Japan Geoscience Union Meeting 2012
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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

Japan Geoscience Union Meeting 2012
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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

Japan Geoscience Union Meeting 2012
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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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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

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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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HDS25-P10 Room:Convention Hall Time:May 20 17:45-18:30

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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HDS25-P11 Room:Convention Hall Time:May 20 17:45-18:30

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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HDS25-P12 Room:Convention Hall Time:May 20 17:45-18:30

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

Japan Geoscience Union Meeting 2012
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HDS25-P13 Room:Convention Hall Time:May 20 17:45-18:30

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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HDS25-P14 Room:Convention Hall Time:May 20 17:45-18:30

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