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

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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

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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

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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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