NASA Lunar and Planetary Mapping and Modeling

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NASA's Lunar and Planetary Mapping and Modeling Portals provide web-based suites of interactive visualization and analysis tools to enable mission planners, planetary scientists, students, and the general public to access mapped lunar data products from past and current missions for the Moon (http://moontrek.jpl.nasa.gov), Mars (http://marstrek.jpl.nasa.gov), and Vesta (http://vestatrek.jpl.nasa.gov). New portals for additional planetary bodies are being planned, including a new Phobos Trek portal currently in development. This presentation will recap some of the enhancements to these products during the past year and look forward to the results of the exciting work currently being undertaken.

Additional data products continue to be added to the Moon Trek portal. These include both generalized products as well as polar data products specifically targeting potential sites for the Resource Prospector (RP) mission. Note that these RP-targeted areas are also of significant interest to a number of planned and potential missions looking at the abundance and sequestration of lunar volatiles. New enhancements are being made to Moon Trek's crater analysis tool. A new path tool for traverse planning is in the works and a surface potential analysis tool is being planned. Current development work on Moon Trek also includes facilitating mission planning and data management for lunar CubeSat missions. In terms of data management, Moon Trek can provide an especially attractive option for missions being developed under newer very low-cost constraints. Looking ahead, Moon Trek will partner with the NASA Astromaterials Acquisition and Curation Office to integrate with their Lunar Apollo Sample database in order to help better visualize the geographic contexts from which samples were retrieved.

Mars Trek, the project's Mars portal, has now been assigned by NASA's Planetary Science Division to support site selection and analysis for the Mars 2020 Rover mission as well as for the Mars Human Landing Exploration Zone Sites. This effort is concentrating on enhancing Mars Trek with data products and analysis tools specifically requested by the proposing teams for the various sites. Also being given very high priority by NASA Headquarters is Mars Trek's use as a means to directly involve the public in these upcoming missions, letting them explore the areas the agency is focusing upon, understand what makes these sites so fascinating, follow the selection process, and get caught up in the excitement of exploring Mars.

The project is currently working with the International Phobos/Deimos Landing Site Working Group and other potential partners to produce a Phobos Trek portal with site selection for the MMX mission being a major driver. Initial implementation will draw from existing data products from missions ranging from Viking to MEX. As the International Phobos/Deimos Landing Site Working Group produces new map gridded global UV, visual, color, IR, temperature, hazard, etc. products, we will make the Phobos Trek portal ready for quick ingestion, visualization, and dissemination of this new data.

The portals also serve as outstanding resources for education and outreach. As such, they have been designated by NASA's Science Mission Directorate as key supporting infrastructure for the new education programs selected through the division's recent CAN. The presentation will provide an overview of the current status of these products and solicit input for future development.

Keywords: Moon, Lunar, Vesta, Phobos, Mars, visualization and analysis tool

Investigating the relationships between land surface temperature and social-ecological variables: A case study of Nanchang City, China

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In the context of rapid urbanization and population growth, urban planners and policy makers require information on factors contributing to the urban heat island (UHI) effect. This study investigated the relationship between land surface temperature (LST) and multi exploratory variables in Nanchang City, China. We used Landsat images from 2000 and 2013 to detect land use/land cover changes (LULC). Exploratory variables included: Normalized Difference Vegetation Index (NDVI), Normalized Difference Built-up Index (NDBI), population density and fossil-fuel carbon dioxide (CO_2) emissions. The urban area increased from 4,830–12,090 ha, a net increase of 150.31%. The autumn LST ranged from 17.09–35.20°C on September 15, 2000 and from 14.98–37.87°C on October 5, 2013. This indicated that urbanization has resulted in a strong UHI effect in Nanchang City. NDBI, population density, fossil-fuel CO_2 emissions and LST were positively correlated, while LST and NDVI were negatively correlated. The highest temperatures were in urban and bare land, while water and forest had the lowest temperatures. Urban green space planning could be used to alleviate the UHI effect and create a livable city. Population density should be distributed more evenly to mitigate disparity and fossil-fuel CO_2 emissions should be controlled to save energy consumption.

Keywords: Urban heat island, Land surface temperature, Land use/land cover, Population density, Fossil-fuel carbon dioxide emission, Nanchang City

Remote sensing and GIS based method for mapping changes in green patterns and its impact on urban environment

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Significant shrinking in vegetation coverage and sprawl in urban constructions to meet the needs of rapid population growth in the past decades have altered the regional environment. This paper investigates the role of green patterns on regulating local environment. A Geographical Information System (GIS)-based model is developed with support of Analytic Hierarchy Process (AHP) scheme to assess the eco-environmental vulnerability in relation to changes in natural space with involvement of green patterns and other indicators retrieved from Landsat time series data. The developed method was tested in the Hue City, Vietnam where has been experiencing significant transformation in land use/land cover (LULC) in the past decades. In general, results of analysis of temporal eco-environmental vulnerability maps in years 1979, 1989, 2003, and 2014 corresponding to changes in green patterns in the Hue City indicate that *(i)* enhancement in *heavy* and *very heavy* eco-environmental vulnerability levels during the timeframes 1979-1989, 1989-2003, and 2003-2014 exposes a good cohesion with increase in building patterns and decrease in green spaces; and *(ii)* at a local scale, certain extended green patterns may have a significant influence on the environment by cooling urban heat island. However, the green patterns may have a limited effect on the surrounding environment. Thus, concentration of larger greenspace at specific locations may not be a good idea. It is suggested that decision makers should wisely distribute the extended green patterns to maximize their role in regulating regional environment.

Keywords: GIS, Remote Sensing, land use/land change

Remote sensing and GIS based method for mapping changes in green patterns and its impact on urban environment

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Urban and Green Volume Estimation Using Remote Sensing-GIS Techniques: A Case Study of Surabaya, Indonesia

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Surabaya is the second largest city of Indonesia, a center of business, commerce, and industry. Thus, this city continues growing. Geographically, Surabaya is located in the east-northern part of Java island. Therefore, Surabaya becomes a center of trade traffic between islands in eastern Indonesia, due to an average economic growth of 7% per year (Surabaya Government, 2015). However, the growth of building is not equivalent to the growth of green spaces. The city government has developed a garden in several parts but it seems that it does not meet the ideal condition. Thus, the study on green volume and the proportion are becoming important. The study area is the Core Unit Development in Surabaya, including the CBD area. Remote sensing and Geographic Information System (GIS) method are applied in this study. This study uses ALOS AVNIR-2 and WorldView-2 as remote sensing data for determining land use/cover (LU/LC). The maximum likelihood classification technique is applied for the first satellite image, then object based classification is applied for the second one. DSM from ALOS-PRISM is employed to calculate the surface feature height. While for filtering the green area, I perform in two different methods, based on NDVI and LU/LC.

The results show that the total urban (built-up) volume of the study area is 395.670.112 m^3. The total green volume based on NDVI filtering is 37.083.997 m^3. It yields the green ratio around 9.37%. While the total green volume based on LULC filtering is 35,589,309 m^3 then it yields the green ratio about 9%. The difference of the green volume from the two methods is about 4.03%, not significant in comparing with the urban volume. However, for the both green ratio, it indicates that the green portion still does not meet the ideal condition.

Keywords: Urban Volume, Green Ratio, Remote Sensing, Geographic Information Systems

Using GIS to Analyze Spatiotemporal Patterns of Industrial Air Pollution Sources and Distributions

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This study developed new methods for using a Geographic Information System (GIS) to map industrial air pollution concentrations, and to analyze temporal patterns in pollutant sources and distributions. While these methods could be applied in a wide variety of cities globally with air quality issues, this presentation will highlight applications to a part of Portland, USA, which features rugged topography that exerts strong influences on winds and atmospheric stability, along with a neighborhood near an industrial area where residents often complain of poor air quality. This study installed a network of weather and air quality stations at varying heights within the area to measure wind speed and direction, gust speed, air temperature, humidity, precipitation, barometric pressure, and air quality. Pollution measurements followed standards from the American Society of the International Association for Testing and Materials (ASTM). Through spatial interpolation and various geostatistical techniques, this study then analyzed spatial patterns in winds and air pollution for the area, at a variety of temporal scales from annual, to seasonal, daily, and sub-hourly. Results show when and where the air pollution occurs most frequently, and in combination with atmospheric data gathered by this study, plus regulatory documents pertinent to the individual industries in the area, strongly suggest which sources are producing the most pollution. Results also show potential solutions to this problem, either by informing regulatory decisions to reduce the emission of pollutants at their sources, or by changes to the schedules of emissions-producing activities by these polluters so that emissions only occur at times when atmospheric conditions would not cause them to reach high concentrations in the nearby neighborhood. Accuracy assessment of the methods developed by this study using known emissions sources in the area with known schedules of emissions suggests these results are very reliable. The new methods developed by this study thus have strong potential to help improve air quality in Portland, USA, and could be applied to a wide variety of other areas globally where industrial air pollution is a problem.

Keywords: Geographic Information Systems (GIS), industrial air pollution

Tsunami vulnerability assessment in the Moratuwa Urban Council area in Sri Lanka

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26th December 2004 tsunami disaster has caused massive loss of life, damage to coastal infrastructure and disruption to economic activities in the coastal belt of Sri Lanka. Tsunami vulnerability assessment is a requirement for disaster risk and vulnerability reduction. It plays an important role in identifying the extent and level of vulnerabilities to disasters within the communities. The main objective of this study is to investigate tsunami vulnerability assessment of Moratuwa Urban Council area in Sri Lanka. We have used tsunami scenario with a maximum run-up 6 meters for 41,633 housing units located in Moratuwa Area. Building population estimation model and 2015 population data were employed to estimate night time population of all buildings located in the study area. LiDAR data were used to calculate the height and volume of the each building. The results of study expect to provide a clear picture of tsunami vulnerability. Outcomes of this analysis can be useful as an important tool for urban planners to assess the risk and extent of disaster risk reduction which could be achieved via suitable mitigation measures to manage the coastal belt in Sri Lanka.

Keywords: Western coastal belt, Tsunami vulnerability, GIS, LiDAR, Population estimation, Building Height

Tsunami vulnerability assessment in the Moratuwa Urban Council area in Sri Lanka

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Keyword. Western coastal belt, Tsunami vulnerability. GIS, LiDAR, Population estimation. Building Height

Improving Performance of Cellular Automata Model by Logistics Based Regression Using Socio- Economic Agents for Intra-City Growth Modeling
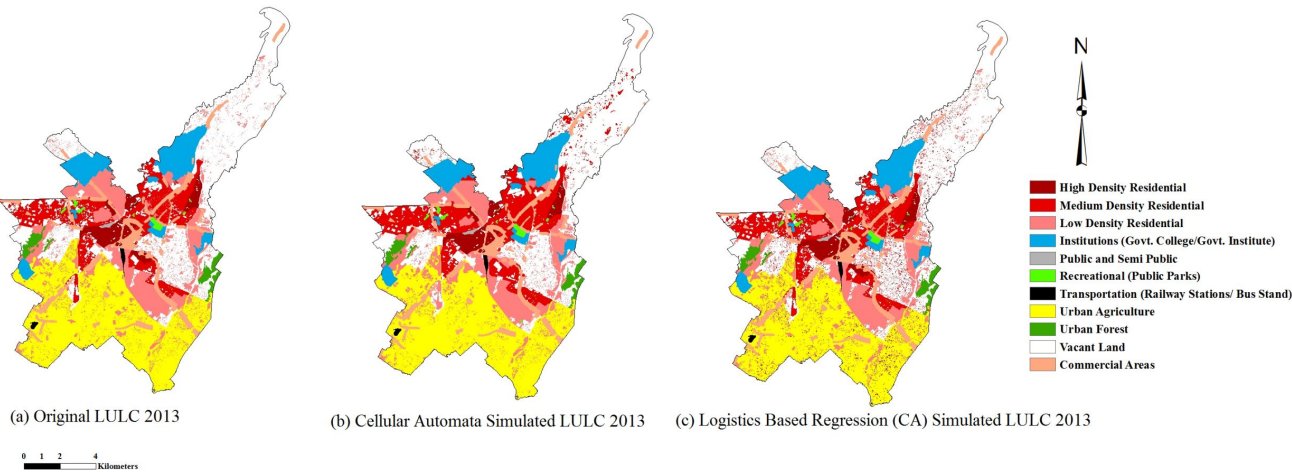
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Urban land use dynamics are studied in terms of quantitative analysis as well as spatial analysis for prediction of urban growth. Earlier urban expansion studies were based on change in the Land Use Land Cover (LULC) pattern with respect to time. However, socio-economic drivers of the city such as population density, literacy rate, household density, distance to road, commercial centers etc. also act like agents and play an important role in the expansion of urban growth. Many Urban Cellular Automata (UCA) models are developed based on spatial resolution and neighborhood properties that affect the urban growth, but implementation of unidirectional nature of socioeconomic parameters in the model are difficult task to implement to give results both quantitatively and spatially. In this study, neighborhood effect with the weighted rule mechanism of socioeconomic effect on each LULC class are calculated. A logistic based regression model is developed to evaluate the expansion data of Dehradun City, India. Collection of socioeconomic data and validation of LULC classes is done using field data. A 3 X 3 simulation window of the model has been considered to evaluate the change in each grid. Simulation based on transition rule and neighborhood effect resulted in improvement of accuracy of representation of built-up classes from 84% to 89 %. However, after incorporating socioeconomic drivers, this improves from 89 % to 94 % in 3 built-up classes i.e. low density residential, medium density residential and commercial classes. Sensitivity study of parameters and relative window size for simulation indicated optimal growth in the northeast and south part of the city. Small patches of growth are also observed in central and southwest part of the city. The study highlights the growing importance of incorporating socio-economic drivers for evaluating urban growth in the city in comparison to just change in land use land cover.

Keywords: Urban land use dynamics, socio-economic data, Logistics based regression model, Urban Cellular Automata model, land use land cover

Comparison of accuracy of cellular automata and logistics based cellular automata for a period of 2001-2013

(a) Original LULC 2013

(b) Cellular Automata Simulated LULC 2013

(c) Logistics Based Regression (CA) Simulated LULC 2013

Legend:
- High Density Residential
- Medium Density Residential
- Low Density Residential
- Institutions (Govt. College/Govt. Institute)
- Public and Semi Public
- Recreational (Public Parks)
- Transportation (Railway Stations/ Bus Stand)
- Urban Agriculture
- Urban Forest
- Vacant Land
- Commercial Areas

0 1 2 4 Kilometers

2013	Reference	User's Accuracy (%)	Producer Accuracy (%)	Overall Accuracy (%)	Kappa Coefficient	Area accuracy (Relative Error)	Spatial accuracy
Simulation with Cellular Automata	Built-up Cell	84	85	87	0.76	10.62%	83.72%
	Non Built-Up Cell	88	87				
Simulation with Logistics Based Regression Cellular Automata	Built-up Cell	89	90	89	0.81	8.78 %	87.64%
	Non Built-Up Cell	84	85				

Geospatial Modeling of Urban Growth in Shanghai

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In the dramatic urban growth process, to quantificationally measure the urban growth process and mitigate the side effect by rapid urbanization had significant meaning in supporting the growth management. It is a big challenge in simulating and modeling the urban growth process for a megacity like Shanghai, the traditional single-core model is incompetent in the geospatial modeling studies. This research aims to modeling the urban growth of Shanghai using geospatial techniques to contribute to the current efforts of improving modeling and understanding of the urban growth process.
To achieve this purpose, three specific objectives are established. 1) Land use/cover classification and change detection using supervised object-based image analysis (OBIA) techniques. 2) Potential underdeveloped area mapping with the nighttime satellite images. 3) Modeling the urban growth process with neural network machining learning algorithm, and predicting the future changes.

Keywords: artificial neural network, urban growth modeling

Drivers of urban land use changes in a rapidly urbanizing African City: A case study of Lusaka, Zambia

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Lusaka, like most African capital cities, has been experiencing rapid urbanization which is mostly uncontrolled and unplanned. The rapid urban growth of Lusaka City has created both environmental and social problems including increased informal settlements and urban poverty, unemployment, environmental degradation and limited access to basic public. To address the future urban planning challenges, understanding drivers of changes in urban land use (ULU) is essential. However, research investigating the drivers of ULU in Lusaka City is lacking.

Therefore, the purpose of this study was to investigate the drivers of ULU changes in Lusaka City from 1990 to 2010. First, we produced three ULU maps (1990, 2000, and 2010) using an integrated approach of remote sensing and GIS techniques. The data used to create the ULU maps included Landsat TM/+ETM data, Google Earth imagery, and spatial ancillary data including detailed road networks, cadastral polygons and land use data. The maps produced contained six ULU classes (i.e. unplanned high and low density residential; planned medium-high and low density residential; commercial and industrial; and public institutions and service areas). The expansion of the ULU classes was then assessed.

To identify the underlying drivers of ULU changes observed, a household questionnaire survey was conducted. First, a representative sample of households was determined. Then, systematic random sampling was adopted. The areas in the city were systematically chosen based on the four residential ULU classes while households were randomly selected to administer the questionnaires. A total of 1,405 households were interviewed. The questionnaire was designed to capture several drivers related to social, economic, environmental and policy/institutional factors.

The results show a City experiencing rapid urban growth with all six ULU types growing at a very fast rate. The City recorded about 233 percent increase in the total ULU area between 1990 and 2010. The survey results show that the rapid City growth observed is a direct consequence of uncontrolled population growth mainly driven by rural-urban migration for economic prospects, expectations for opportunities of higher education and wage employment. The problems in Lusaka City have further been exacerbated due to the lack of clear ULU policy direction, slow policy adjustments, incapacitated urban planning institutions, and low economic growth. This study offers vital insights in the context of future urban planning and policy making when attempting to secure a sustainable urban future.

Keywords: Drivers, Urban Land Use, Remote Sensing and GIS, Lusaka

マニラ大都市圏におけるモビリティの時空間分析
Spatial-temporal Analysis of Human Mobility in Manila Metropolitan Area

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The metropolitan area can be regarded as a multi-functional structure consisting of plural coordinated urban nucleuses. Commuting and consuming activities, which occur for most outdoor travel purposes of human daily activities, are two principal reflected forms of human mobility. This study aims to clarify the characteristics of urban nucleuses and spatial-temporal pattern of human mobility in the Manila metropolitan area. Hourly density of human mobility from 00:00 to 24:00 in the whole study area is quantitatively studied. The main findings are summarized as follows. 1) Urban nucleuses with city center type like Manila, Quezon, Makati and Las Piñas, attract more males, young people and mental workers. More commuting or consuming activities and more mobility by public transit occur there. Inflow trips are mostly dominant at 08:00-12:00 and outflow trips at 16:00-20:00. 2) Business city like Taytay, attracts more working activities. Inflow trips mostly occur at 12:00-16:00 and outflow trips occur at 16:00-24:00, whose peak-time is later than city center type. 3) More returning-home activities and more mobility by walking or car happen in commuter towns like Biñan. Inflow trips mostly occur at 16:00-24:00, while outflow trips occur before 08:00. This shows temporal symmetry compared with urban nucleuses with city center type. 4) In suburban centers like Naic and Guiguinto, inflow and outflow trips mostly occur before 08:00, whose peak-time is earlier than city center type. Relatively more females, middle or old age people, manual workers or no-occupation people move their trips into these areas. 5) Subcenter cities including Cavite and San Jose del Monte, have similar characteristics with CBD cities, but these cities have a high rate of consuming activities and more female movements.This study provides a practical mining method of traffic big data. Moreover, spatial-temporal analysis of human mobility also possesses a meaningful academic value for transport geography.

キーワード：人間のモビリティ、マニラ大都市圏、パターン認識、時空間分析、中枢都市
Keywords: human mobility, Manila metropolitan area, pattern recognition, spatial-temporal analysis, urban nucleuses

写真共有サービスFlickrの位置情報を用いた観光資源のホットスポットの空間分析

Spatial Analysis of Tourist Attraction Hot Spots Using the Online Geotagged Photographs of the Photo-sharing Service of Flickr

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　ICTの進歩はデジタルメディア上で人間活動を記録することを可能にした．たとえば，スマートフォン，GPS，トラベルカードなどの固定型・モバイル型センサーのネットワークによって，人間行動の時と場所を終日モニターすることが可能である．そうした新しい地理空間データの情報源を用いれば，高解像度のビックデータによって，人間行動を時空間上で捉えることが可能になる．オンラインの写真共有サービスは，そうした情報原の一つである．本研究は，写真共有サイトから取得した位置情報付き写真を分析し，東京の観光名所の空間的パターンを日本人と外国人の訪問者の間で比較することを目的とする．データは，旅行体験をアップロードした写真で共有するための代表的なオンラインサービスであるFlickrからダウンロードした．そこから2014年（1月〜12月）に撮影された位置情報付き写真のうち新宿，銀座，浅草の3駅から1km圏内で撮られたものを使用し，GISを用いて日本人と外国人の観光名所のホットスポットを比較する．その結果，3つの対象地域で日本人と外国人に共通する観光名所のホットスポットがみられた．一方，外国人は日本人に比べて写真の分布に空間的な偏りが大きかった．しかし，そうした違いは銀座地区のホットスポットには顕著に現れなかった．

キーワード：写真共有サービス、ビッグデータ、ホットスポット分析、東京
Keywords: photo-sharing service, big data, hot spot analysis, Tokyo

EVALUATION OF BENEFITS AND OPPORTUNITIES OF MUNICIPAL SOLID WASTE MANAGEMENT USING GIS : A CASE STUDY OF THE KANDY MUNICIPAL COUNCIL, SRI LANKA

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Increasing trend of solid waste generation has become a critical challenge especially in developing countries during last few years. Sri Lanka has taken many initiatives to overcome this challenge. Assignment of the responsibility of solid waste management to local bodies in 1987 and the national policy on solid waste management in 2007 that places emphasis on addressing solid waste management problem. However, the implementation of these initiatives has been inadequate and the health and environmental problems associated with the improper waste management have become critical. By 2015, the total generation of municipal solid waste has reached 177 tons per day in the study area. A case study was selected based on its rapid increasing population and waste generation and its location on the central highlands of the country. Kandy municipal council is the third highest solid waste generator. It is expected to find suitable sites to locate recycling plants to facilitate present waste management strategy of the Kandy Municipal council. Furthermore, to find the most influencing factor using Analytic Hierarchy Process. The study proposes and estimates the potential environmental and socio-economic benefits through recycling. The results of the study can be a good reference for the effective application of integrated policies in Sri Lanka and an important tool for the decision making process for the betterment of the public.

Keywords: Waste generation, Recycling plants, Municipal solid waste