



Summary of Papers in Session 2.4—Landslide Hazard, Risk Assessment and Prediction: Landslide Inventories and Susceptibility, Hazard Mapping Methods, Damage Potential—Part 1

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Abstract

Papers accepted in Session 2.4—Landslide Hazard, Risk Assessment and Prediction of the Fourth World Landslide Forum are pertinent to the advances in landslide science ranging from remote sensing to landslide forecasting and the validation of the landslide. Different case studies from Asia, Europe and other parts of the world have illustrated the new technology for landslide monitoring. As landslide risk and vulnerability is very important aspect of science for the human being especially in the mountainous regions, papers presented this session part will add very valuable information on our current understanding of the progress in landslide science.

Introduction

Volume 2, session 2.4, part 1 contains the papers submitted for potential publication and presentation in the Fourth World Landslide Forum, 2017, specifically in the research area of landslide hazard, risk assessment, and prediction that includes landslide inventories and susceptibilities, hazard mapping methods and damage potential. State-of-the-art practices in the pertinent area have been introduced collectively through the accepted papers in this session. Discussions available in those papers are briefly explained in the following section.

Brief Introduction of the Published Papers

Natural hazards and disasters in One Belt One Road Corridors by Cui et al. illustrate the geo-hazard in 60 countries in Asia, Europe and Africa. The investigation of geo-hazards will be very useful to reduce the loss of life and property damage, and to make the project feasible. They have clearly given the measures for risk reduction by mentioning case studies about risk assessment in both the local and regional

scale. More than 50% of the road corridors lie in the high hazard zone.

Web-based inventory of landslide in Italy has been done by using Google Alert's service. Altogether 10,947 notification have been analyzed covering main event location, the number of people and the damage structure. Those data have been inserted into the web-based database. The spatial and temporal distribution of landslide events in Italy and the relationship with geo-environmental factors, in order to recognize the most significant controlling factors, such as lithology, land use, slope gradient and aspect. The use of Google alert is very useful technique; however is should be integrated with more technical information existing in other databases.

Differential Interferometric SAR (DinSAR) analysis using L-based SAR satellite is effective in Japan for estimating slope movement areas. This study compared actual slope movement area obtained from LiDAR data with the area estimated considering interference fringes and micro-topography and evaluated the consistency between both areas by using accuracy rate, cover rate and matching rate. The possibility of actual slope movement is high in the area with a high frequency of appearance of interference fringes when such fringes are repeatedly detected. The research paper concluded that the area of slope movement close to that of actual slope movement can be estimated as slope movement area as area that is around the area with a high

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appearance frequency of interference fringe and has micro-topography shaped according to the estimated direction of slope movement.

Probabilistic landslide hazard mapping techniques is very common in the landslide study. Pandey and Sharma have applied this technique in the Tipri to Ghuttu highway in India. This method provides the precise information of slope stability to understand the mechanism of slope failure. They have used IRS LISS-IV MX satellite image and validated in the field. They have concluded that approximately 87% of the landslide occurred during monsoon season which clearly shows that the rainfall is the prime important factor to trigger the landslide over other parameters.

Integration of geo-hazard into urban and land-use planning, the EuroGeoSurveys questionnaire by Mateos et al. have clearly explained the importance in the context of Europe. They have done research in the framework of the European Geological Surveys (EGS), the Earth Observation and Geo-hazards Expert Group (EOEG) based on enquiry regarding the integration of geo-hazards (earthquake, volcanoes, landslides, ground subsidence, floods and others) into urban and land-use planning. They have found that 17% of the countries have not yet implanted any legal measures to integrated geo-hazards into urban and land-use plans and half of the participating countries have no official methodological guides to construct geo-hazard maps. Such kinds of results stress the need for a common legislative framework and homogenization of the national legislations as well as mutual guidelines which adopt the principles applicable to the management of geo-hazards and explain the process to be followed in the production of hazard documentation.

The research paper on landslide hazard and risk assessment of Lanzhou, province Gansu, China by Tian et al. has shown the importance of landslide risk assessment for the rapidly developing capital of Gansu Province. They have presented the framework of the project and current status quo and outlook for the upcoming activities. The project is between different organizations and focused on improved susceptibility, hazard, vulnerability and risk assessments regarding mass movements. The findings of first phase shall lead to a better understanding of landslide processes in the light of intense anthropogenic activity and evaluate applicability of well-established statistical and physically-based approaches in rapid developing and thus highly uncertain environments.

The need to develop a national map that characterizes landslide across Great Britain is clearly explained by Dashwood et al. in their paper on creation of a national landslide domain map to aid susceptibility mapping in Great Britain. The distribution of landsliding in Great Britain is not uniform. It reflects a complex range of lithologies, both superficial and bedrock, and geomorphological processes active under a range of climatic conditions. This research

paper considers not only the role of land systems mapping at a national scale to create a Landslide Domain Map utilizing a national landslide inventory, but also the techniques used to define the spatial extent and characteristics of landslides within each domain, as well as their application to a range of applied research objectives.

A forecasting algorithm using Support Vector Regression (SVR) used to forecast potential landslide in Munnar region of Western Ghats of India presented by Tech et al. has clearly illustrated the importance of landslide forecasting and the validation in a real world deployment. Forecasting for the possibility of landslide is accomplished by forecasting the pore-water pressure (PWP) 24 h ahead. They have concluded that SVR adaptive model performs better than the SVR-Historic model. PWP and FoS forecast results from the SVRAdaptive model correlates the actual PWP and FoS values approximately 95% of the times. So this model can be used to know PWP and FoS values with 95% accuracy 24 h ahead, which will help the government and public with extra time for landslide preparedness.

The importance of Landslide Susceptibility Mapping for selecting appropriate route for highway is increasing in different parts of the world. Madankan et al. have presented an excellent study in their paper selecting the most appropriate route for Tehran-Shomal Freeway. The analytical hierarchy process (AHP), the frequency ration (FR) and weight of evidence (WoE) methods were applied to study the susceptibility. Those methods produced the landslide susceptibility maps, which are useful to selection of the best route and planning the freeway. They clearly present the areas prone to landslides.

Estimation of landslide activities evolution due to land-use and climate change in a Pyrenean valley by Bernardie et al. described an important challenges in forecasting future landslide risk in a 70 km² wide area of Caunterets in the French Pyrenees. The effect of vegetation cover and the change in hydro-logical condition are reflected upon the changes in cohesions of surface soils and groundwater table. Some future evolution of the land use were clearly seen, leading to significant modifications of the stability of slopes. It is observed that the stability of areas is dropping where the forest is disappearing. The impact of climate change may have significant impact on the increase of the water content of the soil.

Investigation and assessment plan at the Xinghuang Potential Large-Scale Landslide in Sothern Taiwan by Chung et al. has clearly presented interesting case study on slope stability and landslide hazard assessment. This study compiled current methods for investigating and evaluating large-scale landslides. They have divided the landslide into 3 different zones based on potential failure masses. The methods applied can be replicated in other parts of the world to study a large-scale landslide.

Landslide susceptibility assessment and mapping is a powerful tool able to represent coherent information about the spatial distribution of landslides in terms of initiation areas, on the basis of a set of relevant environmental characteristics. The role of landslide inventories in statistical methods is described by Perschillo et al. They have studied the importance by the application of a nonlinear regression technique, namely the Generalized Additive Model (GAM), the use of different landslide inventories, available for the same areas. The research provides a way to deeply investigate the role of the response variable in the landslides susceptibility assessment in order to understand the best choices to be adopted in the preparation of the landslide inventory, to improve the statistical model performance and to obtain more accurate and representative landslide susceptibility maps.

Galve et al. have applied GIS-based deterministic and probabilistic method to the Alpujarras region of Southern Spain to understand the performance of deterministic and probabilistic methods at large scale. Their results show that deterministic methods have less prediction capability at 1:5000 scales than probabilistic methods and it seems that the needed effort to improve their results is not worthwhile.

A new approach to assess the stability of rock slopes and identify impending failure conditions presented by Carla et al. shows that anticipating the failure of unstable slopes is a major concern in the field of landslide risk management. Arbitrary displacement or velocity thresholds are typically used to setup alarms representative of different risk levels. They have measured the cumulative displacement and

velocity measured 48, 24, and 3 h before failure and at failure moment. Comparable results were obtained considering data relative to 3/48 and 24/48 h before failure.

Use of high resolution DTM is very useful to study the deep-seated landslide mapping and geomorphic characteristic which is presented by Lee et al. in their research. They have used a visualization technique of sky-view factor to generate quasi-3D relief image map by overlapping slope gradient, topographic openness, and multiple direction hill-shading maps, allowing us to interpret precisely the features of landslide zonation. The landslide micro-topography interpretations were presented with main scarp and landslide mass in polygon pattern. This work explored the relationship between geomorphic evolutions of landslide and susceptibility. The results of this study could be used for remediation, monitoring and disaster prevention studies.

Concluding Remarks

Papers presented in the part A of the session 2.4, volume 2 of the Fourth World Landslide Forum include information pertinent to the state-of-the art practice and technological developments to monitor, evaluate and analyze data that help in predicting and forecasting landslide hazards. Papers presented from all over the world in this session will help the researchers working in the area of landslide hazard mitigation to reduce the landslide hazards in the world.