster.

Keywords: Deep-seated Gravitational Slope Deformation, landslide, mass rock creep, rock fall, Mt.Hotaka

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HDS25-P09 Room:Convention Hall Time:May 20 17:45-18:30

Development of a new data acquisition system for landslides driven by solar cells

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Recently, rainfall-induced landslides occur frequently. In order to mitigate landslide disasters, understanding of the landslide process and early warning is important. In this study, self-potential (SP) approach has been attempted to develop an early warning system for rainfall-induced landslides. The laboratory experiments of landslides under the controlled artificial precipitation and a sandbox have been performed. Their results show the capability to monitor the subsurface water condition using the self-potential method. However, laboratory experiments have limitations in scale and soil layers. Therefore, it is necessary to verify the obtained results by a field (in-situ) experiment and we selected landslide site in Pelabuhan Ratu, Indonesia as a field experiment site.

However, the data logger system runs down frequently because of electrical power failure in Indonesia. In order to overcome this problem, it is necessary to develop the new data acquisition system avoiding the use of commodity type PC with commercial power source. To achieve this purpose, we marked out solar cells, batteries as the DC power sources, and data acquisition equipment equipped with CPU and memory and built the data acquisition system.

We set up this new system at Chiba University and conducted running test. From the result of running test, the new data acquisition system has been running for 6 months without stopping. And assuming the rainy day, we carried out running test reducing the output voltage of solar panels. In the result, this system operated for about 2 weeks under the assuming rainy condition. From these results, it is hoped that the new data acquisition system can records more stable than the conventional one. The details will be given in our presentation.

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Study of the infiltration characteristic of the rain to the slope for slope stability evaluation

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As occurrence factors of slope collapse and a landslide, the surface saturation and corrosion of slope end by rain can be considered. In this study, the transition of the amount of moisture in the slope by rain was investigated by electric exploration and soil moisture meter for the purpose of carrying out risk assessment from evaluation of the slope stability following rain. The geology of the investigation area is the Cretaceous alternating beds of sandstone and shale, and shale is mainly distributed over this slope. Many slopes with the possibility of collapse exist from the result of aerial photos and topographical maps interpretation. From the geological survey of this area, it is thought that the principal factors of slope collapse were colluvial deposits thickly deposited on steep slopes. Also on the investigated slope, moving blocks and collapse sediments overlap on the shale bed, and displacement is identified near boundaries. This study shows the measurement result of the amount of soil moisture within drilling holes and the transition of the resistivity distribution (moisture content) revealed by electric exploration. And, the result of groundwater analysis and stability analysis are reported.

Keywords: slope failure, soil moisture, electric exploration, Seepage analysis

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The effect of subsurface hydrology on shear destruction of a sandy slope

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To improve the accuracy of predictions of shallow landslide timing induced by rainfall, we focused on the mechanism of subsurface hydrology at an artificial sandy slope of 32? that was 9 m long, 1 m wide, and 0.7 m deep. We measured pore water pressures and volumetric water content occurring prior to shallow landslides in a flume experiment using the artificial slope with rainfall intensities of 80 mm/h. In addition, we evaluated changes in the internal stresses in the slope up to shallow landslide initiation (i.e., effective soil weight, apparent soil cohesion, and seepage force under saturated and unsaturated soil water condition). Then, based on the local safety factors in the landslide body obtained by the internal stresses, we tried to get quantitative information on the effect of the hydrological process on soil displacement and subsequent shallow landslide initiation.

We found that:
1) The timing of the directional change in subsurface flow to parallel the slope in the deep part of landslide body coincided closely with onset of soil displacement.
2) Changes in the local safety factors in the landslide body showed that the expansion of instable area at the up part of the landslide body resulted mainly from the appearance of buoyancy and subsequent decline of the apparent soil cohesion.
3) Changes in the local safety factors prior to the shallow landslide initiation showed that the down part of the landslide body had been holding the instable upslope.
4) Excess shear stress in the up part of landslide body, attributed to the changes in direction and magnitude of saturated and unsaturated subsurface flows, caused both the sudden increase in shear stress in the down part of the landslide body and subsequent whole slope instability, and simultaneously the shallow landslide was induced.
5) Seepage force was more important factor to cause the shallow landslide than the effect of buoyancy and consequent changes in the effective weight of soils. This implies that the changes in local safety factors combining the seepage force under saturated and unsaturated conditions provided the accuracy to predict the timing of shallow landslide initiation.

Therefore, the seepage force controlled by changes in direction and magnitude of saturated and unsaturated subsurface flows in slopes can be the important parameter of soil displacement and shallow landslide initiation.

Keywords: Seepage force, Flow direction, Excess shear stress, Flume experiment, Precursor

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The erosion processes of mudstone surface effected by drying and rain infiltrating cycle in southern Taiwan

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Mudstone which is low utilization and difficult to make constructions is distributed in the south part of Taiwan. Understanding erosion processes, we investigate the influence of porewater chemistry and drying effect of this mudstone under the high erosion rate site. Rapidly slaked zone by drying and heavy precipitation reaches 10?20 cm from the crust surface.

Pliocene?Pleistocene thick mudstone layer is distributed over 250 km2, forming badlands (locally called moon-world) which forms 20 m hight slope. Usually, fresh mudstone exposes on surface of the slope by wash out.

The unsaturated crust covers the mudstone slope surfaces about 2 cm.The crust consists of Na+, Ca2+, Cl-, and SO42- rich porewater.Ion contents of porewater decrease to 10-20 cm deeper area, increase to more deep area, again.

The bonding force for each particles increases with increaseing ion contents, inversely the repulsive force increase with decreasing ion contents as percolation of rain. Drying mudstone quickly slakes by a lot of precipitation and infiltration.

To measure the evaporation rate on site, the drying area will reach 10 cm under the surface in a few days. Especially, mudstone will rapidly shrink and occur the slakeing between the drying and low ion concentrated area (10-20 cm) to infiltrate fresh water.

We consider that this slaking process which has annual cycle of drying and wetting near surface of this area progresses 20 cm erosion (regression) per year.

Keywords: rapid slaking, Taiwan, mudstone, drying

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Terrain and weathering properties that determined mass movements such as landslides and deep-seated landslides

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1. Importance of mass movements in land formation processes in mountains

The concept of cycle of erosion proposed by Davis is mainly based on River Process, that is, downward and lateral erosion by surface water. However, comprehension of precise landform and topographical analysis by recent laser profilers have revealed that the topographical features of mountain slopes are a wide-ranging land not clearly due to the erosion of surface water. Although it can hardly be disputed that the greatest process and agent of mountain erosion is often erosion by rivers, it is also necessary to consider Slope Process in terms of formation of mountain slopes. Approximately 100 million cubic meters of rubble and sand is estimated to have resulted by collapse phenomena such as deep-seated landslides at the time of Typhoon No. 12 in 2011 and approximately one billion cubic meters at the time of the Totsugawa Disaster in 1889. It is assumed that vast sand gravel layers deposited from the Totsugawa River to the Kumanogawa River are the result of repeated large-scale collapses such as deep-seated landslides.

2. Slope characteristics of mass movements

An investigation was conducted focusing on the relationship between slope characteristics of vast areas around the sites of incidence (slope frequency distribution and mode value) and basement rock weathering characteristics, including cases of landslides and deep-seated landslides caused by Typhoon No. 12 and slope collapses of a shallow depth and rock slope collapses having occurred before then.

3. Conclusion

The areas where the so-called deep-seated landslides occurred this time have the distinctive characteristic of chemical weathering development compared with rock creep slopes that have not collapsed despite steeper slopes. In addition, relatively large-scale twin ridges have been formed along the head ridge of the areas where deep-seated landslides occurred in Kitamata. It is thereby assumed that separation and fracture associated with movement and deformation of land blocks due to chemical weathering and rock creep has been developing for quite a long time at least in part of the areas where deep-seated landslides occurred this time. With regard to the locations where deep-seated landslides occurred, it is considered that massif remaining above the knick line, which becomes a post-glacial erosional front referred to by Hatano, constitutes a large portion of moving land blocks and slope inclination angles in the sites of incidence are smaller than the mode value in the slope inclination angle frequency distribution in vast areas around the sites.

Keywords: slope process, mass movemnts, rock creep, deep seated landslide, slope angles, mode

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Characteristic of foundation disaster on the Nagano-Niigata border earthquake

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An inland earthquake with M=6.7 occurred on 12 March 2011, around Nagano-Niigata prefecture border. No persons were killed in this earthquake, but many slope collapse, ground deformation and damage of structures occurred around hypocentral region. As a global distribution of these damages concentrated on a particular area, the authors analyzed the relationship between follows: slope collapse, ground deformation, landform, geology, estimated location of earthquake source fault and region of interference fringes detected by InSAR; combining a field survey, photographic interpretation and GIS analysis.

The result shows that a large number of slope collapse and ground deformation occurred around Shinano (Chikuma) River and mountainous region on the left bank of the river. The road deformations and cracks are gravity sliding of road fill for the most part. Some parts of the deformation may be a tectonic deformation, example of the deformation in surface earthquake fault site reported by Kurosawa et al. (2011) and in camping site of Daigonji Highland in Tokamachi City. Furthermore, landslide and gravity sliding concentrated along Miyanohara fault in Ooidaira district and Kameoka district, Tsunan Town. This event suggested that slope collapse and ground deformation concentrate in and around active fault when great earthquake happen in the immediate vicinity of the active fault, even if it isn't active.

These damaged areas overlap with the area of hanging wall of the reverse fault and the crustal deformation area of main shock (M=6.7) and maximum aftershock (M=5.9) detected by InSAR. This phenomenon corresponds with a conventional view which a large number of damage occur in hanging wall of the reverse fault, and it suggests that a large number of damage may concentrate in the crustal deformation area detected by InSAR.

Keywords: the Nagano-Niigata border Earthquake, slope collapse, ground deformation, InSAR, active fault