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SOUTH IRAQ MARSHES MONITORING USING SATELLITE IMAGES AND REMOTE SENSING APPLICATIONS

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Abstract

The marshes of Iraq are vital and rich in livestock such as fish and plants such as reeds and papyrus in addition to water resources. This research provides important study and monitoring of this vital and important area, It plays an important role to improve the economic, social, biodiversity status in the country. These marshes lie in a large bounded triangular region by three major southern cities: Nasiriyah to the west, Amarah to the northeast, and Basrah to the south. The study was done by collecting several Landsat satellite imageries, for different time periods such as the seventies (MSS- 1973) and the nineties (TM-1993) and the era of fifties Landsat 8 OLI (Operational Land Imager) (2015). A digital image classification method such as a minimum distance measurement was used. And Principle component analysis (PCA) transformation was employ to perform change detection by compute the first and second maximum variance of each band for each image and find the change between them.

Keywords: Marshes, Minimum Distance Classification, Change Detection, Principle Component Analysis (PCA).

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Introduction:

remote sensing technology is a very important tool in monitoring the changes in lands, water resources and plants . . . etc. [1,2]. The remote and inaccessible nature of several land-covers such as vegetation, forest, desert and sea regions limit 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 the obtained information from remotely sensed data. Thus such information provides associated data with other techniques to understand the processes that occur due to increase the areas and levels of water as well as desertification on each of the plant, livestock wealth, growing population and economy. Southern Iraq marshes [3] are very important region Because of the economic, environmental, cultural, tourist, and Agricultural, this region witness high land cover changes due to the human, natural conditions effect, and the past politic decisions; This study interests on detecting and monitoring the important land cover changes for four decades from 1973 to 2015 using different image processing and remote sensing techniques, it includes the change monitoring of all features of the marshes such as water content, vegetation and soil in addition to compute the rate of change for each object in different period. Image classification using different technique such minimum distance classifier, and change detection using principle component analysis are the most important methods have been adopted to achieve this research.

1. Studied Area

Southern Iraq marshes are the studied area which can be interested with it. These marshes covering an area about 10,500 km2 and supporting a diverse range of flora and fauna and a human population estimated to be as high as 500,000 persons, for more information see figure (1). Fresh
Water for the Marshes was supplied almost entirely from two major river systems: The Tigris and the Euphrates [3].

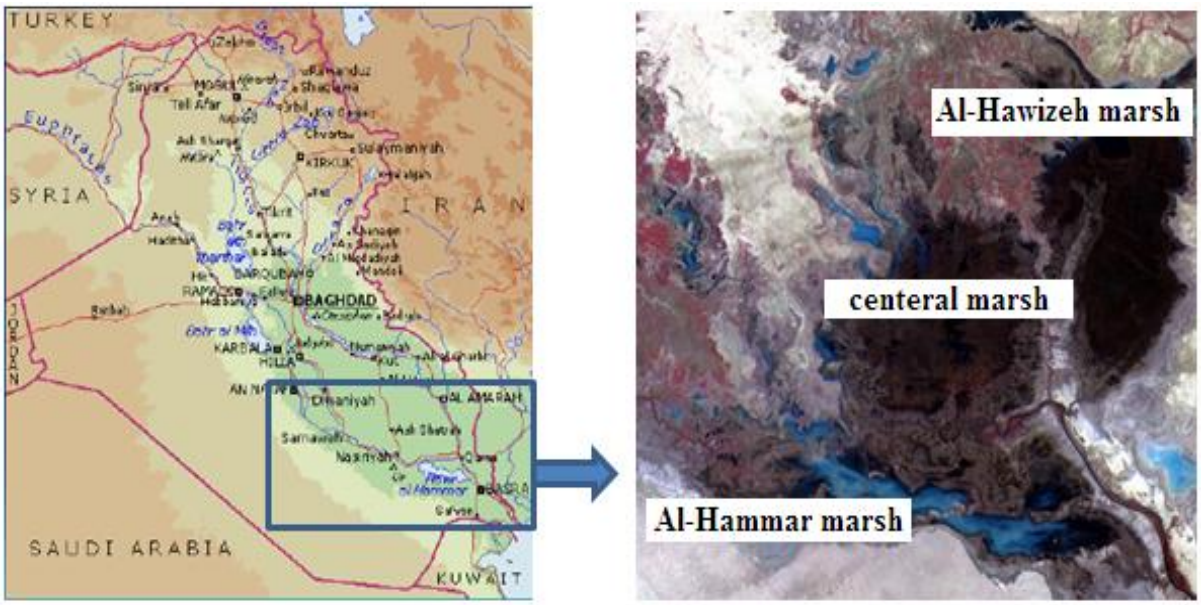

Figure (1) show the studied area.

1. Preprocessing

Digital image processing was manipulated by the software used. The scenes were selected to be geometrically corrected, calibrated, and removed from their dropouts. These data were stratified into ‘zones’, where land

cover types within a zone have similar spectral properties. General, remotely sensed images are gathered by a satellite or aircraft represent the irregular surface of the Earth. Even images of seemingly flat area are 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 the associated distortion. Another important step must have been applied on the original image of the studied area, where the studied area considers to be very large and cannot be captured it as one scene, but the studied area consists of four scene represent the major three important marshes in south of Iraq. Mosaic model [4,5] was one of the most important technique can be used to merge the four scene to obtain one image include the region of interest of the studied area, for more information studied area can be shown in figure (2). the mean steps of image mosaicking can be listed as follow:

Image Registration: given a set of N images {g1, g2, ..., gN} with a partial overlap between at least two images, compute an image to-image transformation that will map each image g2, ..., gN into the coordinate system of g1.

Image Warping: warp each image g2, ..., gN using the computed transformation using first order polynomial.

Image Interpolation: resample the warped image using nearest neighbor interpolation.

Image Compositing: blend images together to create a single image on the reference coordinate system using average overlapping pixels.

2. Image classification

Image classification is the processes by which individual items image pixels are grouped depend on the similarity between the item and the description of the group. Digital image classification techniques generally can be classified in two types supervised and unsupervised classification. In this research supervised based on minimum distance classifier [6-9]. Supervised classification of multispectral remote sensing imagery involves the use of a training dataset consisting of labeled pixels' representative of each land cover category of interest in an image. The choice of training areas that adequately represent the spectral characteristics of each category is very important for supervised classification. Finding and verifying training areas can be laborious, since the analyst must select representative pixels for each of the classes by visual examination of the image and by information extraction from additional sources such as ground reference data (ground truth), aerial photos, or existing maps [10]. A supervised approach is preferred by most researchers because it generally gives more accurate class definitions and higher accuracy than do unsupervised approaches [11]. Regardless of the specific method chosen, the fundamental practical procedures commonly include [12]:

1. Select and decide the group of land covers types into which the image is to be divided. These are the information classes and could, for instance, be water, urban regions, croplands, rangelands, etc.
2. Choose prototype or representative pixels from each of the required group of classes. These pixels are said to be region of interest (ROI) or training data. Training sets for each class can be decided through visits the sites of interest, air photographs, maps, or even photo interpretation through viewing a color composite product created from the image data.
   Often times the (ROI) of training pixels for a given class located in a mutual regions surrounded by a border.
3. Use the training data to estimate the parameters of the particular classifier algorithm to be used; these parameters will be the properties of the probability model used or will be questions that define partitions in the multispectral space.
4. Using the trained classifier, naming or classify every pixel in the image into one of the desirable ground cover kinds (information classes). Here the entire image segment of interest is commonly classified.
5. Produce tabular summaries or thematic (class) maps which summarize the results of the classification.
6. Assess the accuracy of the final product using a labeled testing data set. In practice it might be necessary to decide, on the basis of the results obtained at Step 6, to refine the training process in order to improve classification accuracy.

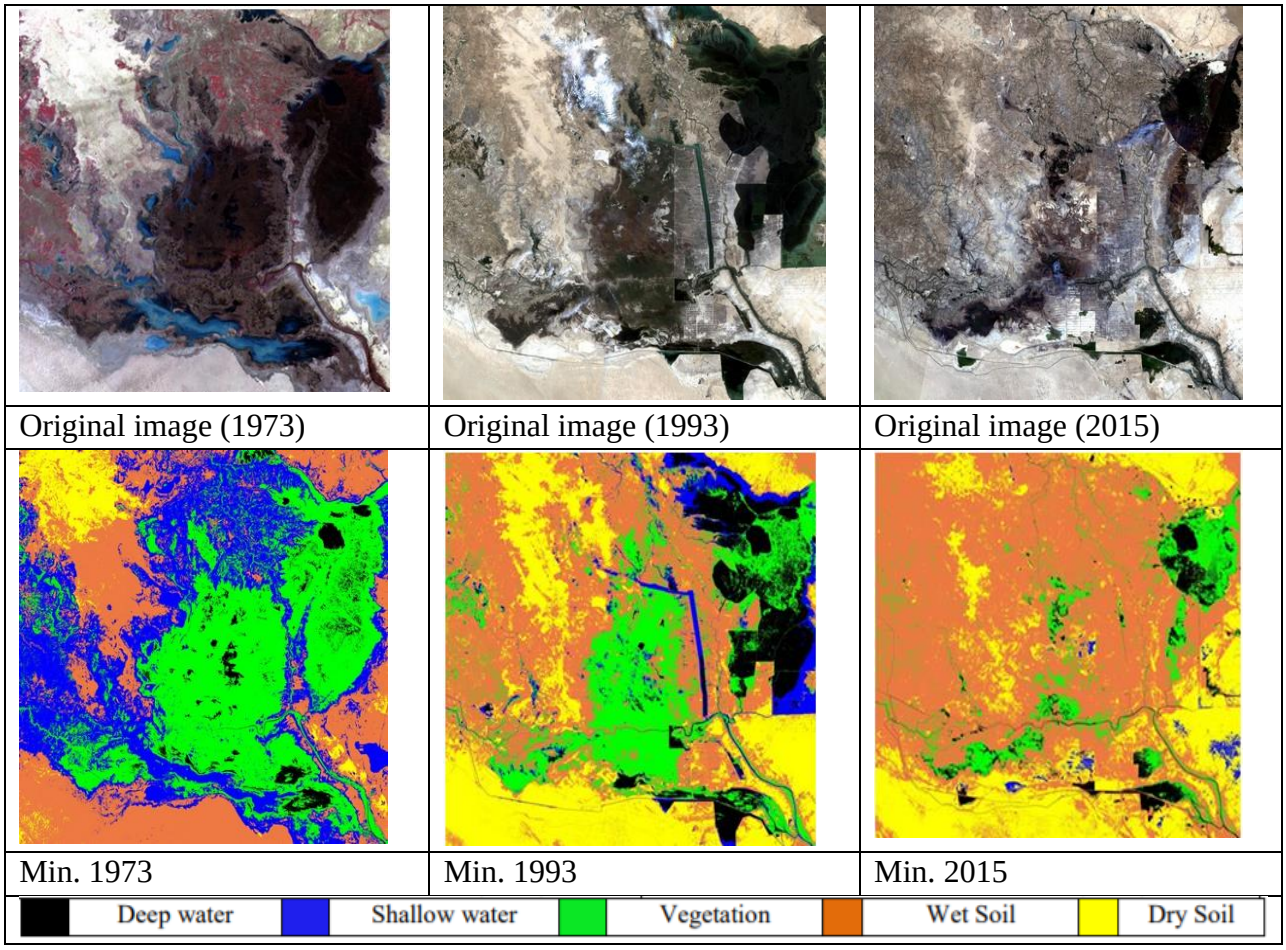

Figure (2) the original images of studied area and its results using minimum distance and maximum likelihood in different period of marshes images.

3. change detection using Principal component analysis

remotely sensed image can be used to monitor changes in land surface condition. There are a large number of methods used for change detection, which have been proposed and applied. A principal component analysis (PCA) is an important data transformation technique used in remote sensing work with multi-spectral data [13]. PCA is a useful statistical technique that has found application in fields such as face recognition, image compression, finding patterns in data of high dimension, and is a technique for detecting changes. Change Detection is a general remote sensing technique that compares imagery collected over the same area at different times and highlights features that have changed. The PCA methods Principal Components Analysis to highlight changed areas [14].

Principal Component Analysis (PCA) is a linear transformation of a given data set into the new data set such as the largest variance by any projection of data set lie on the first axis (PC1), the second largest variance on the second axis (PC2), and further on. It is a technique by which it reduces the numbers of related variables associated with the given data set into the new set of variables which are uncorrelated but retain most of the variability that are associated with original variable of the data set. In this technique, two registered multispectral images img1 and img2 captured by different sensors such as (MSS AND Landsat) of same geographical area and of same size (i.e. of same dimensions) but for a different time time1 and time2. The first and second maximum variance of the two image must be find where each image consists of four bands (blue, green, red and NIR), so eight bands can be received after that the difference using subtractive method between the new bands have been computed. The results of an applying change detection using PCA can be shown in the figures 3 & 5, respectively. Marshes image (1973) considered to be the reference image that all

others marshes images (1993, and 2015) must compared with it. And the statistical properties maximum, minimum and stander deviation of the results can be illustrating in figures 4&6.

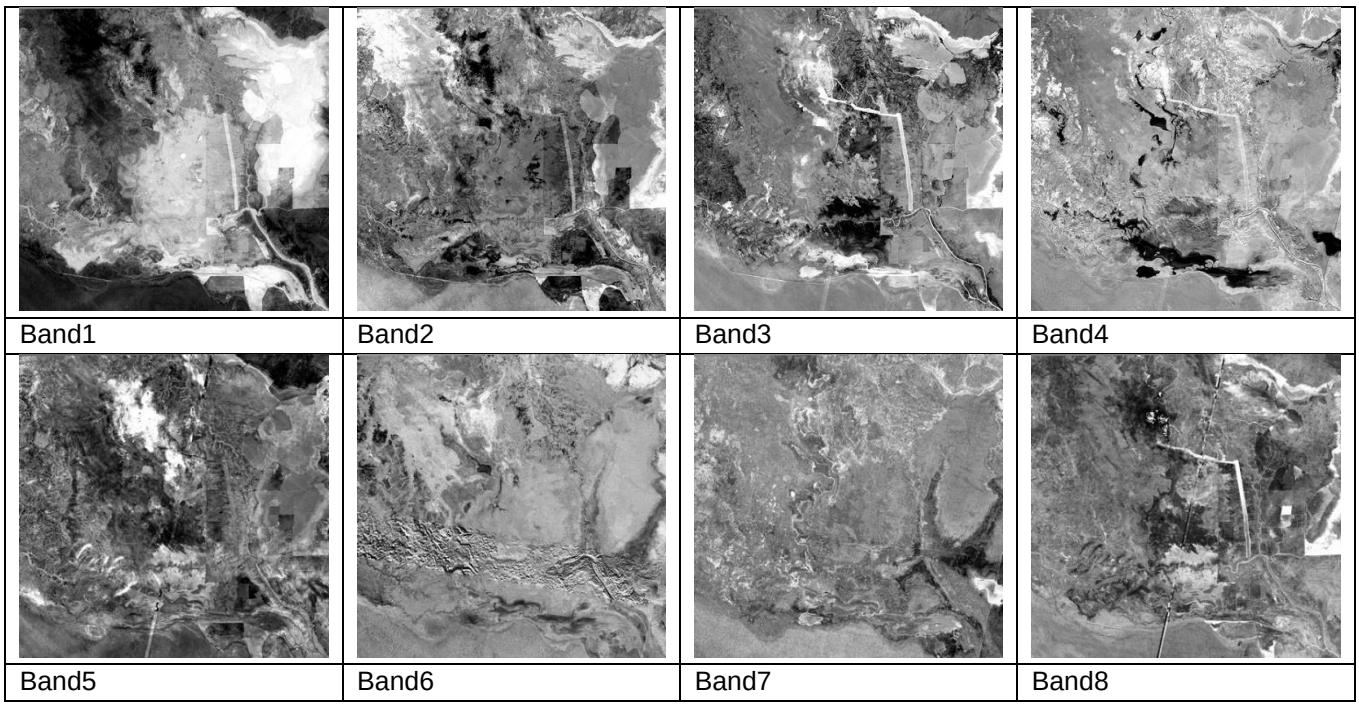

Figure (3) The result of apply PCA subtractive between marshes 1993 and marshes 1973.

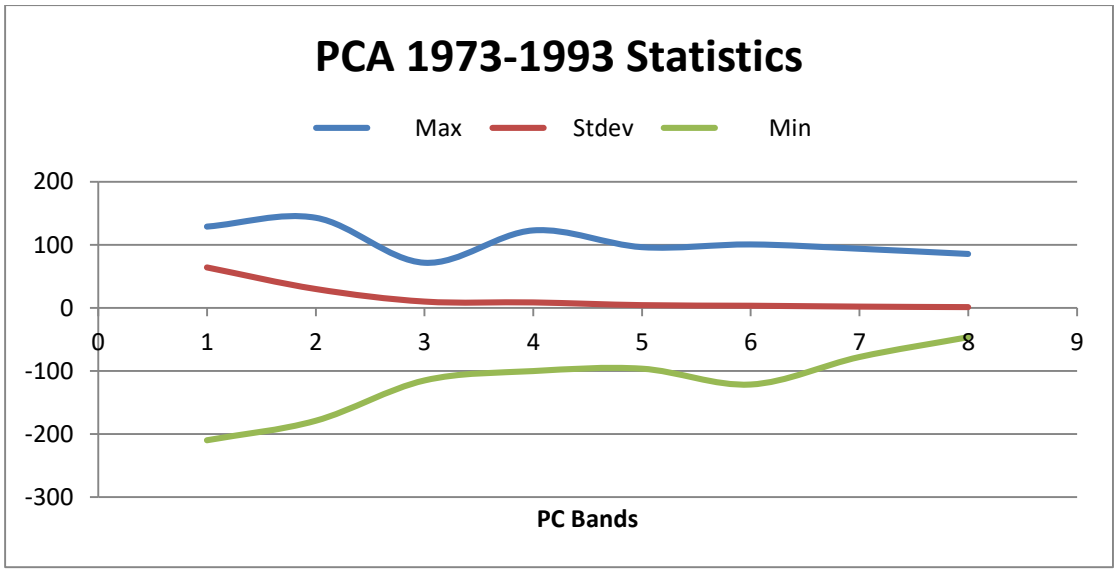

Figure (4) The statistical properties maximum, minimum and stander deviation of the result bands of (1973-1993) image marsh.

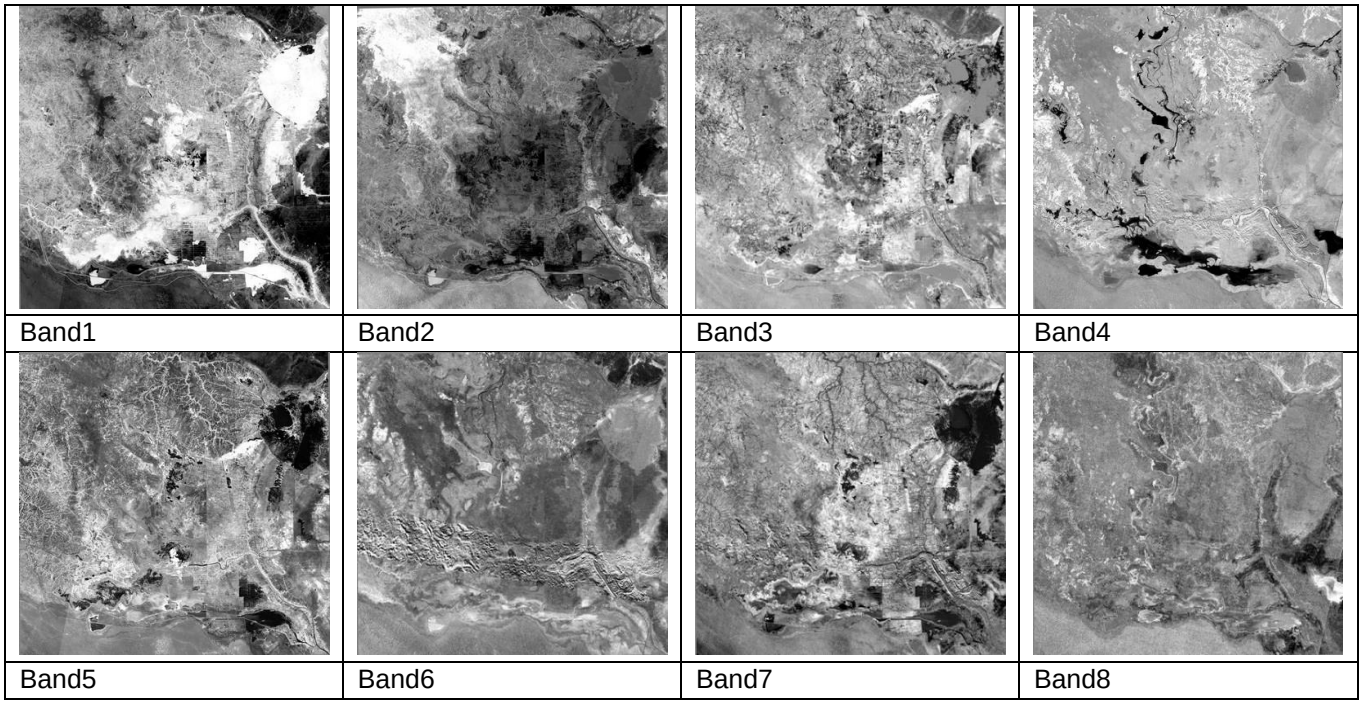

Figure (5) The result of apply PCA subtractive between marshes 2015 and marshes 1973.

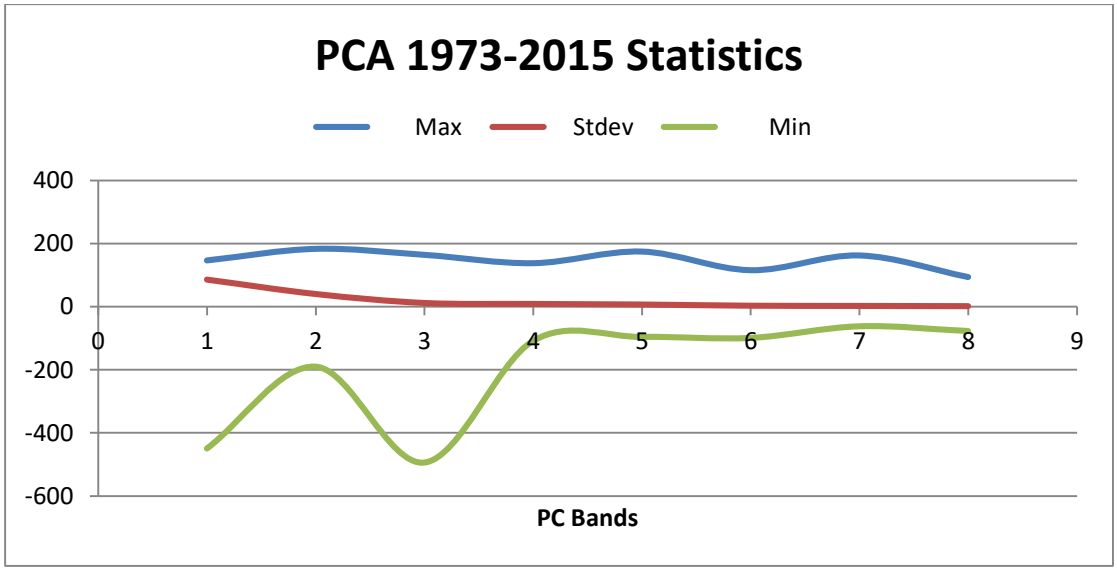

Figure (6) The statistical properties maximum, minimum and stander deviation of the result bands of (1973-2015) image marsh.

3. Discussion

Change detection of land use and land cover was considered very important way to study the environmental changes of any region. This research presents many remote sensing methods to achieve the change detection. Classified the image of the studied area into its classes was implement by using supervised classification such as minimum distance classifier this classification showed the rate of each class and the

statistical distribution of the pixels for each class; The results showed that studied area consists of many region (deep water, shallow water, vegetation (reed & papyrus) n , dry soil and wet soil), these classes witnessed many changes during the period from 1973 to 2015, where one can be noticed that the size reducing of the water and vegetation in 2015 and the size of the wet soil and dry soil have been increased. These changes have been done because of the reduce of the water source which fed these marshes. In other hand the soil area was dominant in most of the area of marsh 2015. This research includes an important method for detecting the changes between the image of the three decade, this method depended on PCA transform where the first and second maximum variance for each compared images were calculated and computed the difference between them. Another technique had been presented for background characterization involving the spatial and data.

4. Conclusion

The most important conclusions of this research can be listed below:

1. Reducing the amount of the water in the southern Iraq marshes from 1973 to 2015 because of the past politic decisions, high temperatures and reducing the rate of training, as well as building many dams by countries of Iraq's neighbors caused water reducing which fed these marshes.
2. Decreasing the area of vegetation such as reed and papyrus beyond time of marshes 1993 and it was at the maximum value in marsh 1973 because the marshes at that time witnessed a big refresh of water.
3. Disappearance of deep water in central marshes of Iraq and spread the dry soil in the most of considered marsh.
4. The area of water in all marshes deceased to low value through the years (1993 and 2015).

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