

PAPER • OPEN ACCESS

Change detection in city of Hilla during period of 2007-2015 using Remote Sensing Techniques

To cite this article: Z M Kadhum *et al* 2020 *IOP Conf. Ser.: Mater. Sci. Eng.* **737** 012228

View the [article online](#) for updates and enhancements.

Change detection in city of Hilla during period of 2007-2015 using Remote Sensing Techniques

Z M Kadhum ¹, B S. Jasim ¹ and M K. Obaid ¹

¹ Babylon Technical Insitute, Al-Furat Al-Awsat Technical University, Babylon, Iraq

Email: inb.bsh12@atu.edu.iq

Abstract. This study was carried out in order to identify and map the temporal changes in the land covers in Hilla province using Remote Sensing and GIS. Two images were used of land sate taken in Quick Bird Satellite acquired for the ETM sensor taken on 15 April 2015 and 15 April 2007 with spatial accuracy (0.6 m). These were used as reference sources in the selection of some classification samples after matching them with the Landsat 8 above. In this research using topography maps of the study area (Hilla) with scale 1/10000 generated from the General Authority as a reference data and achieved compatibility with the image of space after it was corrected geometrically 1976, 2000 and 2014. In this research using Geographic Information System (GIS) software with projection images WGS84 process (based on the projection of the global map and the global geodetic system) and within the 38th north. Supervised classification was used to identify land cover classes dominated in the study area. Change detection results showed an increase in the urban areas, in the year 2015 the area had become 1380.350-hectare unit, while in the year 2007 the area was 318.562-hectare unit. Similarly, the vegetation had increased between 2007-2015 from (132.531 to 507.296) hectare unit. Results indicated that urban land and salinization process can be considered as the important phenomena which positively affected the agriculture area. So, the increase in the cover of water is an important reason of decrease in the arid land, which was due to the increase of urban land reach to 1061.788-hectare unit. Many changes have happened in the quantity of reclaimed land in these arid lands between the two years (2007 and 2015).

1. Introduction

Change detection involves the application of multi-temporal datasets to quantitatively analyze the temporal effects of the phenomenon. Monitoring of agricultural crop conditions and estimating potential crop yields are important processes for operational programs. Assessment of particularly decreased production caused by a natural disaster, such as drought or pest infestation can be critical for countries or locales where the economy is dependent on the crop harvest [1,4]. To estimate land-cover classification areas with suitable accuracy from raw satellite images is a very complicated process without spatial and geographic georeferencing. So, the purpose of this study requires firstly geometric correction using control points. Generally, the area can be delineated and determined through the GIS software (such as R2V, Global Mapper, and ArcGIS) and survey tools (such as planometer). These methods perform after the process of digitizing (raster to vector conversion) through either the GIS software or through hand numbering as in the planometer. Based on these methods, the area is calculated with a varying accuracy when applied on the raw satellite image due to lack of spatial georeferencing



Content from this work may be used under the terms of the [Creative Commons Attribution 3.0 licence](https://creativecommons.org/licenses/by/3.0/). Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

and geometrical correction processes as we have previously mentioned. Also, in the previous methods, the process of determining a repetition state of the similar item (class) appearance in overall satellite image required the visual identification of each part of a single class distributed in the image, then the area of the total parts of the single class are collected to be the area of the required class. Monitoring plant coverings from space, estimating their area or classification and conducting inventories are important for many activities related to the identification of land uses in the management of natural resources and in efficient reforestation of forests, as well as in studies to combat desertification and the encroachment of cities on green areas.

Satellite images have become effective tools or methods for many practical and scientific studies for its comprehensive vision of manifestations of the Earth's surface. It can be used to show locations, distances, patterns, clusters and display geographic relationships, in addition to the possibility of extracting a lot of information through the geographical information system software and the digital image processing techniques.

2. Theoretical Background

Digital classification of a given dataset means the division of these data according to the degree of closeness and similarity in the satellite images. Each pixel in the image can be represented by vector pattern, therefore, each element of this pattern defines the surface reflectivity with a different spectral band for the operating sensors, which have been used to acquire the image features. Hence, the surface reflectivity is usually called a spectral signature. Therefore, image classification, of the remote sensing dataset in its private means refers to dividing the vector patterns into classes depending on the degree of similarity or difference in the spectral signatures of the surface land cover. There are two main types of classification: supervised and unsupervised classification [9,10]. The supervised classification was adopted in the current study for isolating the class, which required calculating its area. This classification type required to identify or represent sampling of the pattern of class or landform that is called training areas, which is a guide for the classification of spectral characteristics of each class.

3. Materials and Methods

3.1 Data and software used

In this search using ArcGIS 10.4 software and ERDAS IMAGINE9.3 for digital image processing, these processes include import, geometric correction and spectral enhancement, image classification and map production of maps (cartographic output), Using the following data:

- The Quick Bird satellite acquired for the ETM sensor for spectral bands (1-7) is accurately observed with spatial accuracy (0.6 m) taken on 15 April 2015.
- The Quick Bird satellite acquired for the ETM sensor for spectral bands (1-7) is accurately observed with spatial accuracy (0.6 m) taken on 15 April 2007, which are used as reference sources in the selection of some classification samples after matching them with The Quick Bird above.
- The topography maps of the study area (Hilla) with scale 1/10000 issued by the General Authority for Survey was used as reference sources and achieved compatibility with the image of space.

3.2 Study Area

The study area is located in (Babil Governorate), located around the city of Hilla. 100 km south of the city Baghdad between, (440246.095 E, 3599988.308 N), to (445919.806 E, 3603738.728 N) by unit meter, covering an area of about 2133.82 by unit hectare, Figure (1).

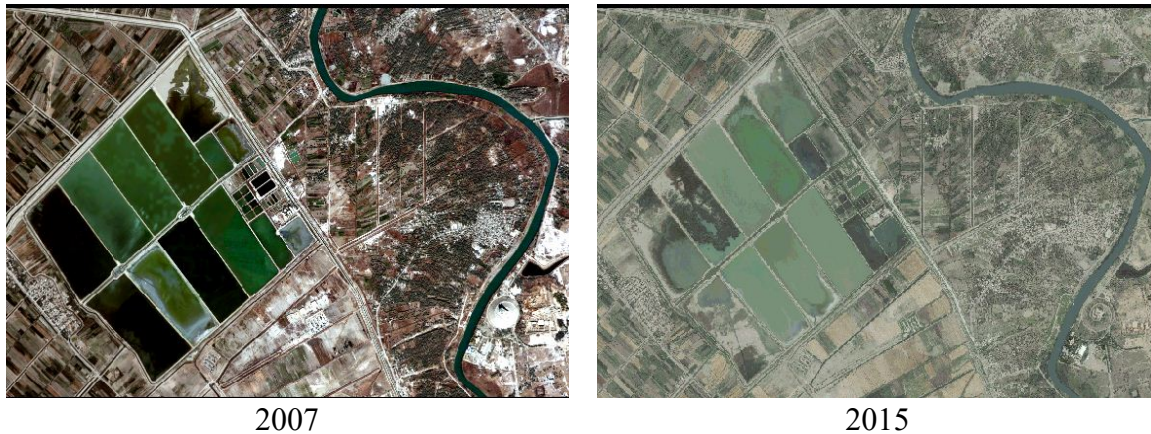


Figure 1. The original of Hilla province images in (2007- 2015) period.

4. Methodology

The objective of this study is to find change detection for seven categories including Water, Small Vegetation, Building, Barren, First street and Second street) using high resolution satellite images with resolution equal to (0.6m) (figure2) using the following steps:

- 1- Geometric correction for two Quick Bird satellite images at date (15 / 4 / 2015) and date (15 / 4 / 2007) using control points from The topography maps of the study area (Hilla) with scale 1/10000
- 2- Classification of the Quick Bird satellite image at date (15 / 4 / 2007) using Erdas program.
- 3- Classification of the Quick Bird satellite image at date (15 / 4 / 2015) using Erdas program.
- 4- Conversion of the two classified images from raster to vector using ArcGIS program.
- 5- Calculation of areas for categories of the classified images.
- 6- Finding change detection between two Quick Bird satellite images.
- 7- Statistical analysis for the results of change detections using Excel program

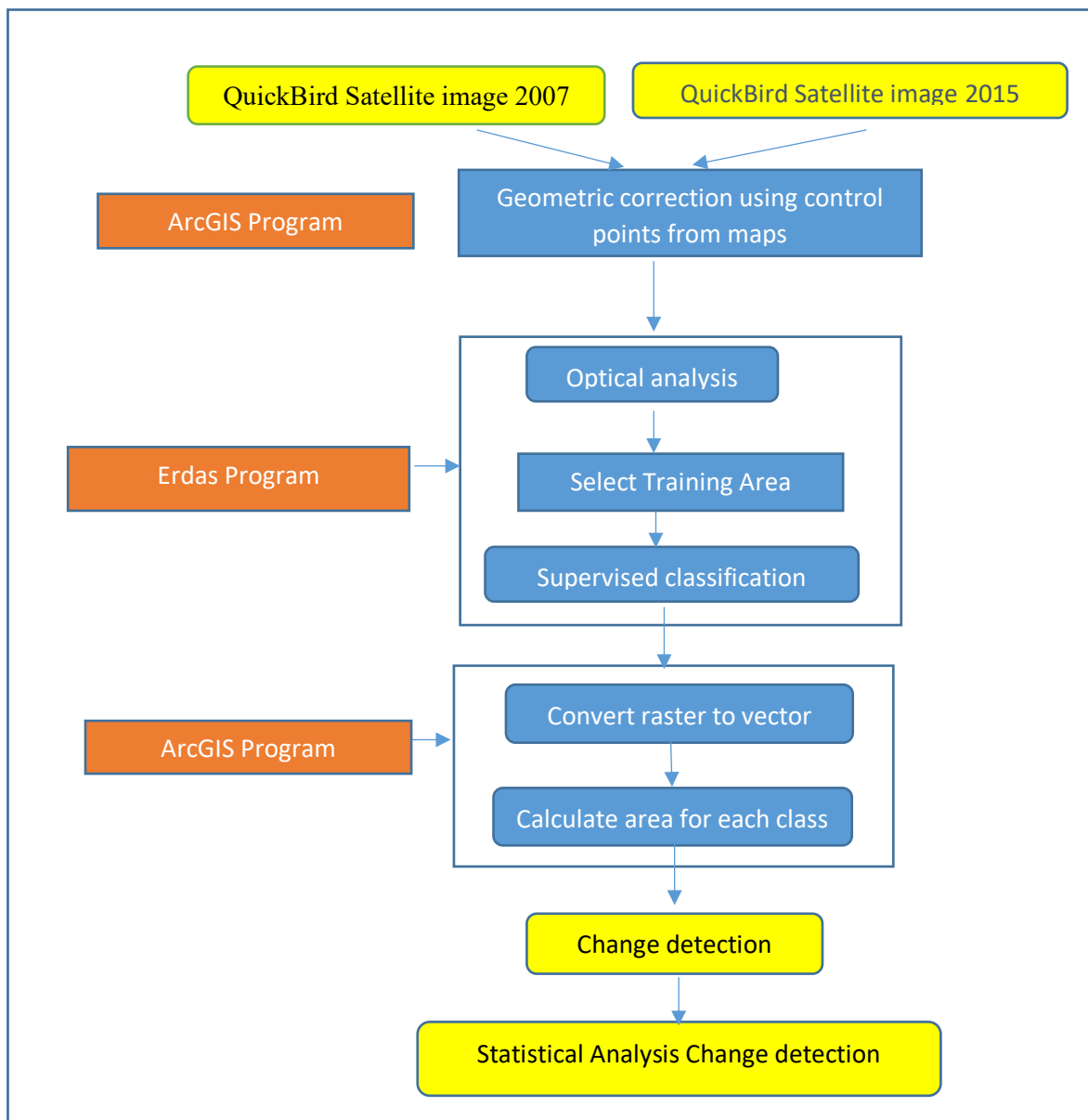


Figure 2. Change Detection Methodology

5. Image Classification

Image classification is the process by which individual elements' image pixels are grouped depending on the similarity between these items and the specifications of the group. Digital image classification techniques generally can be classified into two types, viz. supervised and unsupervised classification. In this research 'supervised' technique based on 'maximum likelihood' have been adopted to classify the image, where each image represents a specified period of the Hilla age. These have been classified into seven classes; urban, vegetal, water, barren and soil (red, green, blue, yellow, and cyan respectively). 'Maximum likelihood' method considers both the variances and covariances of the class signatures when assigning each cell to one of the classes represented in the signature file. With the assumption that the distribution of a class sample is normal, a class can be characterized by the mean vector and the covariance matrix, the results of the applied classification techniques can be shown in figure (3). Spectral

signatures are a set of spectral signatures and each fingerprint corresponds to a particular class. Certain laws are used to identify pixels in the visual space. The statistical distribution of classes using ‘maximum likelihood’ classifier through (2005-2015) years is shown in figure (4). The footprint is used in the vector classification process and each guided classification process requires spectral fingerprinting, which is stored as a sig file and then the vector classification process regions of interest for each object of the studied area have been selected to provide the classes of each image. Supervised classification is the process often used in remote sensing for quantitative analysis. It is based on use of appropriate algorithms for naming each image pixel as representing specific ground cover classes.

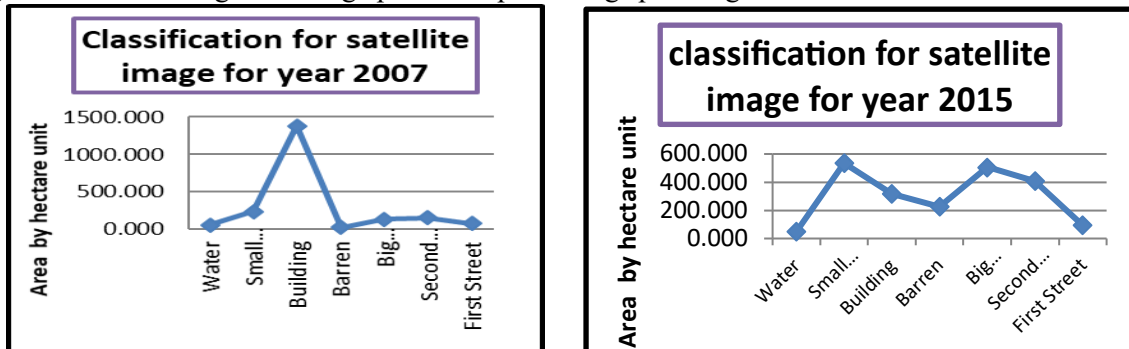


Figure 3. The statistical distribution of classes using maximum likelihood classifier through two years.

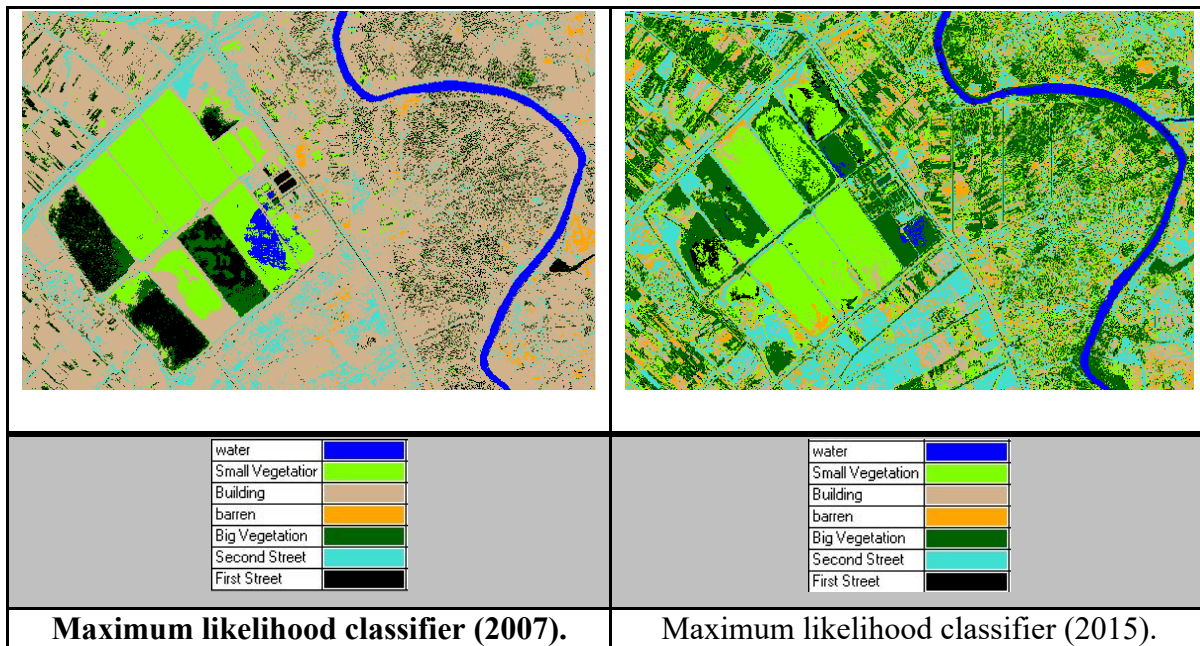


Figure 4. The classified image using maximum likelihood classifier and support vector machine classifier.

6. Results and Discussion

Remote sensing is an effective tool in determining the type and area floor coverings prevailing in the school district. Change detection is a technology ascertaining the changes in land use and land cover features within a certain time interval. It provides the spatial distribution and information of features changes. Many monitoring techniques are used to detect the vegetal cover of the studied area. Supervised classification as shown in figure (5) has been applied and the results show an increase in the vegetation region in 2015 compared with the past years (2007), and also in the total area for adopted classes through

two years is shown in tables (1) & (2) respectively. This research studied the vegetal cover of Hilla province using different remote sensing methods. Difference between classifications for satellite image year 2007 and satellite image year 2015 is shown in Table (3). This increase indicates the interest of people in the cultivation of barren lands and increase in the water share of the province. Change detection is considered to be a very important stage of this research and gives very reliable results to find and detect the vegetal region.

Table 1. Classification for satellite image for the year 2015.

Class Name	Area by hectare unit	Histogram	Red	Green	Blue	Opacity
Water	58.150	1615279	0	0	1	1
Small Vegetation	535.188	6518046	0.5	1	0	1
Building	1380.350	38343063	0.82	0.7	0.55	1
Barren	23.953	665364	1	0.65	0	1
Big Vegetation	132.531	3681409	0	0.39	0	1
Second Street	150.221	4172802	0.25	0.88	0.82	1
First Street	77.185	2144039	0	0	0	1

Table 2. Classification for satellite image for the year 2007.

Class Name	area by hectare unit	Histogram	Red	Green	Blue	Opacity
Water	49.076	482797	0	0	1	1
Small Vegetation	234.650	5265055	0.5	1	0	1
Building	318.562	3133941	0.82	0.7	0.55	1
Barren	225.907	2222419	1	0.65	0	1
Big Vegetation	507.296	4990661	0	0.39	0	1
Second Street	409.365	4027242	0.25	0.88	0.82	1
First Street	95.884	943284	0	0	0	1

Table 3. Difference between classifications for satellite image for the years 2007 and 2015

Class Name	Area satellite image year 2007 by hectare unit	Area satellite image year 2015	Difference by hectare unit
------------	--	--------------------------------	----------------------------

	by hectare unit		
Water	49.076	58.150	-9.074
Small Vegetation	234.650	535.188	300.538
Building	1380.350	318.562	-1061.788
Barren	23.953	225.907	201.954
Big Vegetation	132.531	507.296	374.765
Second Street	150.221	409.365	259.144
First Street	77.185	95.884	18.698

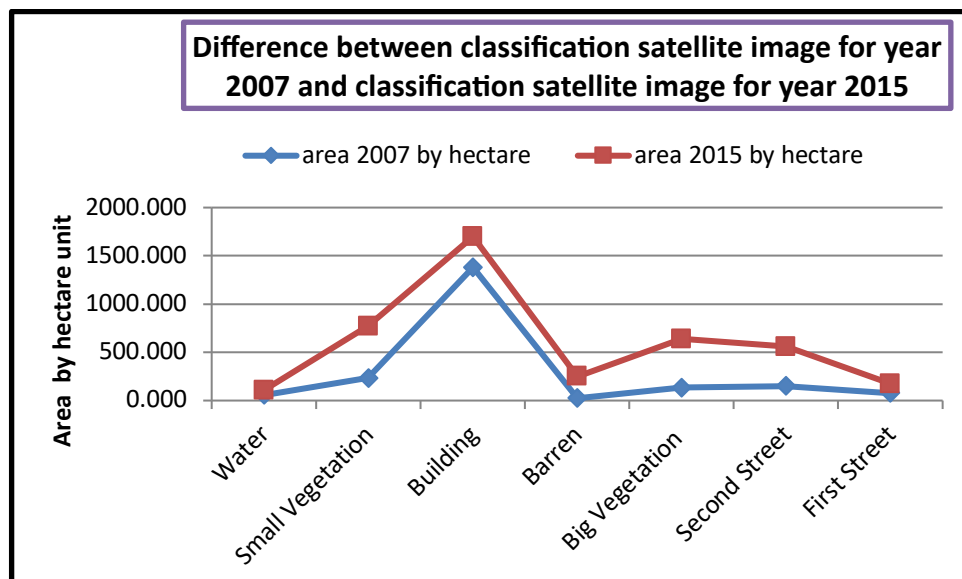


Figure 5. The statistical difference distribution of classes between classifications for satellite image year 2007 and Satellite image year 2015

7. Conclusion

- 1- The results of these techniques coincide with the results of supervised classification about the increase of vegetation region from 2007 to 2015 and the difference in statistical distribution of this region can be shown in table (3) & figure (4), respectively.
- 2- The study recommends the adoption of remote sensing techniques and geographic information systems for their efficiency in monitoring the environment at high speed and accuracy and the lowest costs in relation to the traditional methods.

It is very necessary to encourage tree planting campaigns around the city to combat desertification and establish green spaces.

References

- [1] Setiawan Y and Yoshino K 2102 Change detection in land-use and land-cover dynamics at a regional scale from modis time-Series Imagery. *ISPRS Ann. Photogramm. Remote Sens. Spat. Inf. Sci.*, **1**(7) pp 243–248
- [2] Jasim B S, Al-Bayati Z M K and Obaid M K 2018 Accuracy of Horizontal Coordinates of Cadastral Maps After Geographic Regression and Their Modernization Using GIS Techniques *International Journal of Civil Engineering and Technology (IJCIET)*, pp 1395–1403
- [3] Kumar M 2008 *Digital Image Processing, Photogrammetry and Remote Sensing Division* (Indian Institute of Remote Sensing), Dehra Dun, pp 81-108
- [4] Jabalpur M 2112 Vegetation detection in multispectral remote sensing images: protective role analysis of vegetation in 2004 Indian Ocean. *PDPM Indian Inst. Inf. Technol. Des. Manuf. Jabalpur*, pp. 3–7
- [5] Lilles, T M and Kiefer R W 2000 *Remote Sensing and Image Interpretation* (New York), 2nd Ed. John Wiley and Sons Inco pp 721
- [6] Jensen, J R 2005 *Introductory Digital Image Processing* (Parson Education), Inc. p 526
- [7] Dibiase D 2004 Lesson8: Remotely Sensed Image Data (Copy Right by Pennsylvania State University).
- [8] Zhang X, George B P, Eve H and Lihong Z 2008 *Integrating GIS and Remote Sensing with Urban Hydrology* (Advanced Resource Technology Group School of renewable natural resources, University of Arizona).
- [9] Parsons M, Thomas M and Norris R 2002 *Australian River Assessment System* (Aus Riv as physical Assessment protocol. Australian Government, Department of the environment and Heritagl. Report), p10
- [10] Mather P M 2004 *Computer Processing of Remotely Sensed Images* (An introduction, 3rd ed., Chichester, UK: John Wiley and sons), pp 241-242
- [11] Asner G P and Heidebrecht K B Spectral 2002 Un mixing of vegetation, soil and dry carbon cover in arid regions: comparing multispectral and hyper spectral observations *International Journal of Remote Sensing*
- [12] Bogaert P D 2002 *Estimating soil properties from thematic soil maps* (The Bayesian maximum entropy approach).
- [13] Lu L X and Cheng G 2003 *Landscape evolution in the middle Heithe river basin of north –west China during the last decade* *Journal of Arid environment*
- [14] ESRI documents 2004 *Environmental Systems Research Institute* (ESRI, Redlands, California, USA)
- [15] Huang L S 2012 *An assessment of support vector machines for land cover classification.*