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The Effect of Changes in Land Cover on the Surface Temperature in Hor Al-Delmaj Technologies Using Remote Sensing and Geographic Information Systems

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ABSTRACT: *Hor Al-Delmej and the surrounding areas (southern Iraq) have been classified into five categories representing different land use / land cover. In order to prove the effect of different land use / land cover on land surface temperature, tow space images from Landsat 5 and Landsat 8 dated 1999 and 2016 were used respectively. Images represent (TM) and (OLI/TIRS) sensors used respectively. Supervised classification has been applied. Maximum likelihood method was adopted as to extract land use / land cover areas. These land use /land cover areas represent water bodies, wetland, agricultural land, fallow land and decertified land. In order to know the effect of land surface temperature up on the land use / land cover changes, tow images of (TM and OLI/TIRS) were thermally analyses.*

Keywords: *Temperature change, Temperature classification, supervised classification, Al-Delmaj.*

I. INTRODUCTION

Land surface temperature (LST) is a key parameter in the physics of the earth surface through the process of energy and water exchange with the atmosphere, which plays an important role in a wide variety of scientific studies, such as ecology, hydrology, and global change studies[1,2]. Marshes or Hor are large tracts of lowland flooded by stream near the Tigris and Euphrates rivers. With the advance of time, especially during the last decades these areas dramatically deteriorate due to a number of factors including desertification processes the accumulation of salt mismanagement climate change and the scarcity of water. [3].

The satellite images are an excellent way to monitor the earth's surface and the ongoing changes cover. Rapid monitoring process that requires the application of certain technologies such as change detection procedure. It revealed that change is a process of discrimination the differences between objects or phenomena that observed in different periods, as it includes the ability to define the time effects on land cover using multiple data collection times. The basis for the use of remote sensing data is to detect variation in land covers, which changes in the ground due to changes in surface temperature that should lead to changes in the radiation values received by the sensor.

The selection of Hor Al-delmaj is that it is one of the main agricultural areas of the provinces of Waist, Diwaniyah and also provide an important and rich aquatic tourist environment compared with other southern regions, As well as of the different types of ground covers in the region, In this study we concentrated on spatial temperature changes which influenced by different land cover types.

The applications of remote sensing (RS) and geographic information systems (GIS) on Landsat satellite (TM) for the year 1999, and OLI / TIRS sensor (Operational Land Imager and Thermal Infrared) for the year 2016, land use / land covers were classified into five classes surface temperatures were measured and classified in to five classes.

II. INDENTATIONS AND EQUATIONS

1. Research problem:

The problems can be formulated in the form of the following questions:

- Can we rely on satellite images analysis to understand the relationship between land cover change and the degree of heat emitted from the surface? How can we take advantage of the technologies and software related to remote sensing and geographic information systems (GIS) in obtaining on land surface temperature?

2. Objectives of the Study:

The research seeks in this study applied to get as much as possible to changes in the temperature of the earth's surface. As well as a display of modern technologies of space visuals and dealing with digital technologies for the production of digital maps of classification and treatment (Digital image processing and classification). To reach the goal of the study was to follow the following steps:

- The use of technology remote sensing (RS) and geographic information systems (GIS) in the follow-up changes for the Skins ground and the temperature of the surface of the earth, through a comparison between the visual space for the years (1999-2016) which is called the analysis of the time-space images (Multitemporal analysis).
- See the effect of ground covers are changed on the surface temperature by comparing the surface temperature with the changing area of the ground covers. Derived from satellite visuals.

3. The study area:

The study area (Hor Al-delmej) located in the alluvial plain, in the heart of Mesopotamia, with an estimated area (2,847,404) donums which is equal to (7118.51) km2 [4]. It is located to the west of the Tigris River, about (35 km) south-west of the city of Kut [5], and about (65 km) northeast of the city of Diwaniyah (Figure 1).

The area under study is limited to the area between latitudes (32.54, 31.67) in the north and longitudes (44.70, 45.81) to the east.

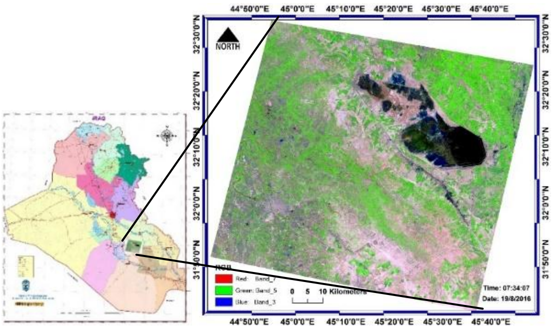

Figure (1) location of the study area site [6]

4. Climate:

The climate of the study area is a semi desert. Characterized by high temperatures during summer, reaching (40^{o}C) and low during winter (9 ^{o}C), leading to a significant differences in environmental covers a in the Region. Usually the precipitation in the study area is in winter and spring, starting from October until May, which varies between (242.6-23.4) mm / year and is considered to be a low-rate, compared with the amounts of evaporation-transpiration, where the total evapo-transpiration of is (5324-3211) mm / year. The relative humidity in the study area ranges between (52% -37%).

5. Satellite data:

The images used in this study are from Landsat 5 and 8 which carry TM and OLI / TIRS respectively. The data were obtained from website of the USGS [7]. These multi-spectral a multi-spectrum data are, shown in table (1), the bands (7, 4, 2) were combined from TM sensor, while the bands (7, 5, 3) were combined from OLI/TIRS. Fig (2) shows the color composites obtained from TM and OLI/TIRS sensors respectively. Fig (3) shows the images of thermal bands of TM and OLI/TIRS respectively.

Table (1) The data used in the study

Date Taken	The satellite	Sensor	Land rating ranges	Thermal range	Resolution (meter)
14/3/1999	LANDSAT-5	TM	7,4,2	6	30
25/2/2016	LANDSAT-8	OLI/TIRS	7,5,3	11	(100)

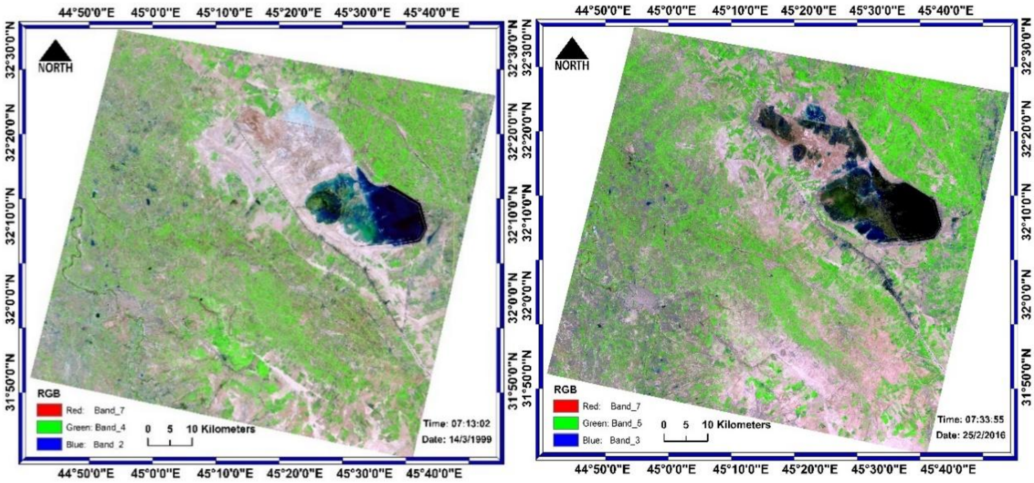

Figure (2) The color composites of TM and OLI/TIRS respectively

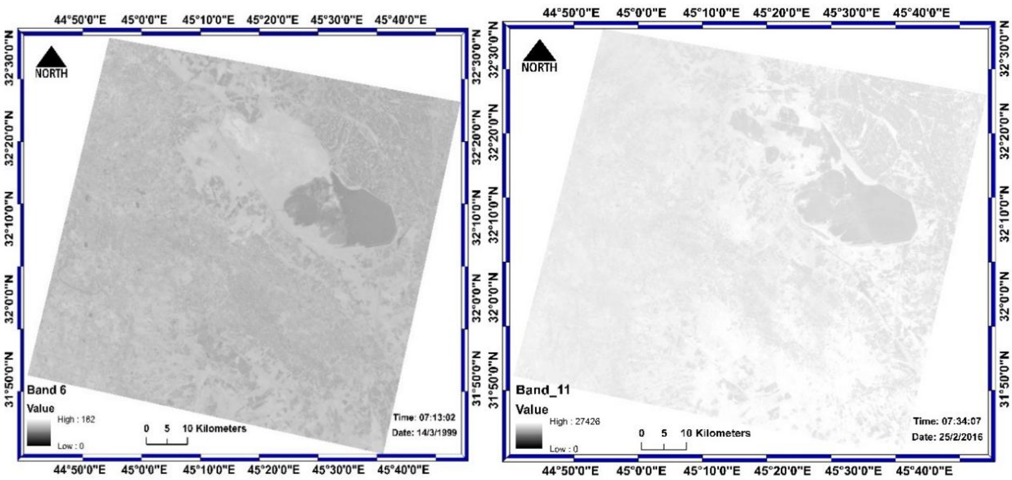

Figure (3) The images of thermal bands for the sensors TM and OLI/TIRS respectively

6. Image Classification:

Supervised classification has been applied on both images TM and OLI/TIRS. Images were interpreted visually with the aid of geographical maps of the area. Specialized field information were collected about land use/land cover from previous survey reports. Maximum likelihood classification provided by ERDASIMAGINE 2014 was employed to execute this classification. Five land use/land cover classes were identified in the study area namely water bodies, wet lands, agricultural land with different density of natural vegetation, fallow land and abandoned decertified land.

Figure (4) shows the supervised classification of TM and OLI/TIRS images respectively.

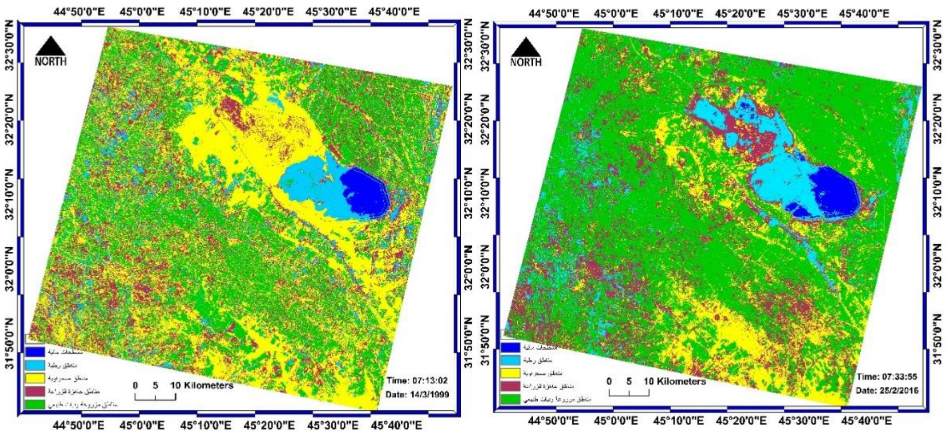

Figure (4) The application of supervised classification up on TM and OLI/TIRS images

7. The quantification of classified areas:

The areas of classified land use/land cover classes has been calculated using ERDAS IMAGINE 2014. Table (2) illustrates areas quantification of land use/land cover classes.

Table (2) Areas quantification of land use/land cover classes (km^2)

Images / Class	1999/3/14	2016/2/25
Water bodies	101.09	134.87
Wetlands	664.63	680.18
Agricultural land	2104.19	3866.98
Fallow land	1352.36	1328.17
Decertified land	2919.95	1132.04

A quick look at table (2), we deduce the followings:

- An increase in water bodies (lake) due to human and climatic factors. A slight increase in the wet land around the lake.
- A significant increase in the agricultural land due to agricultural reformation.
- A slight decrease in fallow land.
- A huge decrease in the decertified land because of the huge agricultural reformation and irrigation projects in the area.

8. Thermal signatures of land cover types:

For Landsat Thermal infrared (TIR) remote sensing provides a unique method for obtaining LST information at the regional and global scales since most of the energy detected by the sensor in this spectral region is directly emitted by the land surface [8]. In order to understand the impacts of land use/cover change on surface radiant temperature, the characteristics of the thermal signatures of each land cover type must be studied first. For the surface temperature estimation, the radiation emitted from the target on the surface is measured by using thermal infrared region (10.4-12.5 mm) of Landsat 7 ETM+ image. Surface temperature of wide areas can be extracted under assumption that satellite sensor should have proximity to the black body. In this study we estimated the surface temperature using NASA model. The digital numbers were transformed into absolute radiance [9], Using:

$$\mathbf{L(\square) = GAIN \times DN + OFFSET} \quad \mathbf{(1)}$$

Which can also be expressed as:

$$\mathbf{L\lambda = (Lmax - Lmin)/254 \times DN + Lmin} \quad \mathbf{(2)}$$

Where: $L\lambda$ is the spectral radiance, Lmin and Lmax [$mW\ cm^{-2} sr^{-1} \mu m^{-1}$] are spectral radiances for each band at digital numbers 0 and 254 respectively. The spectral radiances (L) were converted into effective at-satellite temperatures T by

$$\mathbf{T = K_2 / \ln (K_1 / L\lambda + 1)} \quad \mathbf{(3)}$$

Where: K2 and K1 are constant values vary with the type of sensor. From (2) and (3) concluded the equation (4):

$$\mathbf{T = K2 / Ln ((k1 / ((Lmax - Lmin)/254) * (b6 - 1)) + Lmin) + 1) - 273.15} \quad \mathbf{(4)}$$

Land surface temperature of the study area was calculated from thermal band 6 in TM sensor and 11 in OLI/TIRS sensor using ERDAS IMAGINE program. The following steps was followed:

Two equations (models) have been used (5) and (6) of the sensors, TM and OLI / TIRS respectively, After compensating the constants taken from NASA in equation (4) to convert the value of the cell (Pixel) to temperature value and the results are shown in Figure 5.

$$\mathbf{1260.56 / (\log ((607.76 / ((((15.30 - 1.238) / 254) * (b6 - 1)) + 1.238)) +1)) - 273.15} \quad \mathbf{(5)}$$

$$\mathbf{1282.71/ (\log ((666.09 / ((((22.00180 - 0.10000) / 65534) * (b11 - 1)) + 0.10000)) +1)) - 273.15} \quad \mathbf{(6)}$$

The supervised classification was applied on the resulting images to classify areas according to the surface temperature as shown in Figure (6) the highest and lowest temperature values were tabulated in table (3).

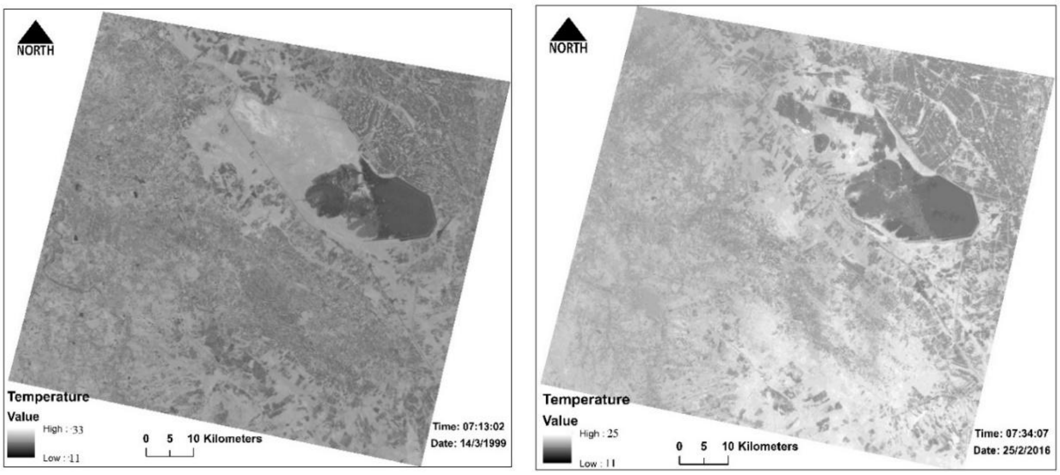

Figure (5) Land surface image Temperature

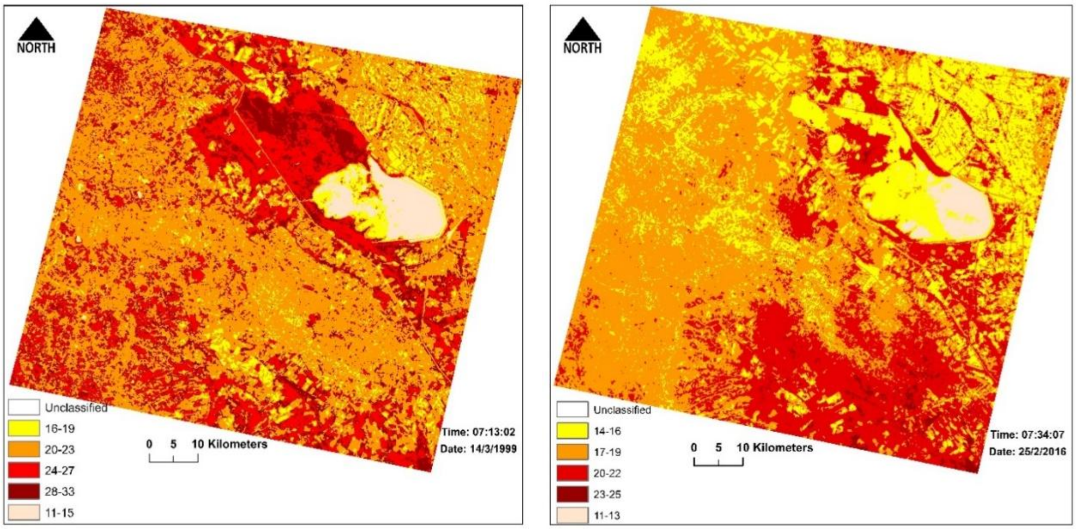

Figure (6) Thermal maps of TM and OLI/TIRS respectively

Table (3) The highest and lowest temperature image values

highest value of the surface temp.(^{o}C)	Minimum value of the Surface Temp. (^{o}C)	Visible
33	11	14/3/1999
25	11	25/2/2016

The comparison between the image of Figure (6) and fig (4) reveal the following:

- The lowest temperature value recorded in the images represent surface water body temperature.
- The surface temperature ranges between the lowest and the highest depending on the nature of the ground cover that covers the study area. As it is closer to the lowest temperature when the land cover is wetlands. The surface temperature medium in agricultural, land while surface temperature is highest in fallow land.
- The highest temperature recorded in the image represents the desertified land temperature.

From the comparison of fig (6) and the following table (3) the following was observed:

- The stability of the minimum value of the surface temperature image compared with TM image.

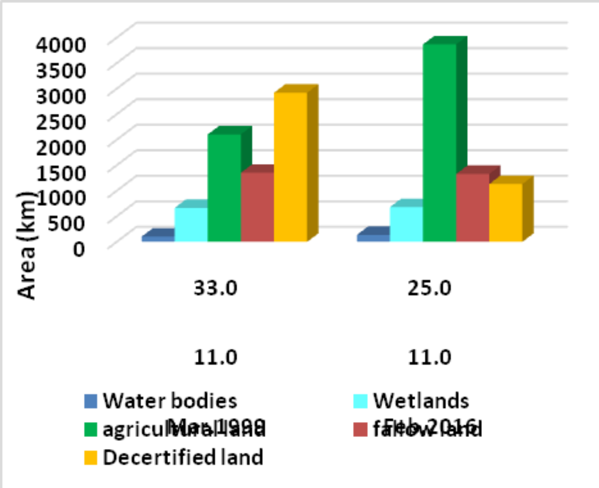

Figure (7) The changes in surface temperature with land cover changes

From Figure (7) we observed the following:
The decrease in surface temperature with the increasing vegetative cover, water bodies and wetlands, while it decreases with desertified and follow land.

III. CONCLUSION

- The stability of minimum surface temperature, in water bodies which represents the lake (Hor).
- The decrease in highest value of surface temperature for the image OLI/TIRS in comparison with TM image which represent the desrtified land.

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