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Investigating the methods of monitoring the changes of urban land use using remote sensing data

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ABSTRACT

Background and objective: Remote sensing due to extensive coverage, high separation capacity and low cost of data acquisition from the ground as an efficient tool, has played an important role in the field of Earth science research and environmental monitoring. One of the most important applications of remote sensing are the ability to detect changes. Today's high-resolution satellite imagery makes it possible for these images to be used to produce urban maps or updating them to identify changes in urban environments. Precise and timely diagnosis changes, both locally and globally, are important for the management of the optimal use of resources. The purpose of this article is introducing all methods for detecting land use change using remote sensing data that has been presented so far.

Materials and methods: In this regard, these methods are examined and the advantages and disadvantages of each expression are expressed. Also, these methods are compared so that the user can, according to the application, select the appropriate method in this direction.

Results and conclusion: In this essay different methods of changes in urban grounds by the evaluation from distance were presented.

All of the mentioned methods include weakness and strength point and should be used based on the needs. The methods can recognize changes in urban regions by the satellite data and help in decision making and managing the urbiculture issues. In combined methods, surely all procedures improve and illustrate better output with a high accuracy and promotes the pictures as well.

1. Introduction

In recent years, the growth of urbanization and the increase of migration to the big cities of country, has led to sudden and abnormal outburst in Cities and the destruction of fertile land and natural resources and irreparable damage to nature.
The urban development phenomenon is one of the main causes of land cover and land use change, which causes many problems such as ruining Agricultural lands, water pollution, soil erosion and social-economic problems.
With increasing population of cities, there has been a great increase in the area built in the region, causing enormous changes in land uses around the cities and the degradation of the fertile land in the

suburbs, so that the continuation of this process can make Irreversible impacts on regional environmental resources. The monitoring and optimal management of natural resources requires timely and accurate information. Changes in land cover at different spatial levels and in different periods of time, expresses the interaction and opposition of the perpetual needs of the human and environmental communities

In this regard, land use / land coverage is considered the most important sources of information in the management of natural resources.

Today's high-resolution satellite imagery makes it possible for these images to be used to produce urban maps or updating them to identify changes in urban environments.

Also, updating information in urban areas is very important, because this information is the base of many usages Which includes studies on changes of user coverage and environmental studies.

Remote sensing satellite data is an opportunity for obtaining information from urban areas in different kind of accuracy and are widely used to identify changes. Identification of changes is called to the series of activities for defining the difference in the status of an object or phenomenon by observing it over different times, Several methods have been developed to identify changes using remote sensing data, and new methods are emerging. However, the correct identification of the land use of remote sensing data often due to the urban prospects are complex compounds of different levels, is difficult.

The remote sensing has proven to be a powerful tool for monitoring the rapid changes in land use

Over the past three decades, technologies and remote sensing techniques have progressed dramatically, including the series of sensors in a wide range of operating systems with potential benefits and positive impacts on land planning and land management in comparison with traditional method.

Remote sensing is a key technology for assessing the extent and of land cover changes. Through this technique we can act with use of multi time pictures collection and processing them with one of the appropriate methods available and almost high accuracy than detection of the desired changes in the region. By using and utilizing remote sensing data we can pay attention to scientific and efficient management of sensitive areas.

2. A review of the research done

In this section, the most important researches that have done, those who have worked in this field and also the methods presented in this particularly are:

Initially, we will express some of the work done by different people.

In 2005, Phalke and Couloigner have examined the man-made terrain changes in the urban area by using IKONOS images with high spatial resolution and terrain extraction techniques. This technique has done based on terrain extraction using the desired points and edges . The method is compared with the PCA method and ultimately the title has been introduced as a more effective method for detecting changes in linear handmade terrain[101]

Nikfar and his co-workers (2010) have done An investigation for Iranian to update coverage maps of 1:25000 . the result of this research is presenting an algorithm based on segmentation of images using spectral and geometric descriptors for segmentation. The important point of this research is using appropriate descriptors for the segmentation and classification of the image that with this method, The pixel classifications of the base and the object have been overcome. But the main weakness is that only general changes in small scale are investigated and in the context of urban area, especially constructional and single buildings in large scale have not presented a solution. [112]

In 2011, RAJA and colleagues concentrated on recognition of urban growth by comparing after the classification of the base wavelet. For utilizing wavelet they used two-dimensional wavelet transform and classification of images for Fuzzy-Cmeans clustering method . [123]

In 2012, Ahmad's brothers concentrated on modelling of urban land cover using the dynamics of growing multi-time satellite imagery in City of Dhaka, Bangladesh. They first categorized the terrain by using Fisher's classification, and then used three different models for simulating land cover maps in Dhaka in 2009.

Ahmad and colleagues in 2012 with an article entitled "Urban Growth Modeling" using multi-time imagery satellite analyzed city of Dhaka using Landsat satellite imagery in the years 19989 and 1999 and then predicted urban growth in2009. First, the images were classified into five classes and then, based on, three Randomized Markof models , automated cells of Markof chain and multi-layer Porstrone- Markof chain of growth stimulated in Dhaka city in 2009, Then the best compatible model with the fact that the multi-layer Prestrone is Markof chain, by that p Urban growth is predicted. [143]

3. analyzing the methods of land use change in urban landscapes

The following article explores and describes the methods are used to monitor changes in land use

3.1. Automatically detects kernel based on changes using multi-lingual images

One of the main challenges in producing map of changes in urban areas is the limitation in spectral separation of constructed lands and arid lands form each other in this area . [154] For this purpose, a method for detecting automated changes is used based on kernel and with capability of simultaneous use from spectral information and different spectral is proposed. At the first stage, the appropriate spectral indices for the separation of covering classes in urban areas are extracted from multi-time images.with the Assist of analyzing the vector component of the change and automatically determining the threshold, inaccurate quasi-tutorials models related to the change classes are extracted without change. [165]

The main idea behind the kernel-based methods is that a non-linear decision making function can be used for demodulation a linear decision making function in a higher-dimensional problem space. [16] That this space is called Space Reproducing Kernel Hilbert (RKHS). So we can expect a better separation between classes and a higher precision. [177] For the purpose of evaluating the validity and integrity of the algorithm, discovering suggested algorithm, was applied to multidimensional and multi-temporal Landsat 5 TM sensor satellite imagery.

In order to perform a comparative evaluation, the accuracy of the proposed kernel-based method in two types is based on the differential-probability method in Initial Entry Space (DFSS) and Differential Method in Specific Spaces (DFHS), with methods for detecting the changes based on (MNF) conversion, Spectral angle writer (SAM), and simple differential equation (DIFF), and for these 5 sets of features was compared. The results show the high efficiency and accuracy of the proposed algorithm than conventional methods of detecting changes and its high potentials in separating all types of spectral classes in urban areas.

3.2. Using coupled satellite images by forming a feature vector for image pixels

In this method, by forming a feature vector for image pixels, instead of the spectral information of each pixel, the image and the use The GeoEye1 stereo image, instead of its single vertical image, the usage of these data in identifying the changes that are created for Building layers and updating 1:2000maps is analyzed.[28]

Now with access to high resolution spatial images, sensors such as Ikonos-2, QuickBird-2, WorldView-1, WorldView-2 and GeoEye-1 and also by using the different detecting Methods Changes such as segmentation and image categorization, manual conversion, the use of combined data and image differentiation have provided Suitable opportunity for producing large-scale maps and accelerating their updating process.[189]

The main step in updating maps is the stage of change detection. A set of methods for detecting changes In order to update the data structure, can be divided into two general different levels:

First level: Analyzing the new image of the region and the old map (image to map)

Second level: New image analysis of the area and the image and the old map (image to image)

In order to identify the changes, a differential-based algorithm based on a feature vector pixel image , is designed to identify building changes, removes the extra pixels and the changes identified by the algorithm, than the actual changes that they were made is evaluated using an error matrix and its results are the most commonly used and produced accuracy are presented.

Due to the precision of the geometric data obtained from GeoEye1 images, we can consequence that these images in terms of planes and elevations are theoretically workable for 1:2000 urban maps

According to the results obtained to identify the changes using the GeoEye1 sensor pair, the proposed algorithm in low density areas has the necessary efficiency, and also in areas with a high density, we can introduce the areas with no change with high accuracy to operator (Fig. 1).

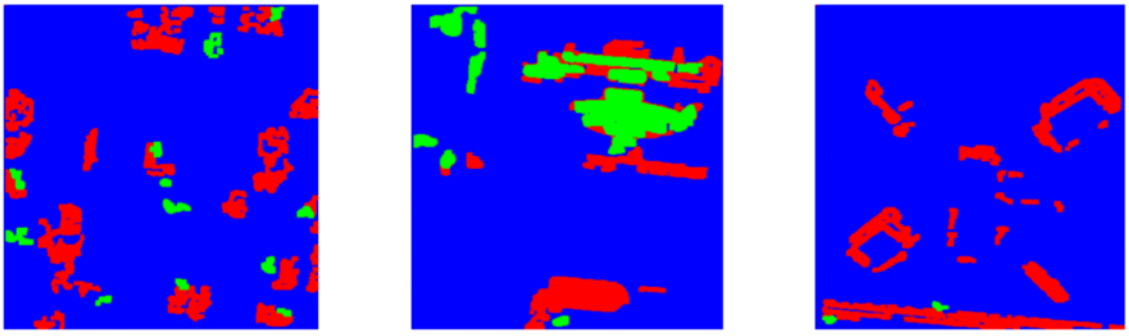

Figure1.The output image of applying the field condition filters to the results of the algorithm

(red and green land changes in a blue base ground)

3.3. Use of spatial-Spectral changes Indicators and Remote Sensing Data

The purpose of this method is to identify changes using Landsat 5 images through the comparison method after classification by considering the spatial- Spectral changes Indicators. [310]

Pixel based methods for identifying changes include algebraic, transitive, classification-based methods, directly comparing multi-time, phase and combined methods. Algebraic methods include visual difference methods, image regression, Image ratios, image vector analysis, and background subtraction, that all of these algorithms have a feature, and that is selecting the threshold for defining area changes.

Two issues in these methods are important criteria. One of these criteria is the selection of suitable video bands and the other is selecting suitable threshold for defining the areas of change. Among the methods based on classification, the comparison after the classification is very practical method [1911]. For example the new tools for identifying changes are classification-based phase methods.

In the proposed multi-time method, images of remote sensing were pre-processed and then spatial spectral change indices were extracted by three-dimensional wavelet analysis. In the next step, the

extracted indices and spectral properties were entered to Fuzzy-C Clustering method till four classes of study area, namely urban, arid land, road and plants cover were extracted. [2012]

In this study, the phase clustering output was used to extract educational data. Using educational extracted data and the maximum classification method are similar to the classes of use in the study area with a higher accuracy than phase clustering method that was extracted.

After classification of the maximum similarity of images, urban growth was identified by comparison method after classification and map changes in urban area were achieved. The resulting changes map with the classification of the maximum similarity and the indicators of changes the spatial spectral has a higher accuracy.

In this research 2 purposes were followed. In the first goal, accuracy of the results was dramatically increased when the function of indexes in classified spectral-locative changes was studied and a spectral-locative index was added.

In the second goal an observed classified method with an automatic solution to catch a didactic example was offered. The purpose was exploring the changes by the use of classified plans.

Results showed that the accuracy of utmost method in FCM by all data was purely practical than clustered method in FCM. Besides, a mechanical method was extracted in order to be compared with the clustered method. [2113]

3.4. Illumination of changes by the use of LCM

LCM (the model maker of earth) which is totally unified with EDRISI plan can be a tool to manage and plan the support for decision making. This model maker lets the user analyze ground alteration as fast as possible. [414]

One of the favorable methods of designers to control the covering of the grounds is modeling. Once this modeling was done by some PRESEPTRON and some layers of fake nervation and the result was amazingly positive. [515]

By studying the results of observed alteration, it can be said that the most growth in ground covering is related to urban areas and the most decline is related to arid places. According to the result of this practical research, horizontal transmittal is pushing cities into unstable situation due to its inappropriate economic and environmental condition.

3.5. Chained model of MARKOF

It must be said that, by the use of MARKOF we can predict the scale of abused grounds in the future. [616]

Therefore the only purpose of this research is investigating the process of alteration related to taken grounds in the past and future. By the prediction of the rate of utilization we can estimate the expansion and destruction of places and lead them to the appropriate spot.

Pictures are classified to 4 groups including pasturage, dry farm, residential area and farms. Prediction by MARKOF method is of great importance due to its eagle eyed view in order to manage the resources. This method of using the maps shows the most sensitive places to the groups in charge, in order to excel better planning and managing. This kind of models should be used for short term (5-10 years) plans because these models are fixed but the ground itself is changing all around the clock.

3.6. Observation upon the alteration by the use of satellite pictures and GIS

Urban area alteration is examined by the combination of satellite pictures, geographical information GIS and different vista including two methods below mentioned.

Classifying ground based on evaluation from a long distance and analyzing the alteration of it based on GIS.[2417]

Specifically, the ground analyzing is a combined and classified method along with GIS which is categorized by LANDSAT satellite pictures™. Finally the photos show a variety of changes on surface of metropolises.

Geographical data system provides a resilient space to penetrate, analyze and discern the expansion and alteration of a station. On the other hand, the combination of GIS and deliberation from a long distance can cause a better topography in urban areas.

For instance, the environs of clustered method have changed to spatial pattern.

Evaluation from a long distance provides a general lookout from the huge places coming back and harmonized with geographical technic.

The purpose of this research was to understand the view, the features of sensor and elicited technics. Some technics were used to assure the accurate classification of ground and covering the data. Based on radiometric, The LANDSAT ™ was used in order to decrease the climate changes to the respond of time spectral(Fig. 2).

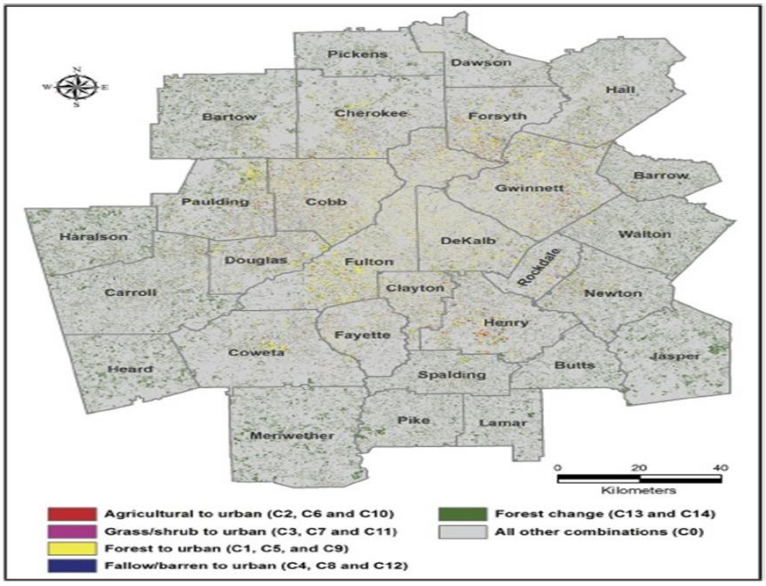

Figure2. A sample map, Land use/cover conversion for the 29 countries in the atlanta Atlanta metropolitan area during the period 2000-2010

3.7. Discernment of changes by the use of multipurpose satellite pictures

In most studies, changing the cover of ground has used LANDSAT™ as the only long term digital archive with an enough compatible clarification.

Acquiring accurate data in huge urban areas by the use of LANDSAT™ is quite hard. Requesting spatial high resolution data and process of important factures is necessary. Nevertheless, using the

multimedia data may result in more understandable and reliable information and also may provide an accurate potential about alteration of ground cover by different unification.[2518]

In this study a multi method plan including, analyzed PCA, 5-SPOT, LANDSAT-7 and panchromatic topography data is used. This act caused empowering and classifying way to diagnose the analysis of ground changes.

This combined method extracted from PCA, is provided with information about direction, nature, rate and place of the ground in order to fasten the industrialization.

PCA method showed a better function rather than the previous one. Nevertheless, there is bafflement in using the ground changes. Although the scale of changes was high, accuracy was for different classes. All in all, the result can be satisfying. Variance of time and spectral difference in separation of sensors caused a flaw in function of grounds and ended up to a mistake. An appropriate method can reduce imitation and increase accuracy at the same time. (Fig. 3).

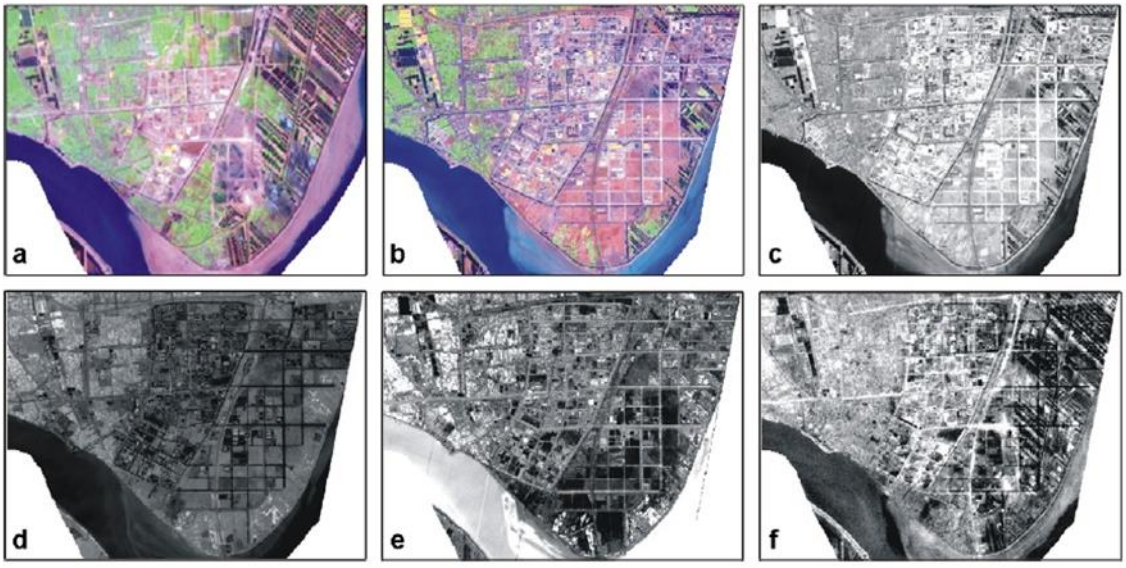

Figure3. Principal component analysis (PCA) of the stacked multi-sensor images: color composition image of Landsat-7 enhanced thematic mapper (ETM) in 2001 (a); color composition image of SPOT (systeme pour l'observationobservation de la terre or earth observation satellite)-5 in 2003 (b); and the first four components of the compressed PCA image (c–f).

3.8. Incorporation of related analysis and pixel base stuff by photic data in urban area

In recent years, analyzing important urban impositions such as buildings and trees from satellite pictures have caught researchers' attention.[719]

Classified and analyzed methods used in urban areas are struggling different and complex problems including detection of buildings and small trees, inappropriate border of trees, some roves overwhelmed with grass and imprisoned buildings by trees in shadow.[2220]

To progress the mentioned problems in previous part, a normal numeral model was offered. [2321]

In second part geometric, spectral, papilla and combined features by a SVM-GA are chosen. Among the mentioned features, the spectral one plays an important role in finding trees in shadow and blind spots.

In third part, a mechanical support through related analysis and pixel base stuff by the use of SVM-GA is functioned to analyze the urban imposition such as trees and buildings.

In forth part, the result of both classified levels is improved.

In fifth part, according to power of each level in analyzing the imposition, the focus was on the improvement of border of buildings and small trees.

The results show that combining two levels of object-oriented classification and base pixel improves identification results, especially in identifying small and low-rise buildings and trees.[23]

3.9. Disclosure of features in urban area changes by the use of optimized algorithm genetic

Despite of the all useful information in high qualified satellite pictures, sometimes using this information will not be enough due to increase in different copies and it will require modern methods which one of them is using the data related location in pictures.

Diversity and manifold features are needed in order to reach an optimized attribute.

In order to access the optimized features and finding an optimized parameter at the same time, crowd genetic particles are used. Also according to weakness of this method in disclosure of one class through bad condition of radiometric a two class version of changes revelation is used.[822]

In this method in addition to spectral feature, an extracted endobiotic attribute is used which has a high separation power in binary plans.

Accuracy of this method is coming from the excellence of crowd algorithm particles to access the binary plans.

3.10. Combination of distance and similarity-method in order to reveal the changes in grounds by over spectral pictures

This method is gradual and based on similarity and distance as well, which is presented in two levels including 1: revelation and 2: decision making.[923]

In the first level, the data gathered from the distance and similarity is put to a modern algorithm called similarity space. [2624]In this space the changed places are highlighted. Then the data sweeps to the second level where it is a binary place and changed places are shown with 1 and unchanged places are shown with 0. [2725]

The most important feature of these methods rather than previous ones are that: they are automatic, simplex, low volume in calculating and well accurate. To measure the function and accuracy of the presented method a set of HIPRON beyond spectral methods are used.

Evaluation of the output demonstrates that it gets the advantage of high accuracy and low warning alarm in comparison to revelation methods.

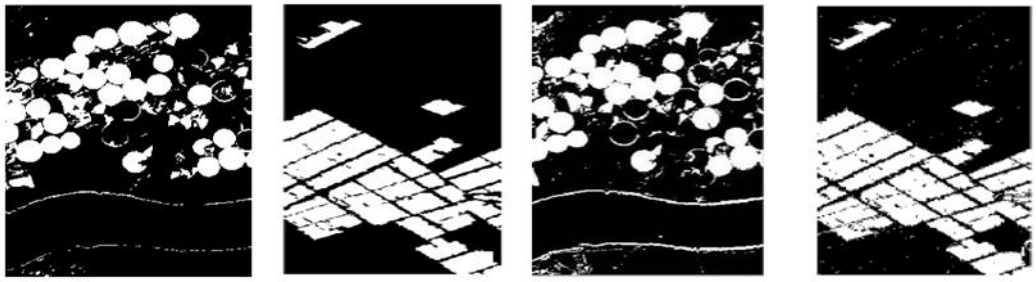

Figure4.Comparison of proposed method (right image) with ground reality (left image)

4. Conclusion

In this essay different methods of changes in urban grounds by the evaluation from distance were presented.
All of the mentioned methods include weakness and strength point and should be used based on the needs. The methods can recognize changes in urban regions by the satellite data and help in decision making and managing the urbiculture issues.
To represent the summery of strength points to each method, the below selection switches can be mentioned:
In automatic method the exploration of multi spectral photos use all data of class separation.
In the method of comparison, by comparing photos we can say which places have not changed and we can reduce the percentage of errors as well.
Utilizing the distance-spectral scales from a long distance proves its function.
Revelation of alteration by LCM and MARKOF methods which are prepared for future plans can help designers and managers decide well.
Observing the changes by satellite pictures and GIS can result in a ubiquitous up dating. Also GIS can save and evaluate data which without it almost all the process is impossible.
Recognizing the changes by the use of satellite multi-functional pictures can solve the problems of mono lateral pictures.
By and large, in combined methods, surely all procedures improve and illustrate better output with a high accuracy and promotes the pictures as well.

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