Desertification Monitoring Using Remote Sensing and GIS Techniques

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Abstract

Proliferated in recent years the desertification phenomenon, and the desert areas started expanding at the expense of green areas, which affected the environment.

This research focused on studying the desertification and its changes regarding to the time, through using different multi band satellite images for the area of interest in different times and studying the changes appear to the land cover and calculating the areas of each parameter to make the comparison for each environmental parameter (soil, agriculture, and water).

Key Words: Flexible beams, rigid-body motion, linear vibrations

مراقبة التصحر باستخدام تقنيات الاستشعار عن بعد ونظم المعلومات الجغرافية

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الخلاصة

انتشرت في الآونة الأخيرة ظاهرة التصحر وبدأت المناطق الصحراوية او شبه الصحراوية بالتوسع على حساب المناطق المزروعة مما اثر في البيئة بشكل واضح. وتركز بحثنا بدراسة هذه الظاهرة ومراقبة التغيرات مع الزمن من خلال استخدام صور فضائية متعددة الاطياف لسنوات مختلفة لمنطقة الدراسة الواقعة الى الغرب من بغداد واجراء المقارنة بين طبقات الغطاء الأرضي وحساب فرق المساحات لكل معلم على حدة لا سيما في العناصر البيئية الرئيسية (التربة، النباتات، الماء). وتم عر ض النتائج بشكل جداول ورسوم بيانية.

1. Introduction

When people think of drylands, they associate them with deserts and hostile living conditions, economic hardship and water scarcity. But that is not what drylands are all about. If managed well, the drylands are also fertile and capable of supporting the habitats, crops and livestock that sustain nearly one-third of humanity. (1)

1.1 Desertification Definition

We found many definitions for desertification, Desertification refers to the degradation persistent of dryland ecosystems by climatic variations and the activities of human. Desertification may happens on continents and affects the livelihoods of people, including a large part of the poor in drylands.(2)

Desertification is not the extension of existing deserts, but it is can be defined as the land degradation as a result of the activities of human in dryland. (4)

1.2 Desertification Causes

"Desertification is caused by a combination of factors that change over time and vary by location. These include indirect factors such as population pressure, socioeconomic and policy factors, and

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international trade as well as direct factors such as land use patterns and practices and climate-related processes."

These factors lead to decreased land productivity and a downward spiral of degradation and poverty, Where conditions permit, dryland populations can avoid degradation by improving their agricultural and grazing practices in a sustainable way

To counter the problems effectively, it is important — but difficult to distinguish between effects resulting from natural conditions and those caused by management decisions as well as economic and policy factors.(2)

As we mentioned that the desertification is mainly happened by land degradation, Land degradation occurs when the land's use by man is incongruent with the land's attributes (FAO, 1976). Man uses land(13 billion hectares - B ha) in four different ways (FAO Statistics Database cited in WRI,1998). (6)

(1) Cropland, including lands under temporary and permanent crops, temporary

meadows, market and kitchen gardens. (2) Permanent pasture, land used for five or more years for forage, including natural vegetation and cultivated crops (3) forest and woodland, including land under natural or planted stands of trees, as well as logged-over areas to be reforested in the near future. And (4) other land or other uses, which includes uncultivated land, grassland not used for pasture, built-on areas, wetlands, wastelands, barren lands and roads.

1.3 Desertification affects

Desertification affects all categories of ecosystem services:

- Provisioning services such as food, forage, fiber, and fresh water,
- Regulating services such as water purification and climate regulation,
- Cultural services such as recreation and cultural identity, and
- Supporting services such as soil conservation.(2)

1.4 Environment and Environmental Elements

The environment is all the physical, chemical and biological factors external to the human host, and all related behaviors, but excluding those natural environments that cannot reasonably be modified. This definition excludes behavior not related to environment, as well as behavior related to the social and cultural environment, genetics, and parts of the natural environment. The environment is defined as including water, air, soil, flora and fauna.(5)

1.5 Monitoring desertification

Because of these serious consequences of desertification there becomes a high need to combat desertification.

The various data sources available through remote sensing offer the possibility of gaining environmental data over both large areas and relatively long time-periods. Although no one can confirm that remote sensing will replace traditional sources of data for inventory and monitoring there is, however, an obvious role that it would play in assessing and monitoring desertification. (7)

1.6 Paper Goal

This paper aims to monitor the environmental elements (water, soil, and vegetation) using remote sensing and GIS techniques calculating areas of each element and check the differences per specific time.

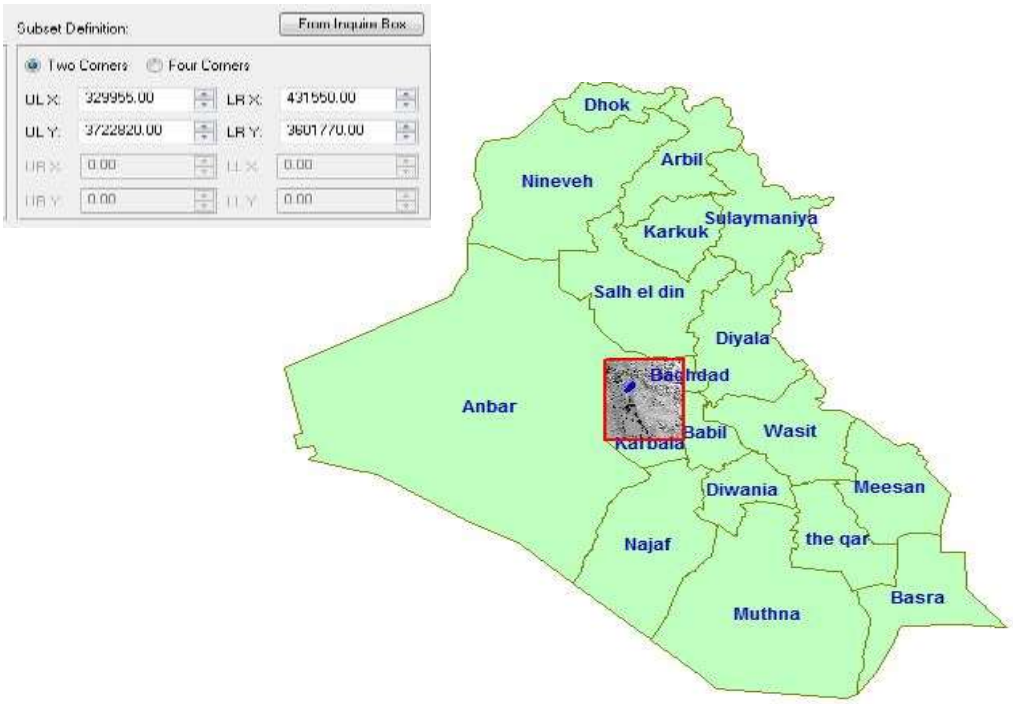
2. Case Study and Area of Interest

The area of interest selected carefully to study the main environmental elements, so we selected the area in the mid of Iraq to the west of Baghdad, Euphrates river passes throw the area from the north west to the south east as well as 2 big water bodies to the north Habania reservoir and Razaza reservoir to the south, agricultural and green areas already surrounded the river and water bodies, in other hand desert represent the rest areas.

Therefor the area of interest selected is suitable to match the goals by including the elements should monitored. The area of Interest Located in between the two corners bellow, the coordinates is in Projection UTM-Z38, WGS-84 system.

UL 329955 ; 3722820

LR 431550 ; 3601770



Map 1. Area of Interest

3. Data and Tools Used

In this paper the following data were used:-

1- Landsat -7 TM, Image dated 2000, full bands Roa data 30m for bands 1 to 5 and 15m for band 8 (panchromatic), will called before image.
2- Landsat -7 TM, Image dated 2010, 3 Bands processed data and pansharpened to 15m. will called the after image

Also we used software for image processing and GIS to calculate and analyses the results.

1- ERDAS Imagine V. 14 Used for Image Processing.
2- Geomedia Pro. V. 13 Used for calculations and analyses.

4. Methodology

Most of the processes were used by previous researches in the same application. Regarding to the importance of the desertification many people worked on in different locations. Many papers reviewed from different scientific research centers to produce the following procedure.

4.1 Radiometric Correction

In the beginning of the work, the processing by the following steps done to reach to the enhanced images. ATCOR Add-on ERDAS module used for atmospheric correction.

4.2 Sub Set the Area of Interest

As you know that LANDSAT image dimensions are about 180 x 180 km, to reduce the processing for all the image, subset both images to the same AOI and corners. This process done for two times one in the beginning to reduce all the processed areas and another one after the geometric correction where a traditional shift happened.

Subset made to set the same corners to both images. Figure (1) bellow explain the shifting in the

Figure 1. shifting of images in different dates

4.3 Geometric Correction

Regarding to the time between the 2 images, shift in the features already exist, so the geometric correction is needed to remove the shift and reach the suitable situation for change detection and classification.

It is important to mention her that in the same time of producing the corrected image, the image resampled to union the pixel size in 15m for both images.

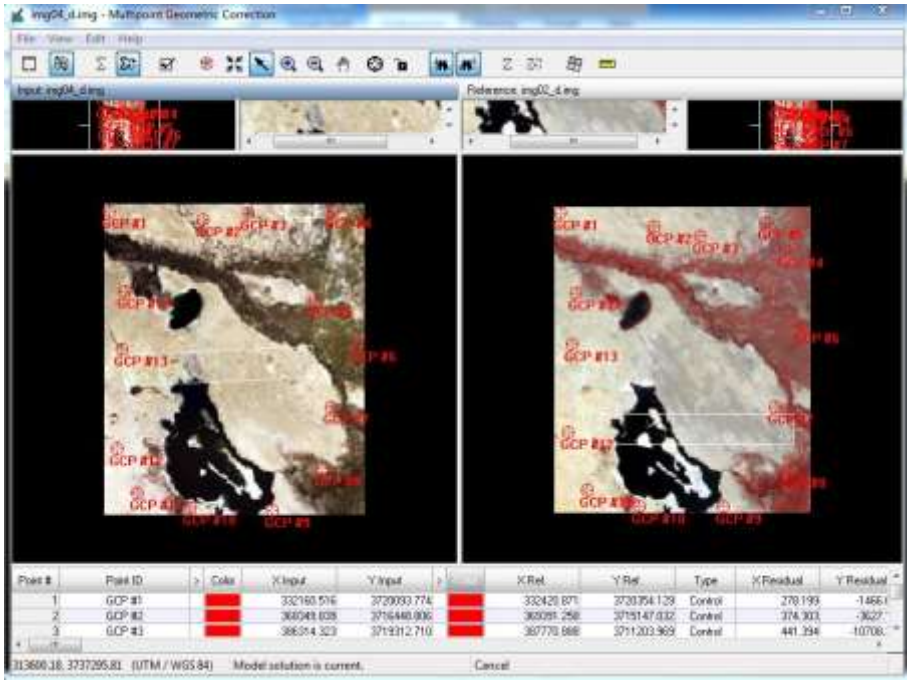


Figure 2. Image geometric correction

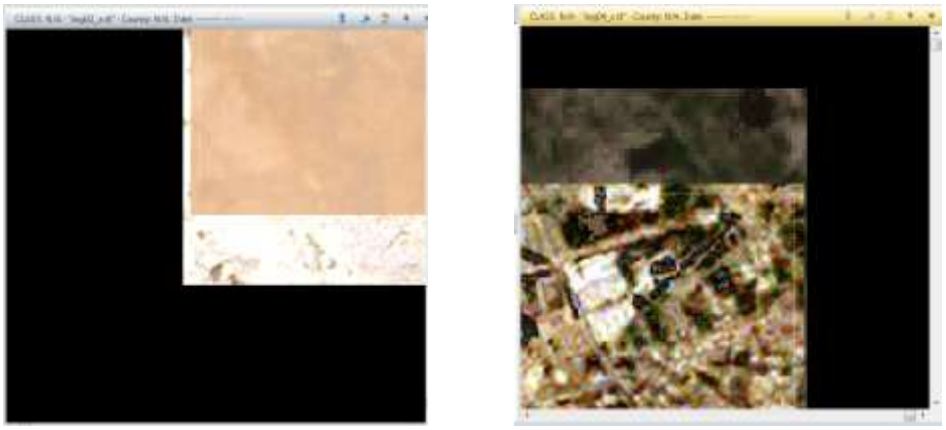


Figure 3. shifting after Image geometric correction

4.4 Change Detection and High Light Changes

Change detection is the most process used in cases like this to search for specifying the sites includes the changes and differences between the before image and the after image to the same area of interest. The change detection process was applied in ERDAS Imagine,

1- The input were the before and after image.
2- The output will be 2 results the change detection as panchromatic image and the high light which will be as a thematic image mentioned the locations have differences between the before and after images.

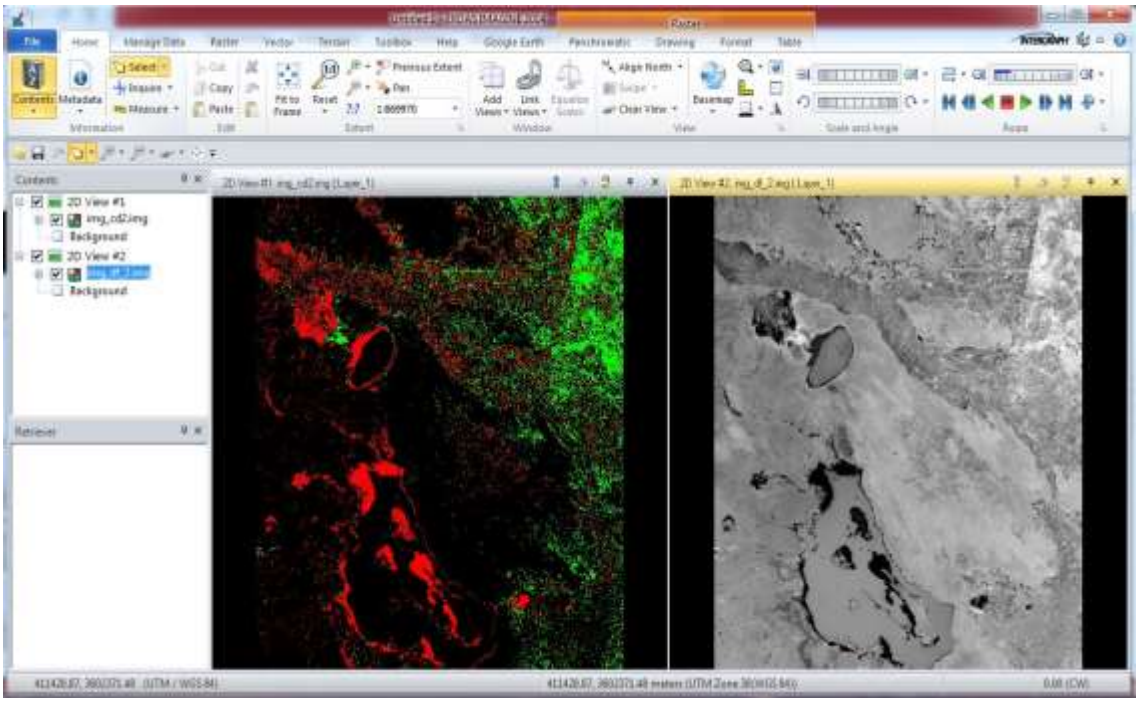


Figure 4. Change Detection

4.5 Classification

Unsupervised classification used to classify both images before and after, from the knowledge and experience of the researcher to the area of interest we abled to manage the classification to reach to 4 classes required. 8 classes selected in the beginning then merged them to reach to 4 only (Soil or Deseret, Water Bodies, Green Lands, and Urban). ERDAS Imagine software used in this process.

4.6 Convert Data to GIS

ERDAS Imagine is the Satellite Image Processing Software produced by Hexagon which already produced Geomedia GIS software.

The results of unsupervised classification converted from a thematic image or classes to vectors, these vectors transferred to Geomedia using the link between the remote sensing software (ERDAS) and GIS software (Geomedia).

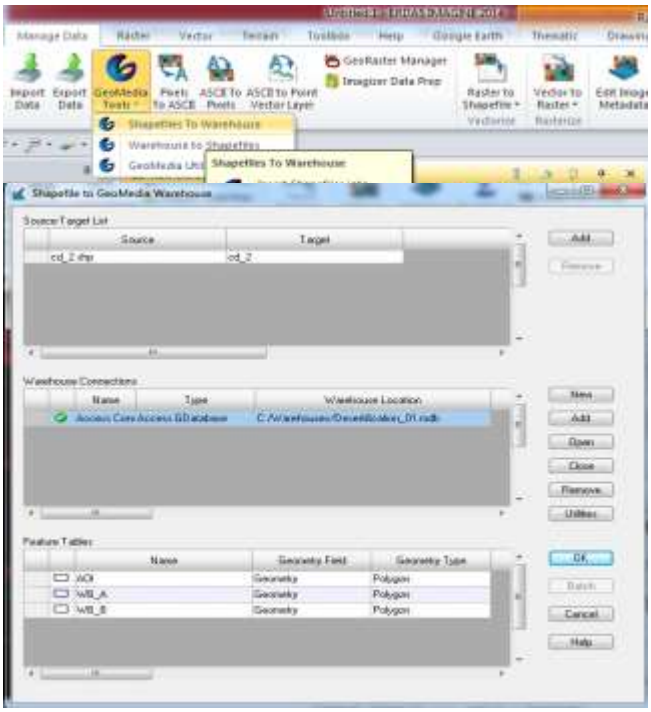


Figure 5. Data Transform From ERDAS to Geomedia

4.7 Thematic Map production.

In Geomedia GIS software, the Thematic map of 4 layers represent the main environmental elements (water, Green lands, and Soil(desert)) as well as the urban areas which appear as a class but neglected in the calculations because of the goals of the study.

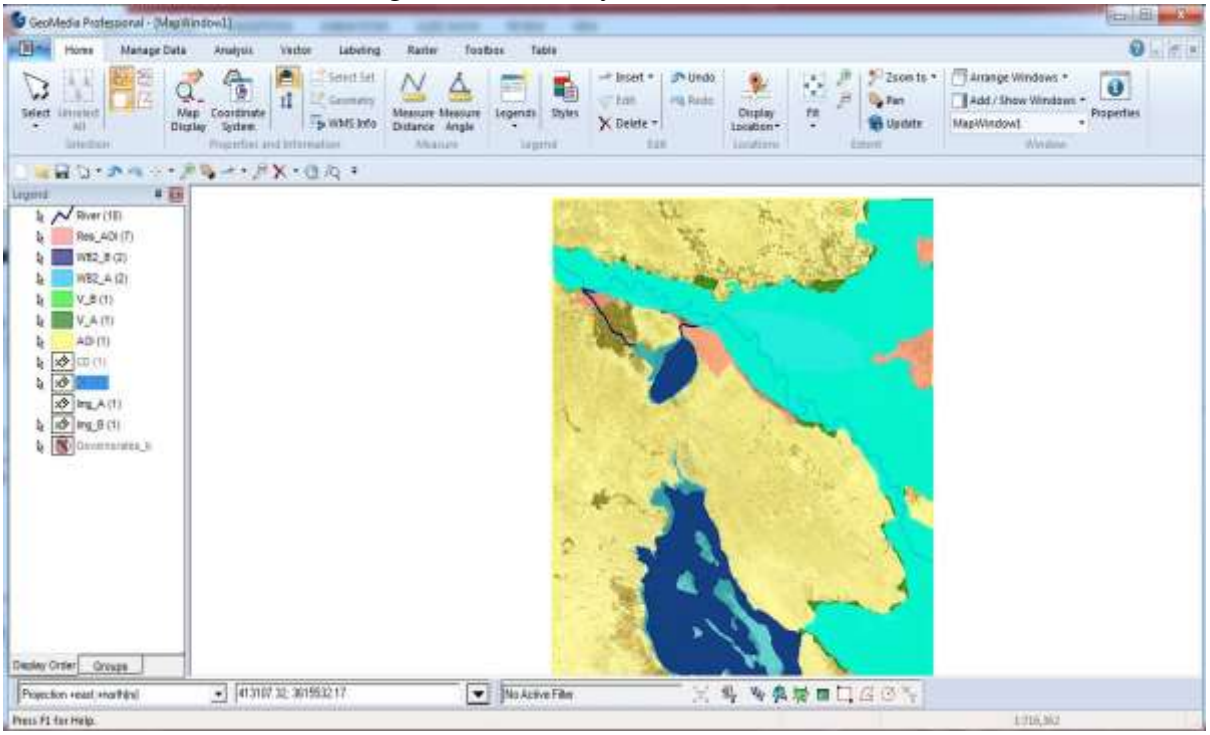


Figure 6. Thematic Map in Geomedia

4.8 Calculate Areas and Produce the Chart.

Table (1) Areas of Classes

Cover	Area km2 2000	Area km2 2010	Delta Area	Differences %
Water	1420.8	1167.6	253.2	17.8
Soil	7412.9	7723.7	310.8	4.2
Vegetation	3466.3	3408.7	57.6	1.66
Total	12300	12300		

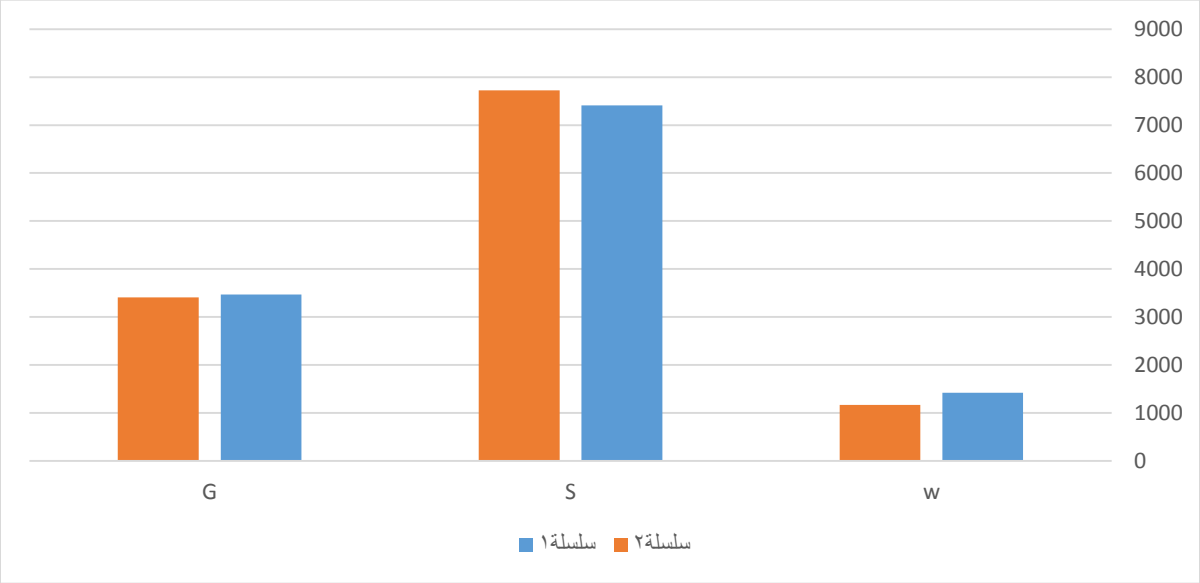


Figure 7. Data Transform From ERDAS to Geomedia

Conclusion

1- We can monitor and study environmental phenomena using satellite images.
2- We can got good results and fast estimation.
3- The link between ERDAS and Geomedia very important for feeding data base more details from the Image processing to use the capabilities of GIS analysis.
4- We found big difference in water, should be reviewed if it is organized or not.
5- The expansion of desertification to the vegetation.

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