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# Monitoring of the Changes in Water Rate for Al-Razaza Lake Using Remote Sensing Techniques

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**Abstract:** ***Monitoring of the changes is the process that helps in determining the changes associated with land use and land cover features with reference to geo-registered multi temporal satellite images, in this paper series of satellite images represent the same area (Razaza region) have been gathered from different sensors such asLandsat (TM 1985, TM 1995, and Landsat 8 OLI (Operational Land Imager) 2015. Preprocessing such as atmosphere correction and rectification has been done. Monitoring of the changes in water content inrazaz lake have been achieved using different remote sensing techniques like image classification and target detection where three methods of supervised clarification such as maximum likelihood, support vector machines (SVM) and spectral angular mapper (SAM) have been done as well as two techniques of target detection such as matching filter and ACE method were used to detect and compute the area of target feature.***

**Keywords:** image classification, target detection, SVM, SAM, matching filter

## 1. Introduction

Remote sensing technology is a very important tool in monitoring changes in land, water resources and plants . . . etc. The remote and inaccessible nature of several land-covers such as vegetation, forest, Sahara and sea regions limits the statistic of ground based and observing methods for vast land areas. Ongoing operations to monitor the land-cover and the land-use alter are increasingly dependent on information obtained from remotely sensed data. Thus such information provide data associated with other techniques to understand the Processes that occur due to increased water areas and water levels as well as desertification on each of the plant and livestock wealth, growing population and economy [1,2]. The mean target have been detected in this paper is water content of Al-Razaz region. In general; and from the averagereflectance curves as shown in figure (1), the spectral reflectance of the radiation incident upon water is not reflected but is either absorbed or transmitted. Longer visible wavelengths and near infrared radiation is absorbed more by water than by the visible wavelengths. Thus water looks blue or blue green due to stronger reflectance at these shorter wavelengths and darker if viewed at red or near infrared wavelengths. The factors that affect the variability in reflectance of a water body are depth of water, materials within water and surface roughness of water [3-5].The monitoring of the water body has been implemented using classification and change detection process. Where, Image Classification has the overall objective to automatically categorize all pixels in an image into classes or themes. The Spectral pattern or signature of surface materials belonging to a class or theme determines an assignment to a class. There are two types of classification supervised classification which have been adopted in this paper and unsupervised classification which can be defined as a means by which pixels in an image are specified to spectral classes without the employer having prior knowledge of the presence or names of those classes. While Change detection (monitoring changes in pixel value between images of a given location acquired at different times) considered of great importance in the monitoring of the earth's features.

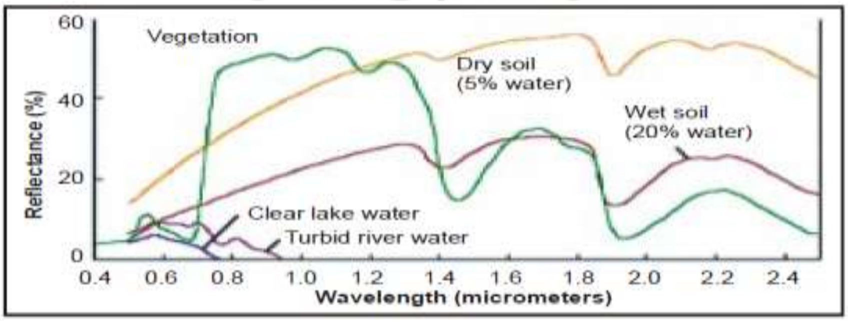



**Figure 1:** Spectral Reflectance curves for vegetation, soil and water [5]

## 2. Studied area and variable data

The main source which was adopted to obtain spectral bands of the studied area was the USGS Global Visualization Viewer of the Earth Resource. Karbala province \ razaza region is the studied areas which enclosed by Path / Row (or Lat 33No / Long 44.0Eo) the mean object of the studied area is water content of Razaza lake. This region has been captured using Landsat 4-5 Thematic Mapper (TM) for(1985 and 1995) period and Landsat 8 OLI (Operational Land Imager) sensor for 2015 period.For more information see figure (2).

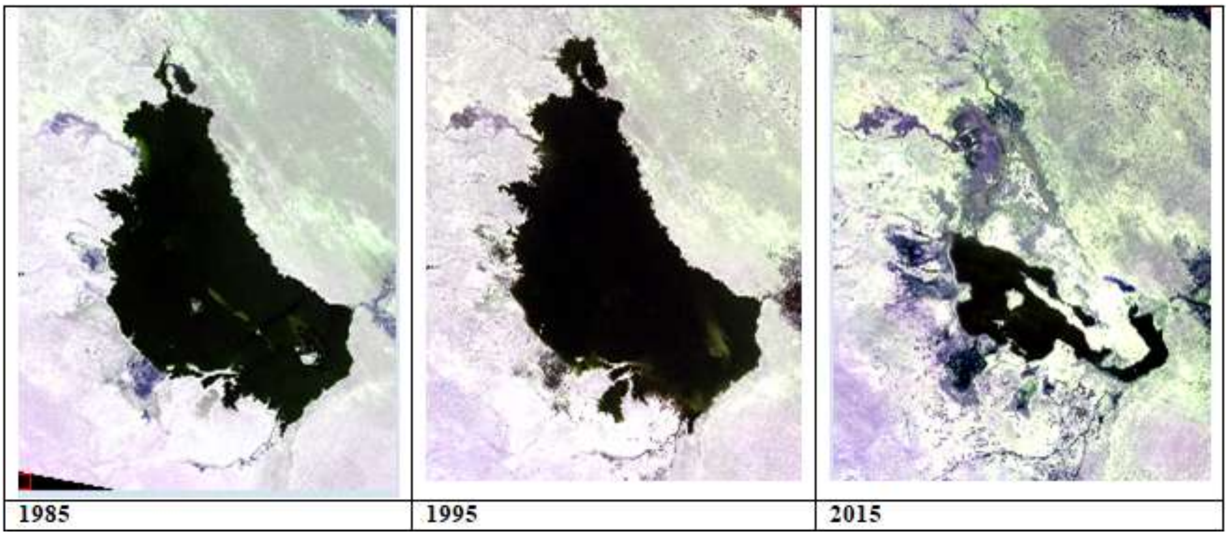


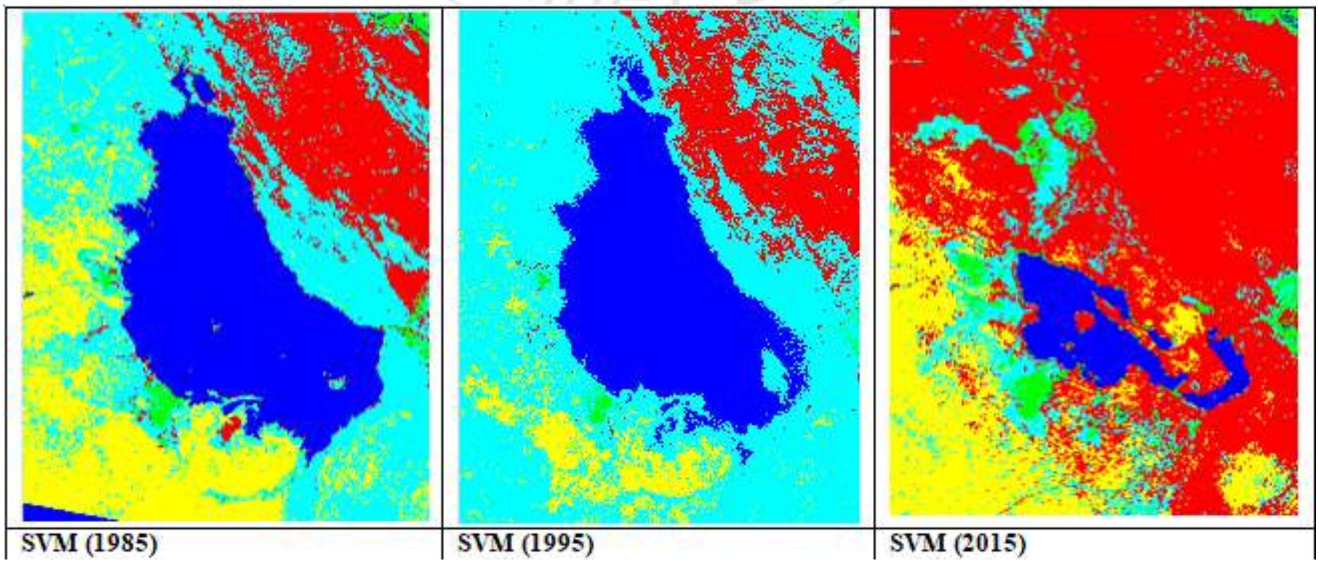

**Figure 2:** The original image of al-Razaza lack in different periods

## 3. Methodology

In general, remotely sensed images were gathered by a satellite or aircraft which represent the irregular surface of the Earth. Even images of seemingly flat area were distorted by both the curvature of the Earth surface and the sensor being used. In what follows, the mathematical operations concerning the geometrical correction and rectification must be done to remove theassociated distortion.This consider to be the first preprocessing after that image processing such as classification and change detection have been used. Where in this paper per-pixel supervised classifications which collect image pixels with the same or similar spectral reflectance features into the same information class [6]. In addition to using relevant land use and land cover areas, the classes must be select in carefully and defined to successfully classify remotely sensed data into land-cover (or land-use) information [7]. Three classification methods have been adopted in this research such as maximum likelihood,support vector machines (SVM) and spectral angular mapper (SAM) and five region of interest were selected to represent different features of the studied area like (vegetation, arid land, soil, water, urban). In this research the water class was the important region which has been adopted to show and detect the change in it for different period from 1985 to 2015 year.The results of applying classification methods were illustrated in figures (3&4) and the statistical properties of pixels distribution can be shown in table (1).

**Table 1:** The statistical properties of the classified image using support vector machines (SVM), spectral angular mapper (SAM ) and maximum likelihood classifier(MAX.)

| Water count | | | | |
|---|---|---|---|---|
| Methods | period | Npts | Total | percent |
| SVM | 1985 | 404473 | 716105 | 24.8593 |
| | 1995 | 1765744 | 3017311 | 27.1311 |
| | 2015 | 399395 | 4525971 | 6.1368 |
| SAM | 1985 | 48059 | 879407 | 2.9538 |
| | 1995 | 137404 | 333388 | 2.112 |
| | 2015 | 268191 | 4469522 | 4.1208 |
| Max. | 1985 | 388055 | 615540 | 23.8503 |
| | 1995 | 1459972 | 2341768 | 22.4328 |
| | 2015 | 272766 | 4105577 | 4.1911 |



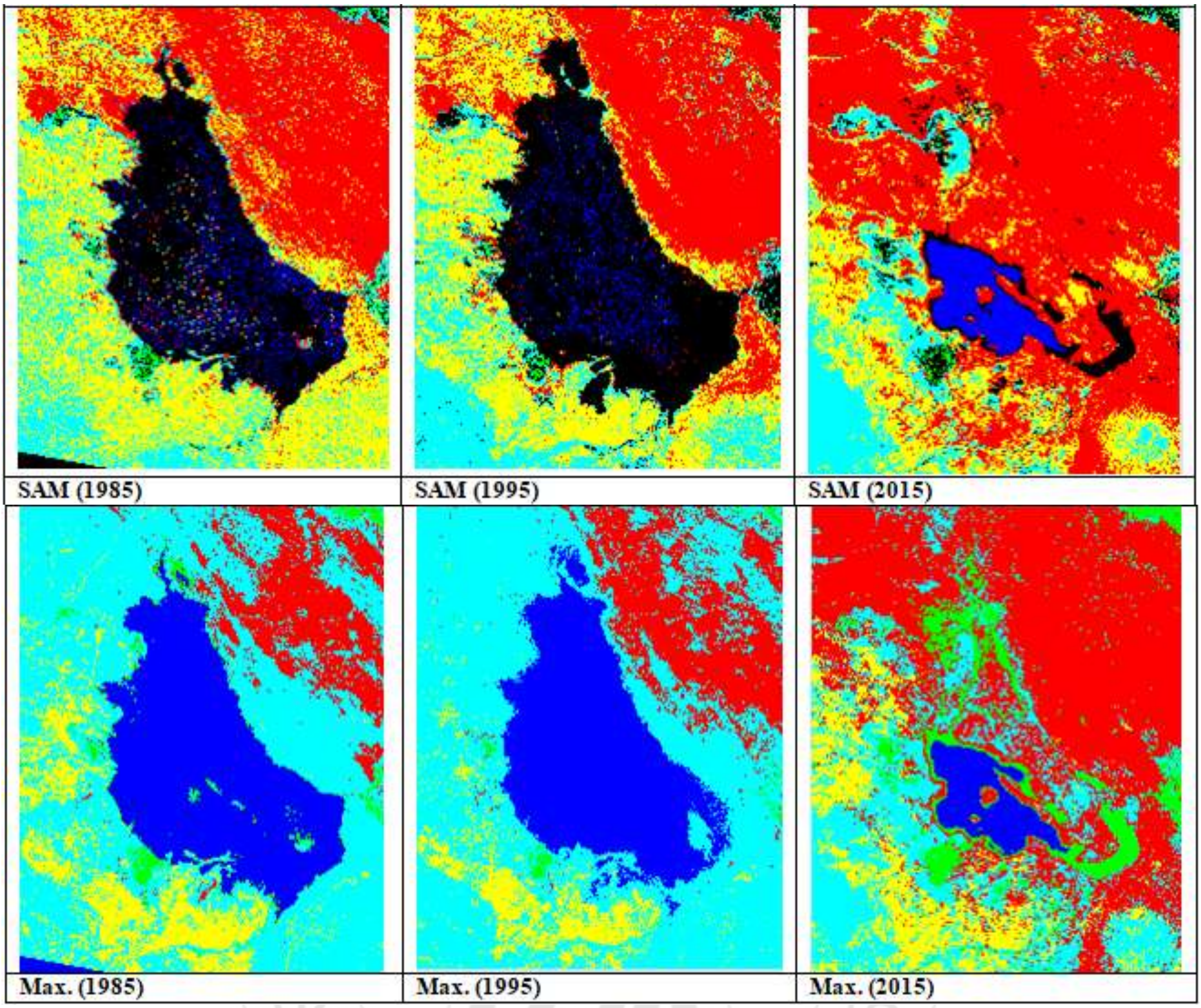
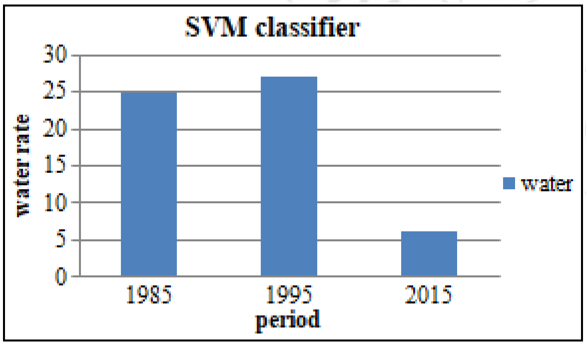
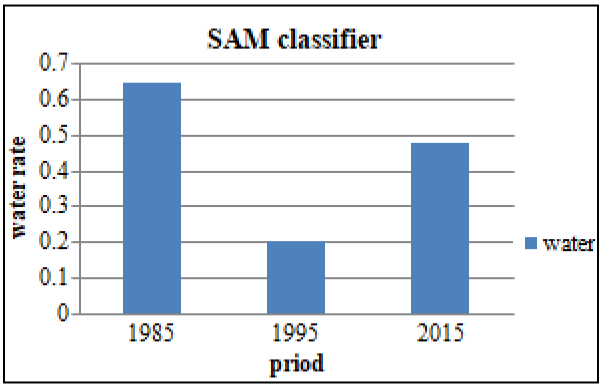



**Figure 3:** classification output using support vector machines (SVM), spectral angular mapper (SAM) and maximum likelihood classifier for different periods



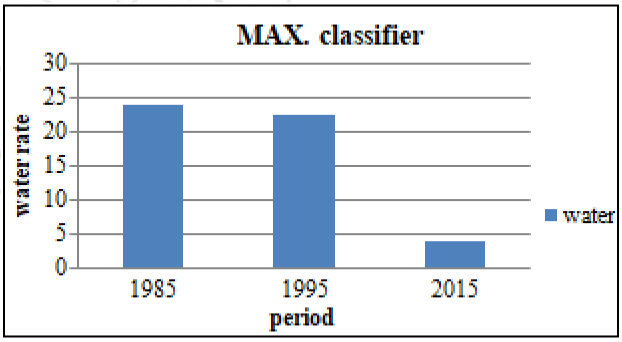




**Figure 4:** represent the statistical properties of water count in different period using different classification methods

### 3.1 Target Detection Using Matched Filtering (MF)

By this filter it is Finds the abundance of targets using a partial un-mixing algorithm. This technique maximizes the response of the known spectra and suppresses the response of the composite unknown background, therefore matching the known signature. It provides a rapid means of detecting specific materials based on matches to target spectra and does not require knowledge of all the end members within an image scene. A variety of matched filters have been developed which use the Mahalonobis (or statistical) distance between a known target spectrum and a scene pixel as the primary measure of target presence. This simple matrix multiplication can be expressed as equation (1). Scene pixel being tested (the test pixel), and superscript *T* denotes thematrix transpose, and a mean vector and a covariance matrix, and D is represented as a known spectrum of a target signature. Noting that thecovariance matrix is inverted, one notes that equation (1) is a spectral matched filter of a signal that divided by the statistical model of background. Thus, the detection statistic *T* may also be considered a measure of signal to background ratio (SBR) [8, 9].

$$T = (D-\mu)^t \sum^{-1} (X-\mu) \qquad (1)$$

the main step of perform this detection can be listed below:

**Step one**: input the oldest multi-band image such as Razaza (1985)
**Step two**: apply preprocessing such as correction and rectification process.
**Step three**: using region of interest to select the feature which has been detected such as water object.
**Step four**: convert the background to zero value.
**Step five**: apply Minimum Noise Fraction (MNF) transformation on the corrected image.
**Step six**: use matched filter (MF)) for target or object detection.
**Step seven**: apply clumbing filter with (3x3) window on final image.
**Step eight**: output result which have the target detection.
The results of applying target detection can be shown in figures (5) and the statistical properties of water detection can be shown in figure (6).

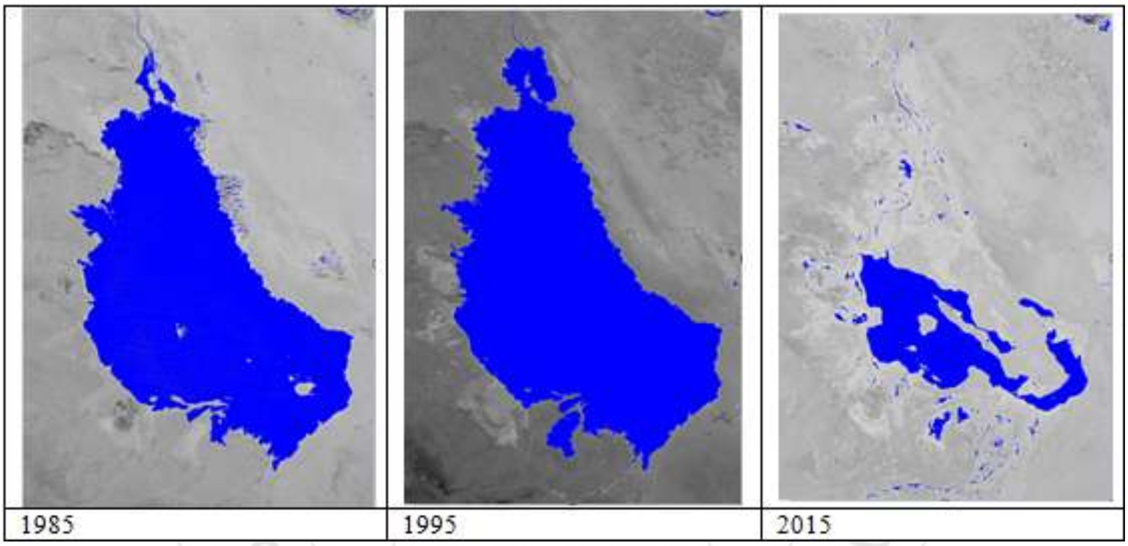


**Figure 5:** The results of applying matching filter to detecrt the water object for different periods.

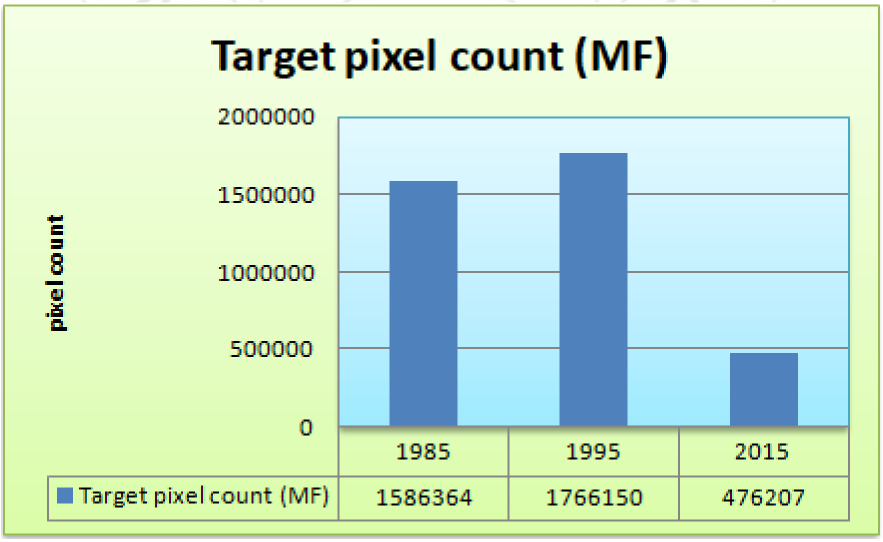


**Figure 6:** The statistical properties of pixel count of water object for different periods

## 4. Results Discussion

AL-RazazaLake has a great importance to the economy and tourism as well as it considersbeing alarge reservoir to collect the seasonal rainfall which contributes significantly to the development of agriculture through irrigation the arid land by water. So it is necessary to study and observe the changes that accompany this lake during sequential decades to note the change in the volume of water contained in order to develop appropriate solutions to address them. In this paper many methods of classification have been applied to reclassify the area into its features. Where the studied area consist of many regions such as vegetation, arid land, soil, water and urban. The important feature which has been adopted in this research is water feature the classification results show that the rate of water size was increase in simple rate in 1995 compared with 1985 while the rate of water decrease after that as its appear in 2015 as shown in table (1) and figures (3&4) respectively. The results of classification give another important notice that the support vector machines (SVM) and Maximum likelihood classifier gives good and right results compared with spectral angular mapper (SAM) as shown in figure (3). For monitoring the change of water size change detection using target detection by applying matching filter (MF) on original image give a good results and it can note that a big appropriate between the statistical properties of apply support vector machines (SVM) classification and matching filter(MF)detection compared with other classifications methods as shown in figure (4) and figure (6) respectively.the output conclusion from the results of this research is that the water rate in Razaza lake was decrease because of scarce rainfall and global warming to have led to a significant rise in temperatures in last decades as well as the country's politic circumstances that led to a lack of interest in this lake.

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