Seismic response on valley fill slope in urban residential region

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Both earthquake ground motion and pore water pressure observations in valley fill were conducted in the southwestern Tokyo, and central Yokohama region. The difference in the earthquake ground motion between records on the both observatories varied with earthquakes. The non-linear response of excess pore water pressure in valley fill was observed during the strong earthquake. These basic information will be valuable for discussing on prediction of valley fills type landslides induced by strong seismic motion in urban region.Earthquake in 5th May 2014 (M6.0) induced strong seismic intensity 5 in central Tokyo (largest earthquake after 3.11). The response 45-60cm/s/s of horizontal motion of soft valley fill less than response on the original ground indicate the “self-dumping effect” of valley fill. In contrast, the response amplified 120-150cm/s/s of horizontal motion, and large UD component of the motion of ordinary valley fill will be caused by amplification of SP trans-wave in unsaturated near surface soil layer. Excess pore pressure increased rapidly after the S peak stage (response to the plastic deformation). Excess pore pressure and barometric pressure changes was opposite in phase before the S peak stage, however, changes of barometric pressure synchronized to the UD displacement changes. So-called “microphone effect”, barometric pressure changes amplified by the UD displacement, was observed in this earthquake.Inclinometer response indicates the movements of the valley fill, and the direction of inclination turns during seismic motion. During the P wave stage, the inclination in ground (G.L. -2, -5,-8m) is small and isotropic. During the 2nd stage (P-S wave), the movement of transvers direction of valley was observed. And, the movement of longitudinal direction of valley was observed at the 3rd stage (S wave). These processes indicate that the friction reduction along the side-wall of valley fill by rolling movement at the P-S wave stage should be prior to the plastic deformation & excess pore water pressure rising during the S wave stage. And, movement along longitudinal valley axis after the peak S wave stage will be possible after the friction reduction in the previous stage. Thus, the friction reduction of side walls will be key process of landslide of urban residential valley fill.

Keywords: Valley fills, Strong seismic motion, Urban landslides

Best Practices for Ongoing Improvement of LIDIA

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Landslide Inventory Database Indonesia (LIDIA) is a database application for landslide inventory. It aims to provide a framework and tools for displaying and analyzing landslide information in Indonesia. LIDIA is a tool to quantitatively assess hazards, systematically manages the diverse and detailed information, and improve the quality of Landslide Susceptibility Assessment (LSA). It was developed in 2011, as a part of inhouse development of the Federal Institute for Geosciences and Natural Resources (BGR), Germany and were tested within the Georisk Project and Geological Agency of Indonesia (GAI). In 2012, LIDIA was translated from english to Bahasa. It becomes a user friendly database software, specially for local goverment. Up to 2016, LIDIA has stored more 5000 landslide events. The information in the database updated on an ongoing basis. For best practices, GAI requires additional database functionality to develpved a pratical and effective approach for LSA and disaster risk reduction. A WebGIS information and an android platform on landslides inventory considerably to be the next improvement. It will provide fixed, reliable and up-to-date information on landslide in Indonesia.

Keywords: Landslide, LIDIA, Database, Inventory

Landslide mapping using AW3D 2m DEM: a case study in Tegucigalpa, Honduras

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In 1998, Tegucigalpa, the capital of the Republic of Honduras, suffered heavy damages by landslides induced by Hurricane Mitch. We have conducted the project of landslide mapping and susceptibility evaluation to reduce landslide disasters as a contribution of the work carried out by the Japan International Cooperation Agency (JICA) since 2015. In this project, we used digital air-photographs taken by JICA and high resolution DEM (Digital Elevation Model) generated by NTT Data and RESTEC (Remote Sensing Technology Center of Japan) using Digital Globe imagery. These data enabled us to create a detailed landslide distribution map to compare with the previous map that used 1:50,000 Honduran topographic data as base map. In the presentation, we will introduce the result of landslide mapping and explain the advantage of using the high-resolution AW3D 2m DEM.

Keywords: Landslide distribution map, AW3D, Tegucigalpa

Detection of the 2015 Gorkha earthquake-induced landslide surface deformation in Sunkoshi River watershed, Nepal using InSAR images

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On August 2, 2014, Sunkoshi river was blocked by the large landslide near Jure village. At 2km downstream Jure, slight displacement on the slope was interpreted by InSAR (Synthetic Aperture Radar interferometry) image. According to field survey the displacement was surely identified and it was triggered by the 2015 Gorkha earthauake, according to local residents. InSAR image was produced from ALOS-2/PALSAR-2 (Phased Array type L-band SAR) data, which were observed on Feb 21, 2015 (before the earthquake) and on May 2, 2015 (after the earthquake). In producing InSAR image, RINC 0.47 software (Ozawa 2014) was used. Path and frame of the PALSAR-2 data is 156 and 550, respectively, and observation mode is Stripmap Fine [10m] mode. To remove the effect of topography from InSAR data, I used SRTM DEM (Digital Elevation Model) in 90 m resolution, but in processing InSAR image, DEM spacing were resampled finer in 45-m resolution. According to the field survey debris were push out from the slope (Photo 1a), and some cracks were identified near the top of the displaced slope, as shown in Photo 1b. The amount of the deformation was measured at ca.10cm, in the site (Photo 1b), and according to interpretation of InSAR image, deformation amount along satellite line of sight was estimated as less than 12cm toward southwest. Therefore, it is thought that both amounts were harmonized; further effort of noise reduction, e.g., finer resolution of DEM will be used. PALSAR-2 data used in this study were provided by JAXA in the framework of special collaborative research (B) “Surface deformation study using a new generation SAR” by Earthquake Research Institute, the University of Tokyo. This study was also supported by "the Nepal Earthquake and Hazard Mapping of Future Landslides for Making the Plan of Better Reconstruction” (Principal investigator, Prof. Chigira) related to the April 2015 Nepal earthquake in the J-RAPID Program by Japan Science and Technology Agency (JST).

* Reference Ozawa T (2014) Development of InSAR processing tools in NIED -Part 3-. Proceedings of Japan Geoscience Union Meeting 2014 STT59-P12.
http://www2.jpgu.org/meeting/2014/session/S-TT59.html

Keywords: landslide, earthquake, Nepal, Gorkha, Synthetic Aperture Radar

Landslide mapping in Nepal: the impacts of the 2015 Gorkha earthquake and the subsequent monsoon

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The Gorkha earthquake (M 7.8) on 25 April 2015 and later aftershocks strongly hit the central part of Nepal and induced numerous numbers of landslides. The Japan Government requested rapid and frequent advice from the Japan Landslide Society in collaboration with Ministry of Land, Infrastructure, Transport and Tourism, Japan and a team supported by J-Rapid of JST on the impacts of the earthquake-induced landslides. As a first step to underpin the advice, the members utilized optical satellite images provided by archive of Digital Globe Co. Ltd., Google Earth, JAXA, and NASA to produce landslide inventory with mapped landslides as polygons. The type of landslides included in this inventory were disrupted rock and debris slides, rockfalls, and debris avalanches and they are either newly formed landslides or enlarged old landslides. The inventory was verified through limited field check in corporation with researchers in Nepal in the catchments of Trisuli River and Bhote Kosi River. We mapped 3594 landslides and significant landslide concentrations were highest to the east of the epicenter (in Gorkha, Dhading, Nuwakot, Rasuwa, Sindhupalchok and Dolakha districts) than to the west. The field survey suggested majority of landslides tend to occur along the slope break that confined the fluvially debuttressed steep valley slopes (>35°) and steep scarp slopes (>35°), which are located against the direction of the dip of the strata, of mountain ridges. These suggest that the landslide distribution might be controlled by fault rupture direction and topographic and litho-structural conditions.
The field survey in late October 2015 after the monsoon season also allowed the observation of development of new landslides as well as the reactivation of pre-existing landslides prompted by the subsequent rainfall. Some newer head scarps tend to develop retreating upward from pre-existing landslide scarps formed in weathered or the earthquake loosen rocks of about 10-20 m in thickness. In addition, a rainfall-induced debris flow was observed with debris served from a debris avalanche in the upper slope which transported into a gully eroding gully deposits.
We are now working on verification of the inventory sine the existing inventory was created by different persons. The results are being used as based data for further hazard evaluation and shared with the government of Nepal.
*The research work of the Japan Landslide Society and J-Rapid are supported by Japan Science and Technology Agency.

Keywords: Gorkha earthquake, Nepal, landslide

Relationship of local precipitation on the landslides over Nepal

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Nepal is a mountainous country located between the Indian and Himalayan tectonic plates. In such a country, landslides represent a major constraint on development. Hence, various statistics related to the landslides are reported by local researchers as well as some international researchers. However, meteorological data over Nepal is not completely opened, so that relationship between local precipitation and the landslides are few. Since landslides occur by many factors in addition to precipitation (e.g. earthquake, soil wetness), it is important to clarify the background relationship between Nepali precipitation and landslides there.
We are investigating the relationship between precipitation, landslides and landslide fatalities using various sources. Regarding precipitation, we are developing APHRODITE-type rain-gauge based precipitation for the earthquake year 2015. While, here we show a preliminary result of APHRODITE precipitation over Nepal on 0.05 degree and landslide fatalities. Landslide and its fatalities data are based on Petley et al. (2007, Nat Hazards) and Disaster review (2014) issued by Ministry of Irrigation of Government of Nepal. The country-summed loss of lives by landslides are compared with APHRODITE's high-resolution gridded precipitation over Nepal.
The result shows Nepali's local monsoon precipitation (June- September) shows significant positive correlation over the western most part of Nepal, the central and eastern part of Nepal. On the contrary, a part of the western part of Nepal and the easternmost part of Nepal showed weak negative correlations. The Kathmandu area does not show a significant correlation. Since the disaster statistics are based on country-wide average, we need to further investigation between the local precipitation and the local landslides including floods. Further, after assembling the local precipitation data over 2015, we will show the precipitation condition before/after the earthquake in April 2015.

Keywords: APHRODITE precipitation, Nepal, Earthquake

Landslide Hazard and Risk Zonation of Chamba Valley in Himachal Pradesh, India

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Being located in the fragile Himalayan regions of Himachal Pradesh, Chamba is highly susceptible to landslides and mass wasting. Frequent landslides pose not just a risk to lives and properties of places in and around Chamba, but also block vehicular traffic and communication channels in and out of an already inaccessible area. However, most disaster management measure focus on post-disaster relief operations and hazard mitigation. To provide a more holistic support to the local population, it is important that preparedness at the level of pre-disaster planning is needed. This can be done by first identifying the regions in Chamba Valley that are most vulnerable to Landslide. The present study is an attempt to identify such areas by preparing a Risk and Vulnerability map of Chamba Valley. To obtain the land use classes Landsat 8 images will be used and Cartosat DEM will be used to create the slope, aspect and hillshade layers. In this work, a Risk Zonation map of Chamba will be prepared by overlaying maps of high population concentration, major transport networks, past Landslide events, and Digital Elevation Model.

Keywords: Vulnerability, Landslide, Digital Elevation Model, Risk Zonation

Effects of active fault types on earthquake-induced deep-seated landslides

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We collected documents on historical earthquake-induced deep-seated landslides (DSLs) published by the Japan Landslide Society and active faults from the digital active fault map of Japan, the Headquarters for Earthquake Research Promotion, and the National Institute of Advanced Industrial Science and Technology. Comparing and analyzing the distribution of DSLs with corresponding active faults, we found following results. (1) DSLs induced by reverse fault earthquakes were distributed equally on a wide range of about 20 km from the active faults. On the other hand, more than 80% of DSLs induced by strike-slip fault earthquakes were concentrated within a narrow range of about 5 km to the active faults. (2) Most of the DSLs (24 out of 25 cases) induced by reverse fault earthquakes were distributed on the hanging wall side of the reverse faults. (3) As is shown in the cases of reverse faults, many DSLs in the cases of strike-slip faults earthquakes occurred in the hanging wall if the location of an epicenter is considered to be in the hanging wall.
As is known in the earthquake engineering field (e.g., Sato and Hirata, 2000, KAGAKU, vol. 70, No.1, 58-65, in Japanese), the damage caused by a strike-slip fault earthquake is more concentrated in a narrower range around the fault compared with the case by a reverse fault. A similar phenomenon was also confirmed for DSLs in this study. Many recent cases demonstrate that many DSLs occur in the hanging wall because the hanging wall suffers larger seismic motion than the foot wall by reverse fault earthquakes (e.g., Has Baator et al., 2010, JSECE annual meeting abstract, No. 57, 48-49, in Japanese). A similar result was also observed for the historical events. The discussion above suggests that, in addition to the distance to the nearest active fault of a potential landslide, we should take account of types of the active fault (reverse/strike-slip/normal) and whether the landslide is located in hanging or foot wall to assess the occurrence of earthquake-induced DSLs. The popular attenuation model (Si and Midorikawa, 1999, Journal of Struct. Construct. Eng., No. 523, 63-70, in Japanese) of peak ground velocity (PGV) that is commonly used for the building assessment is also required for similar considerations when used for the landslide assessment.

Keywords: deep-seated landslides, earthquake, reverse fault, strike-slip fault, hanging wall, foot wall

Simulation of the Aratozawa Landslide using Ring Shear Tests and LS-RAPID model

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The deep large-scale landslide near Aratozawa Dam of Miyagi Prefecture in Japan was occurred due to main shock of the Iwate-Miyagi inland earthquake on 14 June 2008. The earthquake magnitude reached 7.2 which results a huge mass movement close to the Aratozawa reservoir. Study on the Aratozawa landslide is necessary in order to understand and clarify the initiation mechanism and motion behavior particularly when the seismic loading plays as a main triggering factor. This paper shows the newest version of the undrained dynamic ring shear apparatus which then integrated with the LS-RAPID as a landslide simulation model. In further, results of this research could be a significant step forward for the landslide hazard assessment efforts to reduce human casualties and public infrastructure damage.
The laboratory experiment for the Aratozawa samples was carried out by means of ring shear apparatus ICL-2 version. This version is the newest apparatus that has been built so far by Sassa and other colleagues started in 2012 for practical use. Still, the main purposes of this apparatus for landslides are to observe the pore water pressure generation in undrained condition, shear strength reduction and failure motion behavior of samples within a large shear displacement. The development of this ring shear apparatus also emphasizing the change of normal stress platform from pillar-beam based, to the single central axis-based. Several parameters resulted from experiment by ring shear tests then occupied for the LS-RAPID geotechnical simulation. Landslide simulation model using LS-RAPID aims to observe the overall process of landslide phenomena started from the initiation process by pore pressure increase and seismic loading up to the moving process which involving the volume enlargement and traveling process of the landslide mass.
The critical pore pressure ratio was obtained from ring shear tests. In addition, the friction coefficient, shear displacement at the start of shear strength reduction and steady state shear resistance of the Aratozawa samples were also produced from the tests. We brought the results from ring shear tests as an input parameter in the LS-RAPID. The results of LS-RAPID so far could explain the initiation mechanism and motion of Aratozawa landslide. However, further detailed study is still needed, particularly for the factors from reservoir catchment and relation of reservoir and groundwater condition before and when the earthquake takes place.

Keywords: Aratozawa landslide, Ring shear tests, Shear strength reduction, LS-RAPID

Gravitational Slope Deformation in the Hiyoso District in the Central Kii Mountains

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In order to know the history of gravitational slope deformation, we investigated the deposits in ridge-top linear depressions formed by gravitational deformation in the Hiyoso district in the middle Kii Mountains. In the south area from this district, four huge deep-seated catastrophic landslides (Ui, Akatani-E, Akatani and Nagatono) occurred in 2011 by Typhoon Talas (Chigira, Tsou et al. 2013). Gravitational deformation is important for topographic precursors of deep-seated catastrophic landslides (Chigira, Tsou et al. 2013). This area is underlain by Jurassic-lower Miocene accretionary complexes. The strata belong to the Miyama Formation and the Hanazono Formation in the northern Zone of Shimanto Belt (Kurimoto, Kimura et al. 2015) .
We investigated the deposits at the two sites (HY1 and HY2). HY1 is correspond to the ridge-top linear depressions and HY2 is the almost flat plane formed under the down-facing scalps. We sampled the deposits by the penetration sampler made by Chigira and investigated the tephras and 14C ages of the humus soils. To identify the tephras in the deposits, the refractive index and the shape of the volcanic glass shards and heavy mineral assemblage were studied. The refractive index was measured by using thermal immersion method (RIMS).
As a result, we found three tephras, which could be correlated to regional key tephras. The newest tephra is the Kikai-Ah (K-Ah) and the middle one is Aira-Tn (AT). From the refractive index and the shape of the volcanic glass shards, we found that the oldest tephra near the base of the deposits might correspond to SI or Kj-P1 deposited 50 ka, suggesting that the gravitational deformation started at this age.
Chigira, M., et al. (2013). "Topographic precursors and geological structures of deep-seated catastrophic landslides caused by Typhoon Talas." Geomorphology 201: 479-493.
Kurimoto, C., et al. (2015). "Geology and radiolarian fossils of the Upper Cretaceous Hanazono Formation in the Koyasan area, northwestern part of Kii Peninsula, South west Japan." BULLETIN OF THE GEOLOGICAL SURVEY OF JAPAN 66(3-4): 41-79.

Keywords: gravitational deformation, linear depression, tephra

A test on infiltration induced sliding failure of a model slope

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This study built a 3m (width) x 2m (height) x 2m (thickness) model slope in Huisun Forest Experimental Station, Nantou, Taiwan. The purpose is to discuss the characteristics of the seismic signals and self-potential variation during failure of the model slope that induced by infiltration. Several accelerometers and self-potential electrodes were installed for monitoring. The water was placed on the top of the model slope to simulate infiltration. Cameras were installed to observe the failure process. The measured seismic signals were analyzed by empirical model decomposition and Hilbert transform and were compared with the self-potential data.

Keywords: landslide, seismic signal, self-potential, model slope, infiltration

Effect of ground freezing on landslide displacement during rainfall events

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In this study, we monitored landslide displacement, ground temperature and other related factors to understand the effect of ground freezing on the properties of landslide displacement in Hokkaido, Japan. Although intermittent landslide displacement was observed throughout the entire study period, a significant relationship between the increase in soil water content and landslide displacement was not established during rainfall on frozen ground events.

Keywords: ground temperature, soil water content, pore-water pressure

