HTT07-01   :102A   :5   22   09:00-09:15

Laser scanning surveys to analyze morphological impacts of the 2011 Tohoku-Oki Tsunami, northeastern Japan

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A massive earthquake of Mw = 9.0 occurred on Friday 11 March, 2011, off the Pacific coast of northeastern Honshu, Japan. The earthquake triggered destructive tsunami waves that struck the Pacific side of Japan, traveling up to 9 km inland. The damage caused by the tsunami waves was much greater than that by ground motion due to the large earthquake. We investigated the impact of the huge tsunami on landforms in the coastal area. The tsunami waves destroyed numerous buildings and other artificial objects, and they entrained mud and sand from the seabed. However, erosion and deposition on flat lowlands and relatively wide valley bottoms were unexpectedly limited. In contrast, side-slopes of valleys along a ria-type coast locally underwent erosion, including the removal of vegetation, soil, and regolith, and even bedrock may also have been modified due to strong wave action. To understand the characteristics of landforms affected by such erosion, we conducted field surveys in some coastal valleys and collected high-resolution 3D topographic data using a terrestrial laser scanner (TLS). The targets of scanning include both relatively broad valley-side slopes and specific landslides caused by the tsunami waves. They include the valley of Aneyoshi, where the maximum tsunami run-up height was measured (38.9 m). The results indicate some differences between the surveyed slopes and more usual slopes. For example, nearly vertical segments often occur at lower slopes, although they are almost free from erosion by normal coastal waves and rivers. The inclination of side slopes of river meander bends also differs from that resulting from normal fluvial erosion due probably to erosion by tsunami waves. In addition, the locations of some landslides correspond well to the measured heights of tsunami inundation, pointing to erosion induced by the tsunami on March 11. Historical and sedimentological records indicate that the study area experienced multiple large tsunamis in the late Holocene. Erosion by the repeated tsunamis seems to be responsible for the observed unique slope shapes. In other words, topographic characteristics of slopes may be used to identify areas with high risk of large tsunamis.
Keywords: tsunami, erosion, bedrock, terrestrial laser scanning, valley-side slope

Terrestrial laser scanning of a tsunami-affected valley in Aneyoshi, northeastern Japan

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The devastating tsunami wave induced by the Tohoku-Oki megaearthquake caused erosion of side-slopes in valleys along a ria-type coast. The tsunami-wave erosion, including the removal and modification of vegetation, soil, regolith and even bedrock, is observed at inland areas of a valley facing the coast. One of the most typical cases is the valley of Aneyoshi, where the highest runup of tsunami wave, 38.9 m, was recorded. We investigated detailed morphology of its eroded valley-side slopes using a terrestrial laser scanner (TLS), together with airborne laser scanner (ALS) data. Topcon GLS-1500 was used as the scanner, and the geographic coordinates of the position of laser scanning were defined using a 2-band GNSS capable of carrier phase correction. Point cloud data obtained from multiple scanning positions of the TLS were compiled using the relative positions and/or geographical coordinates of targets for scanning. Morphological analyses, such as slope computation and cross profile extraction from the topographic data, suggest that the asymmetric valley shapes, as well as small topographic features such as near-vertical segments of slopes located at the tsunami-inundated height, are correlated to the large tsunami-wave attacks, which could have occurred multiple times in the late Holocene period. Also, the width of the valley suddenly increases toward the ocean at an incised meander bend, and a knickpoint is observed at the maximum tsunami-runup point, c. 100-m upstream of the bend. The increase in the valley width could be correlated with the change in the direction of tsunami wave invasion, whereas the position of the knickpoint, nearly at the run-up height of the tsunami, may be affected by the repeated tsunami-wave erosion and/or post-tsunami fluvial erosion.

Keywords: tsunami, erosion, bedrock, terrestrial laser scanning, valley-side slope

HTT07-03 :102A :5 22 09:30-09:45

Upper Pleistocene to Holocene geomorphic changes in the Osaka Intra-arc Basin, Japan: GIS analysis of borehole data

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Development of the late Quaternary depositional sequences in the Osaka Intra-arc Basin were reconstructed based on analysis of subsurface geology and geomorphology using a borehole database and GIS. The results indicate some significant geoscientific phenomena that occurred during the Upper Pleistocene to Holocene: 1) formation of alluvial fans and river terraces during regression from the marine isotope stage (MIS) 5 to MIS 2; 2) formation of ravinement surfaces by wave and tidal erosion during transgression from MIS 2 to MIS 1; 3) formation of barriers and wave-cliffs during the maximum high-stand of MIS 1; and 4) progradation of fans, deltas and strand plains during the latest Holocene. The obtained insights include: 1) expansion phases of fans; 2) different styles of geomorphological development under the influence of clastic sediment supply in relation to incised-valley formation between MIS 3 and MIS 2; and 3) importance of geomorphological changes forming ravinement wave surfaces and seabed during transgressions with different rates of sea-level rise.

Keywords: borehole data, ravinement surface, terrace, Upper Pleistocene to Holocene

HTT07-04   :102A   :5   22   09:45-10:00

ETM+ ALOS
Estimating CO$_2$ Sequestration by Forests in Oita Prefecture, Japan, Combining LANDSAT ETM+ and ALOS Satellite Data

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Carbon sink, which is one of the alternative methods for reducing CO$_2$ emission, as mentioned in the concept of Kyoto Mechanism, is very important in the current research context, considering that 68.9% of lands in Japan is covered by forests (OECD, 2004). While many Prefectures in Japan have been researching about the forests sequestration and have come up with policies for the implementation of reducing CO$_2$, still many others have not yet been involved in such processes although they have a great amount of forest cover. Oita Prefecture is one of them.

The final objective of this research is to re-assess the estimation of CO$_2$ sequestration by the forests in Oita Prefecture by evaluating forests extents and by quantifying their potential storage capacity using GIS and remote sensing techniques. This research is done in 3 steps: (1) Producing a detailed land cover map using satellite remote sensing data; (2) Analyzing the status of the forests (tree age) using satellite remote sensing data, and (3) Estimating CO$_2$ sequestration by the forest covers by combining the information obtained in steps 1 and 2.

LANDSAT ETM+ (May 25, 2002 and Dec 30, 2006) and ALOS PALSAR (Sep 15, 2009 and Oct 14, 2009) satellite remote sensing data covering the study area were acquired and were analyzed using IDRISI Taiga, the GIS software platform. Hybrid classification based on maximum likelihood method was performed for producing a detailed land cover map, and the areas were calculated for each forest type (coniferous, deciduous broadleaf and evergreen broadleaf forests). First, CO$_2$ sequestration for each forest type was calculated using the sequestration value per unit area multiplied by the total forests area. A total sequestration of 6.6 MtCO$_2$/yr was obtained: 3.56 MtCO$_2$/yr for Coniferous; 0.77 MtCO$_2$/yr for Deciduous-Broadleaf; 2.25 MtCO$_2$/yr for Evergreen-Broadleaf. Second, through a deeper analysis, the stem volume of the forested area was estimated by using the backscattering intensity information derived from the PALSAR image to find out the tree age for each forest type in order to estimate precise sequestration. Coniferous and deciduous broadleaf forests were classified into categories per ages and the sequestration re-estimated. We obtained 2.9 MtCO$_2$/yr and 0.3 MtCO$_2$/yr for coniferous and deciduous broadleaf forests, respectively.

These results show the importance of considering not only the forest type, but also the tree age for more precise CO$_2$ sequestration estimates, and therefore for avoiding overestimation of the forests sequestration capacity. They also show that analysis using LANDSAT and PALSAR data can provide better information on the status of the forests, helping thus for sound decision making and for more effective planning in resource management over time.

HTT07-05 :102A :5 22 10:00-10:15

Fixed Rank Filtering
Mapping radiation dose with fixed rank filtering

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Spatial statistics provides a powerful tool for spatial data analysis. Spatio-temporal kriging makes it possible for researchers to interpolate data in arbitrary space and time points. However, as the world is entering a "data rich" age and datasets are more often massive both in space and time, spatio-temporal kriging is not feasible. Recently, a new methodology called fixed rank filtering via spatio-temporal random effects (STRE) model has been proposed to reduce computational complexity for spatio-temporal interpolation. It can handle very large datasets that spatio-temporal kriging cannot. Thus far, however, to the best of our knowledge, only a few researches have been carried out for empirical analysis. Incidentally, various actors including municipalities and residents have been measuring radiation dose after the Tohoku Earthquake struck Eastern Japan in 2011; however, there is no radiation dose distribution map based on an academic methodology.

This study applies the new spatio-temporal interpolation methodology to the radiation dose measurement data of seven municipalities in South Ibaraki, and examines the possibility of creating the radiation dose distribution map. In particular, the study uses three different ranges for radial spatial basis functions and calculates prediction errors to check the sensitivity of the results. The spatial basis function is a key instrument for capturing spatial correlation among the observed data, and therefore, the setting of the range is very crucial. The result shows that the wider the range, the lesser are the prediction errors. This might be due to a sparsity of the radiation dose measurement data in space. If the ranges are narrow, some of the basis functions would have few observed points around them and cannot capture spatial variation.

: , , fixed rank filtering
Keywords: radiation dose, spatio-temporal interpolation, fixed rank filtering

Land use/cover change and landscape fragmentation analysis in Baguio: A hill station city in the Philippines

Land use/cover change and landscape fragmentation analysis in Baguio: A hill station city in the Philippines

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Land is a very important resource and its use or cover depends/and or changes on a given underlying purpose. Land use/cover (LUC) change, however, is a complex process influenced by the interrelated components of the natural and socio-economic systems. It has been part of the current global environmental issues. In a much smaller scale, LUC change can also influence the fragmentation of a particular landscape that often results to the loss of aesthetic values of the landscape. For these reasons and due to the negative consequences of uncontrolled population growth and urban expansions, environmental protection and conservation for the benefits of human beings of the current and future generation becomes a vital component of modern land use planning.

The objective of this study is to analyze the LUC changes and landscape fragmentation in Baguio, a hill station city and the summer capital of the Philippines. It also aims to capture the factors encouraging its urbanization. Remote sensing data were used to derive the 1988, 1998 and 2009 LUC maps for Baguio containing four classes, namely built-up, forest, brushland and cropland, while GIS techniques were used to detect the LUC changes and patterns. The fragmentation of the landscape of Baguio for the three time periods was analyzed using the landscape metrics at class level, namely number of patches, patch density, largest patch index, mean patch area, landscape shape index, and interspersion and juxtaposition index. Socio-economic survey was conducted to capture the perceptions of people on the factors that encourage the urbanization of Baguio. The respondents were grouped into non-residents, residents and employees of concerned agencies like office of the city planning and development, national economic and development authority, department of environment and natural resources, housing and land use regulatory board, among others.

Results revealed that built-up area almost had a 3-fold increase during the study period (with an area of 1,076 ha in 1988, 1,973 ha in 1998 and 2,985 ha in 2009) at the expense of the other land uses/covers. Results of the fragmentation analysis revealed that built-up class became more aggregated and clumped indicating an in-fill pattern of urban development. However, forest class became more fragmented, while brushland and cropland classes show complexity in their changes. Results of the socio-economic survey showed that among the top five factors encouraging the urbanization of Baguio that are common to all the groups of respondents include population growth, presence of economic opportunities, presence of schools and universities, land use plan/policy, and favorable cool climate.

The results showed that the transformation of the landscape of Baguio was greatly influenced by its urbanization as indicated by the significant increase in its built-up area resulting to a substantial decrease and more fragmented green spaces, which are vital components in its status as the summer capital of the country. The city must rise to the challenge to address the problems of rapid population growth and urban expansions in the name of modernization and sustainability, taking into consideration the significant roles that Baguio city plays, and its potential. The city government and its constituents must work in unison in drawing up responsive development plans, with emphasis on the conservation of the natural environment in tandem with sustainable economic development.

: Land use/cover, Landscape fragmentation, GIS, Remote sensing, Baguio, Hill station
Keywords: Land use/cover, Landscape fragmentation, GIS, Remote sensing, Baguio, Hill station

HTT07-07　　　　　　　　:102A　　　　　　　　　　:5　22　10:45-11:00

Multi-agent simulation of farm-based decision making: a deforestation case of Dzalanyama Forest Reserve, Malawi
Multi-agent simulation of farm-based decision making: a deforestation case of Dzalanyama Forest Reserve, Malawi

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　Subsistence agriculture continues to be the mainstay activity in most tropical regions and opinions on how it impacts tropical deforestation vary significantly. The sparse literature available on subsistence farm-based models highlights the existing methodological gap in the ability of present day agent-based models (ABMs) to simulate the impact of subsistence agricultural production on frontier tropical deforestation. Though issues concerning agent specification and its variability have been successfully dealt with, gaps exist in the explicit incorporation and articulation of linkages of subsistence production and consumption theories on the one hand, and frontier tropical deforestation on the other. In this paper, the decision making process of tropical subsistence farmers surrounding the Dzalanyama Forest Reserve in the south western part of Malawi's capital Lilongwe is simulated in a multi-agent Java environment to evaluate how it impacts quantities of production and fulfillment of household requirements that include food which is then tested against the need to use forest reserve resources to supplement any deficiencies. This demanded explicit determination of the decision-making process and the objective functions for subsistence farmers. In this particular study area food production depended less on physiographic factors of soil and elevation for instance. However, availability of policy intervention mechanisms that include subsidized inputs and agricultural expertise positively influenced the sustainability of the food production. This study is further aimed at substantiating the hypothesis that over two thirds of all the charcoal produced in Malawi is largely as a coping mechanism against food shortage and/or cash needs. Most of deforestation in Malawi, especially of protected areas, is attributed to charcoal making. In this regard we hope that once the decision making at the household level in far as crop production is concerned is simulated, the trajectories of deforestation and its trigger mechanisms can well be understood. Overall, we also hope to show that farm-based ABMs have the potential to allow insightful understanding of the small and slow individual homogeneous subsistence practices that have resulted in massive deforestation in the tropics, especially in this study area where significant shifting cultivation and commercial logging is nonexistent.

　　　　　　　: Agent-based modeling, Tropical deforestation, Farm-based decision making, GeoComputation, Subsistence farming
Keywords: Agent-based modeling, Tropical deforestation, Farm-based decision making, GeoComputation, Subsistence farming

Geographic Concentration and Development Potential of Poultry Microenterprises
Geographic Concentration and Development Potential of Poultry Microenterprises

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Bangladesh 's economy is agricultural with a poor industrial base. Consequently, the incidence of unemployment and poverty is high. Creation of employment is a prerequisite for poverty reduction. There is a growing potential for development of microenterprises (MEs), created through extensive collateral free lending of microcredit to the poor for small business by several non-government organizations (NGOs) throughout the country, and thus to create employment opportunities for the unskilled poor. The poor do not have access to loans from formal banking institutions since they lack collateral. The term' microfinance ' is often used interchangeably with' microcredit '. Microfinance is financial services of any sort provided in very small (micro) amounts to meet the unique financial needs of the poor and allow them to improve the status of their living. Progressive microcredit borrowers are provided larger loans. Microenterprise refers to a small business or activity that is independently owned and operated with small investment and has much opportunity for further expansion and creation of employment. In recent years, many commercial poultry MEs have flourished in rural areas in Bangladesh and thus created employment for a significant number of poor population, so playing a significant role in poverty alleviation. The poor entrepreneurs have extensively developed these MEs, utilizing their homestead land with the help of microfinance. But not all of these MEs are located in favorable places, which results in poor input supply and marketing facilities for their products in most cases, and thus causes higher production costs and less profit. So, this paper tries to explain the geographic concentration and development potential of poultry MEs in relation to the suitable sites for poultry MEs delineated through Geographic Information System (GIS) using factors like flood-free land and infrastructures. In this paper, geographic concentration of poultry business in Gazipur district has been analyzed using primary geo-referenced data collected from government livestock department and to determine spatial inequality to realize the potential sites for poultry MEs development, the most important criteria were identified based on interviews with the microentrepreneurs through a field survey by the author and the literature review. The most important criteria are basically the infrastructures required for the poultry subsector development and physical environment of Gazipur district, such as (a) spatial economic criteria like highways and roads, location of market places, sources of support services, (b) physical factors like land and flooding, and (c) constraints like rivers and water bodies, and the location of forests. Digital data were collected from different institutions to consider these different determinant factors for analysis using GIS software.

Dhaka Division accounted for more than 50 % of commercial poultry, as the demand and consumption of commercial poultry meat and egg is high among the capital city dwellers in Dhaka. Gazipur District, a 1741.53 sq.km. stretched area located near the capital city of Dhaka, has the highest concentration of poultry farms. In Dhaka Division, out of sixteen districts, Gazipur district ranks first in commercial poultry production producing almost 23.9 %. The result of the GIS analysis reveals that a huge area (1253 square kilometers, 69%) is considered to be highly suitable in Gazipur district, as these areas have very suitable infrastructural potential with regard to proximity to roads and highways, proximity to government livestock offices and markets, and land free from regular flooding. While, a small percentage (149 square kilometers, 8.22 %) of area is unsuitable/ marginally suitable for poultry MEs development.
Keywords: Geographic Concentration, Spatial Inequality, Poultry Microenterprises

HTT07-09   :102A   :5   22   11:15-11:30

Spatial modeling applied to the cities in Japan

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1. Introduction

This study analyses large and middle scale cities in the northern and eastern areas, in special case of Sapporo and Sendai cities, adopting the compact city model. We present this model to improve the cities' master plan; and we will compare it with Aomori city. Using Geographic Information Systems (GIS) we study the land use system, population and urbanization areas. Sendai and Sapporo each have more than 1 million people while Aomori city has almost the 30 percent, for that reason it is important to study the land use transformation and population growth using time series. We applied Kriging models to study the population density, and statistical analysis was performed to analyze the land use transformation with the projected population. The objective of this study is to analyze the relationship between the population and land use in a 100mt mesh area through spatial analysis models such as variograms, krigging models and linear mixed models.

2. Method

Regarding to the spatial predictions of unknown quantities, the Krigging models are a good way to achieve the missing information (Bivand 2008), these models have been applied by several researchers in different fields, for example: to determine the spatial distribution of termites in a shortgrass steppeland (Rives-Dasi et al. 2001), to develop a potential temperature-dependent distribution map for the male gypsy moth (Sharov 1999); but to study the spatial correlation we developed some variograms models, this model quantifies the spatial extent of correlations(Marzban 2009), for that reason it is useful to analyze the population density per mesh area using variables which can affect it such as land use, and so on.

3. Data analysis

In a previous experiment we found the land use promotion area, land use control area and district area for the metropolitan areas involved. That data was obtained through the LUCKY system, it presents the land use planning areas. From the GIS homepage we were able to get the land use information by 100 mt mesh in 3 periods of time (1991, 1997, 2006), after we overlayed this information with the land use planning area in order to analyze the land use in the promotion, control and district areas. The population data was downloaded from the Official statistics of Japan, however just the information of 2000 and 2005 is available. This information was measured by districts and towns. We contacted the Statistics Bureau to get the information of 1990 and 1995 in order to study the land use transformation and the population in the same period of time.

4. Discussion

The people located in Aomori city is leaving the rice fields since 1995, the reduction has been given in more than 60% until 2005, however the building sites are being increasing in the first period in more than 13.35% and in the second period in more than 20%, while the population in the promotion area has grown in 6.09%. It means that people prefer to reach the places with high population density. In the kriging models developed we figure out that the promotion area's core is fulfilling with the compact model and some high population groups are appearing in this area. In a future experiment we will analyze those groups, and we will be able to get some information about the population behavior according with the land use; also we will analyze those groups through clustering methods taking in count the time series. For Sendai and Sapporo,in the periods 1995-2000 and 2000-2005, the building area increased more than 25% and 30% respectively, the population located in other agricultural land decrease in more than 20% and more than 50% respectively, it also means that people are leaving this area in order to achieve the metropolitan area. To analyze the behavior of the population in Sendai and Sapporo metropolitan areas, it is needed to study the population clusters in the area which depending on time series and land use.

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Keywords: Krigging model, Land Use Transformation, Urbanization, Compact Cities

HTT07-10　　　　　　　　　:102A　　　　　　　　　:5　　22　　11:30-11:45

Geostatistical Sampling Optimization: An Empirical Study Using Officially Assessed Land Prices

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In Japan, where the budget screening is in progress, improving the efficiency of the administrative system is an urgent task. Assessment of Officially assessed land price is also need to be improved. In this assessment, 26 thousand sites are assessed to determine the land price every year.

From the perspective of administrative efficiency, it is necessary to evaluate the sites assessed in this assessment. The problem of evaluating sampling allocation is called sampling design. As for the sampling design of spatial data, the use of geostatistical techniques has been reported in some studies.

Geostatistical methods are useful in evaluating the sampling design of land price assessments. However, as far as the authors are aware, there have been no such studies conducted in Japan. This study evaluates the sampling design of land price assessments by applying geostatistical methods.

In this study, first, the sampling design of the officially assessed land price is evaluated from the viewpoint of the allocation or the number of the sampling sites. Next, an optimized sampling design is deviated on the basis of the result. Subsequently, the sampling design of the prefectural land price survey is evaluated and optimized on the condition that the allocations for the officially assessed land prices are given. To evaluate the consistency of the sampling designs, the allotment pattern of the land price data must be considered in our model. For example, it is known that most of the land price data are assessed on urbanization promotion areas that have a high demand. Hence, such information is explicitly introduced into the model.

The results of the aforementioned evaluations are applied for assessing the cost of each sampling design. Policies are then suggested on the basis of the result.

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Keywords: Geostatistics, Sampling design, Officially assessed land price

HTT07-11 :102A :5 22 11:45-12:00

Spatial Analysis of Terrorism Vulnerability
Spatial Analysis of Terrorism Vulnerability

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Terrorists are no lunatics. While their ideologies and goals, as well as their means to get there, are hardly to relate to, and out of question in their brutality and furtiveness, they are better organized and purposive as public discussion is often willing to admit. In contrast to natural disasters, which follow the law of nature alone, and technological disasters, which can be perceived as random in their occurrence, acts of terror will always pursue a certain objective. This objective is governed by a greater aim or agenda, which differs from perpetrator to perpetrator. Yet, one element all terrorist agendas share is the most basic root of terrorism: exercise fear, also known as terror. Hence, it is sensible to ask what we should be afraid of, what not. Or to put it more precisely: what can be expected to happen, and where?

As complete safety from terrorism can not be guaranteed, there is a necessity for a methodological framework to identify the places at highest risk for being the target of a terrorist attack, to quantify those risks, and ultimately to prioritize them by their risk in order to make sure the means spent for the counter-terrorism activities are invested in the most promising and effective outcomes.

This research tries to establish a spatially grounded methodological framework for the analysis of vulnerability to terrorism within urban areas. While little focus has been put on the topic of vulnerability to terrorism so far, it is equally definitive for any threat as is risk. Therefore it has to be better understood in order to be able to grasp the threat of terrorism as a whole, and to give recommendations for policy makers and the public likewise. The outcome of this research can be a map showing the geographical distribution of vulnerability to terrorism.

Three categories of targets have been identified: buildings (including the special case of key assets such as nuclear power plants, which require special attention), infrastructures, and public space. This paper covers only the analysis of infrastructures.

The framework builds upon the concept of Geographic Valued Worth by Patterson & Apostolakis (2007), which evaluates how important each element of an infrastructure (e.g. water valve, electric switch, gas pipe) is to the decision maker, and thereafter analyzes for spatially collocated elements. The importance of the elements is determined by performance indices, based on certain performance measures (e.g. physical property damage, impact on people, impact on the environment) that are used to operationalize the decision maker's objectives regarding a terrorist threat (e.g. impact on health and safety, economic impact). The weighting of those performance measures as well as their disutility functions are defined per stakeholder (modeled by user categories, e.g. residential, commercial, industrial) and infrastructure.

This importance measure aside the framework also accounts for the susceptibility of an infrastructure element to being successfully attacked by a terrorist, which will lead to the failure of said element. The framework presented here is thereby a holistic approach to quantify vulnerability and analyze its spatial distribution.

: terrorism, vulnerability, spatial analysis, risk, infrastructure, GIS
Keywords: terrorism, vulnerability, spatial analysis, risk, infrastructure, GIS