

Analysis of topographical characteristics of flooded areas for constructing simple warning system of pluvial flooding

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Pluvial flooding is a major disaster in Japanese urban areas. Physical models are often used for assessing pluvial flood risk, but the models are complex. Therefore, this study aims to analyze topographical characteristics of flooded areas in the 23 wards of Tokyo as the basis for constructing a simple warning system. At first, we extracted four factors as topographical characteristics: depression depth, catchment volume, elevation difference and slope using a digital elevation model (DEM) for the whole study area, but there were some problems when the methods were simply applied to the DEM. Accordingly, we extracted the factors only for roads, and then compared the obtained values for flooded and non-flooded areas. According to t-test, there were significant differences between the two types of areas for all factors. However, similar values sometimes occur for these areas, indicating that not only topography but also rainfall and drainage systems should be analyzed in future work.

Keywords: pluvial flooding, topographical characteristics, road, DEM, GIS

Effect of the definition of a single rainfall event on the rainfall threshold of mass movements

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This study analyzes mass movements caused by rainstorm and typhoon events in Taiwan during 2006 to 2012. Data for 263 mass movement events were collected from the reports of the Soil and Water Conservation Bureau of Taiwan, including 172 landslides and 107 debris flows caused by nine frontal rainstorm events and 15 typhoon events. After checking the location of each event, we compiled relevant rainfall data by interpolating data from the surrounding rain gauges. This approach is useful to analyze rainfall conditions for the events and discuss the mechanism of the rainfall-induced mass movements. This study uses two different definitions of a single rainfall event in relation to the triggering of mass movements. One is defined as a period from the time when hourly rainfall becomes greater than 4 mm to the time when the hourly rainfall becomes less than 4 mm for the next six consecutive hours. The other is defined as a period delimited by a non-rainfall period of more than 24 h. These two definitions gave significantly different results concerning the rainfall condition of mass movements. The first definition represents higher rainfall intensity, shorter duration and less cumulative rainfall. The second definition represents lower intensity, longer duration and more cumulative rainfall. We also used the rainfall intensity-duration (*I-D*) relationship from these two definitions to establish two *I-D* thresholds of mass movements in Taiwan. Comparing the thresholds from this study to those for Taiwan and Japan from previous studies, we found that the definition of a single rainfall event and the number of data are two important factors affecting the rainfall threshold of mass movements.

Keywords: mass movements, rainfall event, landslides, debris flows, I-D threshold

Implementation of Random Forest in landslide susceptibility study, a case study of the Tokamachi area, Niigata, Japan

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Random Forest (RF), a bagged trees ensemble, is widely appreciated for its superiority amongst classification algorithms and is popular in various fields of data mining. However, the application of RF in susceptibility analysis of landslide hazard remains very limited. This study highlights the results of such an attempt. The study area was selected on the basis of landslide density distribution. A density map of landslide distribution in Japan was prepared from the landslide inventory provided by the National Research Institute for Earth Science and Disaster Prevention (NIED). The Tokamachi area in Niigata Prefecture has a very high density of events and was thence selected for this study. Seven topographic factors (aspect, curvature, drainage density, elevation, plan curvature, profile curvature, and slope) derived from the 10 m DEM obtained by the Geospatial Information Authority of Japan (GSI) were used for the analysis. The classification data concern 9747 landslide events and 20685 randomly generated instances from the areas with no landslides. Unlike the values of a centroid used in many other studies, each landslide event in the classification data was represented by a mean of values of the respective factors in each landslide feature. Information gain for each factor was also evaluated and it was found that the profile curvature is the most effective factor in classifying landslides in the area, whereas elevation is the least effective. A 10-fold cross validation of the RF model with 200 trees resulted in an 'out of bag error' of 0.1443, an accuracy of 85.87%, and an ROC area of 0.926. These results suggest the suitability of RF in susceptibility analysis, the stability of which can be further strengthened with an increase of factors and the number of trees.

Keywords: Landslide susceptibility, GIS, Machine learning, Random Forest

Viewshed analysis of the trails in SriPada mountain area in Sri Lanka

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Each year about 3 millions of people climb SriPada Mountain. The trail system around SriPada in the Peak Wilderness has been used over centuries in good harmony. According to local people, there used to be 18 trails to reach the top of SriPada Mountain. Some of those trails were rarely used and thus getting vanished over time. This research focuses on analyzing Viewshed and the flow of people along some of the trails.

Geospatial analysis of deforestation factors in central Cambodia after 2000s

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Reducing emissions from deforestation and forest degradation; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries (REDD-plus) have attracted interest in Southeast Asian countries where deforestation has been a serious issue. To estimate future deforestation, the REDD-plus requires analyses of trends in land cover changes and the effects of various factors including infrastructure development, national policies and natural environment such as topographic conditions. This study analyzed the spatial characteristics and important factors of recent deforestation by taking eastern Kompong Thom, central Cambodia as an example.

We used three periods (i.e., 2002, 2006, 2010) of forest cover maps produced by Cambodian Forestry Administration (FA) and an object-based image analysis map made from Landsat 8 imagery taken in January 2014. We examined three types of geographic factors, namely, (1) distances from roads, rivers/water bodies, settlements, and forest edges (2) terrain features, e.g., gradient and relative slope position generated from 90-m SRTM DEM, and (3) zoning categories such as forest concession, economic land concession (ELC), community forestry and protected forest, in order to clarify the trend and explanatory variables of deforestation. All the spatial data were converted into 90 m resolution raster. A generalized linear model (GLM) with logit link function (i.e., logistic regression) was then used to analyze the effect of each factor on deforestation.

Between 2002 and 2006, deforestation mainly occurred in canceled forest concessions. During the period 2006-2010, this trend of deforestation accelerated particularly in and around the newly designated ELCs for rubber plantation. After 2010, deforestation further increased due to the development of small-scale agriculture by local farmers in addition to the newly designated ELCs. Factors consistently selected during the study periods with negative effects were " forest concession " and " distance from forest edge " . These indicate that deforestation occurred more readily in the canceled forest concessions and closer to forest edges. The magnitude of the effect of " distance from roads " has become smaller, indicating that recent deforestation occurred more in the forest interior. Gradient had a negative effect, highlighting the difficulties in farming on slopes. Community forestry and the protected forest established by the FA from the late 2000s also had negative effects on deforestation, indicating that these zoning have their value for forest conservation.

Keywords: REDD-plus, land use/cover change, generalized linear model, GIS

ENSEMBLE-CELLULAR AUTOMATA (CA) MODELS FOR IMPROVING FOREST COVER CHANGE SIMULATION

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Reliable spatial simulation models are a prerequisite for understanding temporal and spatial forest cover changes. However, spatial simulation models require accurate transition potential maps, which represent the probability of change from one forest cover class to another. Previous studies have shown that conventional methods such as logistic regression, weights-of-evidence and neural networks fail to adequately model forest cover transition potential. The objectives of this study are to: (1) evaluate the performance of adaboost (AB) and random forests (RF) algorithms for computing transition potential maps, and (2) simulate forest cover changes using the computed transition potential maps and cellular automata (CA) model. Our results show that adaboost-CA and random forest-CA models produced better simulation accuracy than logistic regression/ weights of evidence-CA models. These results provide valuable insights, which can be used to improve transition potential modeling and forest cover change simulation in complex landscapes.

Keywords: Adaboost, Random forests, Cellular automata, Transition potential, Forest cover changes

Capacity building initiative for satellite data utilization for evaluation of environmental degradation using FOSS4G

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Recently, satellite image data become more and more easily accessible. For example, NASA provide MODIS and LANDSAT data as Open Data. ESA will provide Sentinel data free and open access for any user. In addition, GIS data will also become accessible under the influence of the global trend of promoting Open Data. In such circumstance, a demands for utilizing satellite images and GIS also have been growing steadily and widely. But, it is still complicated to get original satellite data and how to deal with it for for the non-specialist, such as public employees.

Under such circumstances, Ministry of Education, Culture, Sports, Science and Technology in Japan (MEXT) has considered the plan of removing the barriers on satellite data usage. From 2009 to 2014, we have taken part in this project, and have strived to overcome this problem through the following three points.

1. Developing the Free & Open Source Software for Geospatial (FOSS4G) tools, such as GRASS, QGIS, GDAL/OGR and Proj.4.
2. Making tutorial about processing and analyzing the satellite data with FOSS4G tools.
3. Constructing the e-learning contents of satellite data usage and conducting outreach activity and capacity building in not only Japan but also developing countries.
(cf. <http://www.osgeo.jp/foss4g-mext>)

In first three years, main targets of our project were Japanese and novice user. We translate QGIS and GRASS GIS menu and manuals into Japanese and improve such FOSS4G tools to adapt Japanese data format and projection. Also, basic and advanced the tutorials for satellite data utilization were published as e-book and e-learning system including video tutorials.

The software and knowledge base have been rapidly improved by our works. These achievements are anticipated to expand base of satellite data users and to create a new utilization scene for space derived products. One of the effective results from this project was shown in actions against the Tohoku Earthquake in 2011. Many people could collaborate on that software base and offered ortho-image of Tohoku region (i.e. Iwasaki et al. 2011, GISA-Japan).

Based on previous result, we are started next project to develop an evaluation system for environmental degradation based on above GRASS and QGIS. In the project we use Global Map (<http://www.iscgm.org/cgi-bin/fswiki/wiki.cgi>) as a fundamental information for evaluating environment. The project had started from 2102 and focused on natural hazard and environmental degradation, especially in developing countries. We will report the status and progress of the project.

Keywords: FOSS4G, Satellite data, Capacity building

Assessment of Natural Landscape Resources for Tourism Development in Hangzhou, China

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This study aims to establish criteria based on various factors and then provide comprehensive assessment to the value of main natural landscape resources in Hangzhou, China. Twenty-two attractions in Hangzhou are selected to be the research objects of this study. Also, eight factors are selected as the criteria of this study, which are general scientific value, rarity, aesthetic value, integrity, scale, popularity, transportation and hotels. The model of Analytic Hierarchy Process(AHP) is utilized in this study to determine the weights of the 8 factors.

In order to collect the root data for determining AHP weights, a questionnaire form was sent out to 12 experts. The other data for measuring the 8 factors are collected from the previous papers, census and reports, the websites and pamphlets of the attractions, Google earth, and also collected by questionnaire survey to the public and doing fieldwork. ArcGIS is a supplementary tool for making evaluation with spatial distribution, especially being used when measuring the factors of transportation and hotels. After evaluating the attractions with abstract scores, rank the scores of the 22 attractions and see the spatial distribution with the map.

Hangzhou's natural landscape resources are mainly categorized into volcanic rock, Karst landform, granite, scenery with hills and waters, waterfall scenery, lakes, wetland and rivers. As the result of the assessment, 9 of the 22 attractions comprehensively have high value, and 10 of them have medium value, and the left 3 have low value. Hangzhou is originally famous for the West Lake, however, after the research it is learnt that the west region of Lin'an city also has abundant natural landscape resources with remarkable value, where should be paid more attention in the future development and preservation. As the suggestion to the future, it is better to construct more nature preserves and Geoparks in Hangzhou.

Keywords: Hangzhou, tourism, natural landscape resources, AHP, evaluation

Tsunami Vertical Evacuation Sites: A Case Study of Shizuoka City

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The City of Shizuoka directly faces the Nankai Trough which has given two M8.1 earthquakes in modern history (1944 and 1946), which were tsunamigenic. After the great Tohoku earthquake the Japanese government updated its worst case scenario for a tsunami from the Nankai trough, which is expected to have a maximum run-up of 34m. This study aims to use GIS in order to locate vertical evacuation sites in the City of Shizuoka within the existing urban structure, and to assess their potential in supporting the population for immediate evacuation under an extreme 34m run-up tsunami event. This study is still in its initial phase, however, spatial analysis of the current designated evacuation locations in the city indicates that under extreme circumstances only a very small minority of sites would remain if such an extreme tsunami were to happen. Therefore, there is an apparent need to investigate for new evacuation sites that will be suitable even under a tsunami of great magnitude.

Keywords: Tsunami, Vertical Evacuation, Shizuoka City, GIS

Spatial Analysis of Urban Accidents; A Case Study of Tehran,Iran

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Road accidents may be seen as discrete promote events, localized in space and time. The most important objective of the study was to identify the spatial pattern of urban accidents in Tehran city in order to finding the causes and consequences as well as the temporal and spatial variation of accidents. Based on spatio-temporal data analysis method, this paper aims to analyse traffic accidents data in time and space. The spatial relationship between time of daily activities which generate trips and urban traffic accidents is examined and applied to Tehran for 2010~2011.

The research was based on different primary and secondary data sources, which include locations of accidents and many rich attribute such as date, reason, kind, etc. Questionnaires were distributed to 600 drivers in the study area in order to gather data about drivers' knowledge, beliefs, attitude and behaviours. GIS software was used in this study and different maps were made using GIS Arc view 10.2. Tehran urban accidents point by point data with different attributes was collected from Police Department of Islamic republic of Iran, Tehran. These rich accident data were used as source of information and data analysis. The study considered different factors in urban traffic accidents. These include environmental, human and cultural factors, etc. this study stated that the concentration of educational, commercial and cultural activities that make large number of urban trips and road usage and traffic volume in peak hour and road type are among the main causes of the urban accidents in Tehran city. The spatial distribution and variation of Tehran's urban accidents indicated those accident occurrences are highly concentrated along the residential, primary, and secondary roads as well as dense in highways and freeways. This study also shows the relationship between the occurrences of accidents with peak hours of the day. Highways and freeways are the most dangerous road type in road type variation in Tehran city. And the key reason of accidents in these road types is high speed. High occurrences of urban accidents were caused by culture and behaviour of not only drivers but also all users of the roads. It has been recommended that the improvement of knowledge and culture by education through the public Medias and the rules for offenders must be reissue soon.

Keywords: GIS, Urban Traffic Accidents, Peak time, Road Type

Historical changes in land price formation factors over 100 years in Kyoto, Japan: comparison of the land price distribu

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The land price formation factor is an index, which shows the social economy situation of the time.

Although a large number of studies have been made on evaluating land price formation factors which show socio-economic situations, most of the studies have been cross-sectional analysis focusing on specific factors, such as zoning, road width and accessibility to public transportation. Little attention has been paid to historical changes of land price formation in a long-term perspective, mainly because of the lack of historical data representing land price distribution in the past. Fortunately, the Kyoto cadastral map made in 1912 was digitized to create the historical GIS database containing detailed land price information for each land parcel by the GIS research team at Ritsumeikan University. It should be noted that the city has not received large-scale disasters and war damages since the age of the cadastral map. We can thus investigate historical changes of the city without effects of such large-scale disasters. Comparing the current land price distribution with that in early 20th century in the city of Kyoto, we examine historical changes in the geographical factors of land price formations reflecting changes in urban physical and social formations of the city. With the aid of GIS-based mapping and overlay analysis, we mainly argue on the effects of the changes in urban formation on land price distributions over 100 years in the city.

The land price formation factors of quantitative getting are road width and distance from the train station is easy. However, quantitative getting of ambiguous land price formation factor represented by downtown property is difficult. In this study, for the understanding of land price formation factor of 100 years ago, take advantage of old photographs.

Keywords: Kyoto cadastral map, land price formation factor, old map

Spatio-Temporal Analysis of Bicycle Commuting Behavior in the Greater Tokyo Area Using a Micro-Scale Persontrip Database

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Compared to other nations, the share of motorized individual traffic in the daily commuting flows in Japan is rather low. Instead, the share of railway transportation is significantly higher. In addition, this generates feeding traffic from homes and workplaces to and from the stations, which is done mostly on foot or by bike. This holds especially true for highly urbanized areas, such as the Greater Tokyo Metropolitan Area with its 34 million inhabitants, which we use as a study area in this paper.

Here we investigate the role and structure of the use of bicycles in the course of commuting traffic. This paper provides a thorough spatio-temporal analysis of bicycle behavior, since we analyze how bicycles are used in the daily commutes, by whom, and where. We investigate how bicycles are integrated in the commuting process and what spatial factors determine the use of bicycles.

For this paper we employ a massive micro scale person trip database provided by the Center for Spatial Information Science at the University of Tokyo. It contains sociodemographic data about approximately 600,000 sample individuals, as well as information about the purpose of each of their trips, their chosen means of transportation (e.g. car, bus, bike, etc.) and their location in 1-minute steps over all 24 hours of one sample day.

As the scientific discourse about bicycle traffic in Japan is scarce, we hope to be able to contribute by this study and provide valuable insights into this important mode of transportation.

Keywords: bicycle, big data, commuting, gis, japan, tokyo

Geospatial analysis of land changes in the megacities of Southeast Asia

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The advancements of remote sensing and geographic information systems technologies enable us to monitor land changes at various spatial and temporal scales, and analyze the implications of such changes from different perspectives. This study assesses the spatiotemporal patterns of land changes in the megacities of Southeast Asia, namely Bangkok (Thailand), Jakarta (Indonesia) and Manila (the Philippines). The goal is to gain better understanding on the land transformation process in each megacity, which may be useful from the perspective of sustainable landscape and urban planning. Remote sensing data were used to develop land cover maps for the megacities across three epochs, i.e. t1-1990, t2-2000 and t3-2010. A hybrid classification method that integrates pixel-based and object-based techniques was employed in land cover classification. Transition matrices for the two time intervals (t1-t2 and t2-t3) were computed and geospatial tools and techniques were applied in order to reveal the spatiotemporal patterns of land changes in each megacity. The implications of the findings for future landscape and urban planning in relation to the sustainable development of the three megacities are explored.

Keywords: GIS, Remote sensing, Land change, Urbanization, Megacities, Southeast Asia

Spatial analysis of archaeological sites and landforms in Kayseri, central Turkey using multiscale topographic data

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Human habitat and cultural activities had been significantly influenced by natural environments including landforms in the prehistoric periods. Assessment of such relationships between palaeoenvironment and artificial remains is therefore crucial in understanding the historic development. Here we examine the nature-human interactive system in the ancient period of Kayseri region, central Anatolia Highland in Turkey, in terms of spatial analysis of the distribution of landforms and archaeological settlements, targeting mainly the period from B.C. 3000 to A.D.100. We perform geospatial analyses based on several topographic data including topographic maps, satellite-based remote sensing (10 m DEM derived from PRISM sensor images on ALOS), ground-based laser rangefinder measurement with global navigation satellite system (LRF + GNSS) and ground-based structure from motion multi-view stereo photogrammetry (SfM-MVS). The topographic data at different levels of scales provides both regional- and local-scale views of landform conditions, landform classifications, and detailed characteristics of settlements. Certain effects of gradual and sudden changes in palaeoenvironment on human activities are detected, and potential of natural disasters in the study area is also discussed.

Keywords: geoarchaeology, landform classification, digital elevation models, structure from motion