Eco. Env. & Cons. 26 (1) : 2020; pp. (446-453)
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ISSN 0971–765X

To study climatic factors effect on Land Covers (LC) for Salah Aldeen region by using remote sensing data

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(Received 24 December, 2019; accepted 20 January, 2020)

ABSTRACT

The purpose of the study area was monitoring and classify the changes in topography (i, e, water, over grass or vegetation, shallow, terra, and soil, etc.) for Al-shari lake region, and using applied satellites data raw as weather factors (European Centre for Medium-Range Weather Forecasts – Official (ECMWF)), and doing fixed study area climatic maps. To execute this goal in search applied Landsat satellite imagery used in study simultaneous decade periodic. The supervise and unsupervised techniques wear classification the satellite imagery after band ratio tools process for chosen the features suitable, in order to compute and determined the features of topography area. The weather factors employed by to use satellite data raw for study climatic variables cover the region. They are doing many convert process of these to corresponding the procedures, and they applied interpolation techniques process. Extraction the contour lines maps, which determined the study area weather factors movement for temperature (^{o}C) degree, relative humidity (percentage) and total precipitation (mm) for three-decade period. In addition, to compute with account area for each features depended on the satellite imagery dataset which for each a pixel (smallest object in imagery) represented spectrum texture for feature in grid of raster. All the process may be applied the remote sensing (RS), geographic information science (GIS) techniques, Earth Resource Data Analysis System (ERDAS) and some converted programs as Excel program from Microsoft Office Word Corporation.

Key word: *Landsate satellite imagery, Statistical method, Climatic factors maps, Classification techniques and RS with GIS techniques.*

Introduction

Remote sensing is a science that has made its way very quickly. This progress has helped to achieve the accuracy in obtaining information from orthophoto imagery (aircraft, aerial photo and satellite), it has become a basic science used to solve many issues related to Land, atmosphere, surface phenomena and natural conditions without contact with any variances, through the amount of collection information provided and manipulation with digitization by high technology (Lillesand and Kiefer, 1994) .

The topography study must be obtaining climatic factories particularly the surface weather effective such as temperature, evaporation and total precipitation, by using (ecmwf) model (All weather models use different physics, set up parameters and many complex equations to calculate meteorological data such as wind speed, direction, temperature, pres-

sure, rain, cloud), which the data set effort good reflectance this techniques. These datasets must convert coordinate system from geographic (latitude and longitude coordinate) to universal transvers Mercator (UTM coordinate), they compatible to geo reference of satellite land sate imageries.

In addition, they computerized by tabular this dataset in table or database, which covered study area by fixed distance period which represent actual measure stations. This process to abbreviate huge potential by applies remote sensing techniques (Jay Lee and David Wong, 2001; O'Sullivan and Unwin, 2003).

In addition to, the digital numbers were transformation into absolute radiance, surface weather factories of wide areas can be extracted under assumption that satellite sensor should have proximity to the black body. For landsate, thermal infrared (TIR) remote sensing provides a unique method for obtaining LST (land surface temperature) information at the regional and global scale since most of the energy detected by the sensor in this spectral region is directing emitted by the land surface (Fouad Mashi, 2018).

The definitions interpolation process technique are making assumption areas that are closing to one another which are corresponding to alike than those nearest apart, Which led to a clear predict values for any unmeasured regions, which have influence than those farther away.

Inverse Distance Weighted (IDW) processing might been using the measured values surrounding the prediction location, IDW assuming that each measured point has a local influence entire regions with distance, this process yield greater weights of points closest prediction location, moreover weights diminish as a function of distance (Mitchell, Andy, 2005).

Study Area

The study area is located in Salah al-Din Governorate between 35.00°N and 34.45°N latitudes, 43.60°E and 44.50°E longitudes.

It is bordering on the northeast by the Hamrin mountain ridge. On the western side bordered by the Tigris River, and on the south the historical town of samara, the most important natural phenomena in the region is the existence of the Shari salt lake as well as the presence of sand dunes located between the salt lake and the installation of Hamrin as well as valleys.

The region is economically important as its people practice agriculture, especially grains such as wheat, barley and maize. Relying on rainwater, as well as planting some summer and winter vegetables, Groundwater is extremely important in area as a source of water for irrigation. Except in the areas adjacent to the Tigris, irrigation canals had been excavated old for irrigation (Al Janabi, Mahmood Hasan, 2008; Fouad *et al*., 2017), show Figure 1.

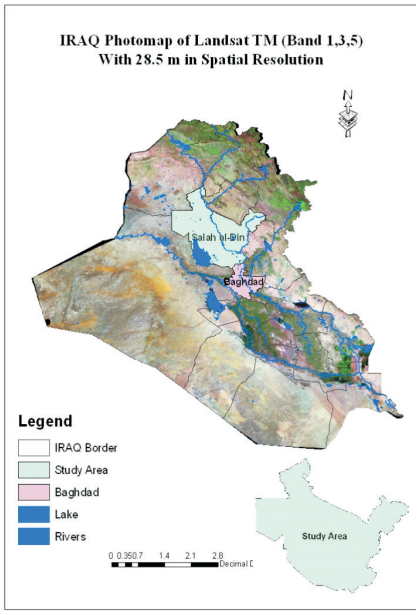

Fig. 1. Study area landscape exposed in north middle of IRAQ.

The Data Acquires

Four satellite images were using in this study, obtained from Landsat 5 and Landsat 7 satellites, which carry sensors (ETM+, TM), In addition, taken with simultaneous decade periodic and divided into two reasons summer and winter, see the Table 1.

Table 1. Information on the images of Landsate are using in the study

NO	Satellite Name	Lunched Date	Sensor Type
1	LANDSAT-5	14/3/1987	TM
2	LANDSAT-5	26/8/1987	TM
3	LANDSAT-7	17/3/2017	ETM+
4	LANDSAT-7	21/8/2017	ETM+

In addition, Figure 2 show a sample of satellite images used in the study

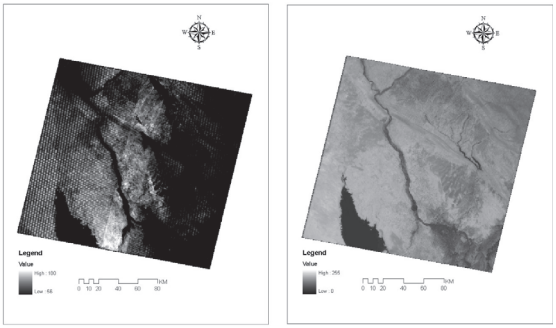

Fig 2: Illustration, Sample of Landsat images taken from 1987 and 2017 for both Sensor (TM, ETM+).

And producing study area landscape from merge many bands with colour (RGB) from two sensors (TM, ETM+), and spectral bands were merged (NIR, Red, Green), see the Table 2, and shown Figure 3.

Table 2. Composites bands process for merge images

Landscape	Band Merge	Pixel Size
TM and ETM+ Color	Band (4, 3 and 2) Band (NIR,RED and Green)	Resolution 30 Resolution 30

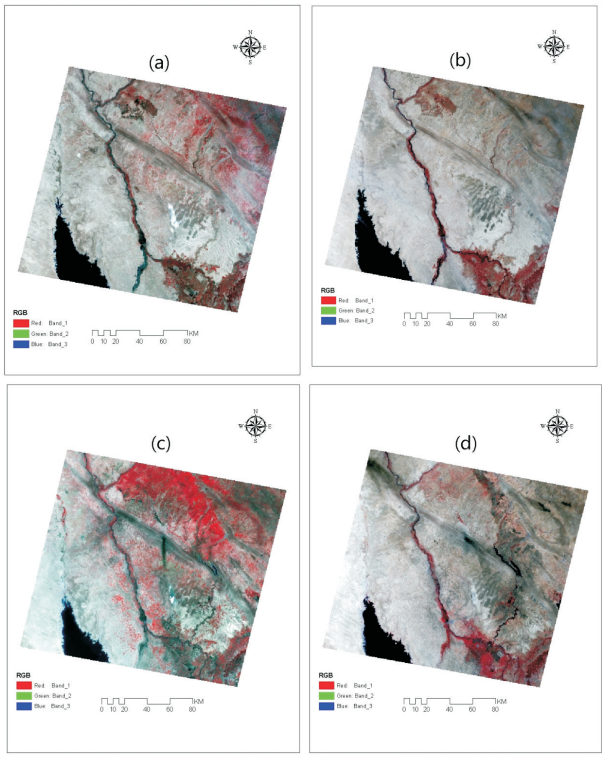

Fig. 3. Illustrtion, composites process for (a, b) TM and (c, d) ETM + and

In addition, employment the data raw of European Centre Weather factors Forecasts (ecmwf), and doing fixed study area climatic maps, see Table 3.

By convert process for these data, content the geographic coordinate system to UTM-zone coordinate system, afterwards by the data of weather factors adaptation and employment to interpolation techniques for study area.

Methodology

The main goal of this study consists of three stages; first, determination the work area from source image for scene (Al-shari Lake of salah Al-deen in location north middle of Iraq), and landscape geometry accuracy matching will be doing with correct coordinate system (WGS_1984_ UTM_Zone_38N).

Second, by work on band individually, to see track and detect the changes spectral band on land around of Al-Shari Lake Topographies.

Third, Spatial Analyst of ortho photo imagery processes are represents cell or pixels from all scene of images, such us, cell statistics, and Classification process, this technique depends on cell algorithms, And finally, reflectance the result and illustration in graphs map, prediction map and tables the cover area of each object (water, vegetation, soil or shallow, saline soils and sand dunes).

Topography Study

Topography is interested in studying the structures and types of the Earth's surface and understanding the physical processes of the earth's form, remote sensing provides a good way to extract information on Earth's surface installation, mineral extraction, and oil reservoir detection, as well as monitoring natural growth, changing and environmental topology.

Hydrology is concerned with the study of water on the surface of the earth whether it is groundwater, surface, rain or winds. Remote sensing science offers advantages in this science where it is providing extensive information on the nature and changes of hydrological phenomena.

Although, Monitoring and movement sand dunes. They are known that the increase of arid land is at the expense of agricultural land and its negative impact on the lives of both human and animal, here the importance of remote sensing comes to identification of drought-prone areas through

Table 3. Computing, Dataset Statistical for area counts (pixels) of study area topographies

date of image	*Rivers and canals*	*Sand plains*	*Abandoned land and saline's*	*Sand dunes and rocks*	*Low density arable land*	*High density arable land*
14/03/1987	183.9	1749.9	95.9	783.5	4429.1	900.4
	(37.8%)	(16.8%)	(11.4%)	(18.3%)	(25.4%)	(29.5%)
26/08/1987	90.3	2270.7	177.4	525.4	5933.3	394.8
	(18.5%)	(21.8%)	(21.1%)	(12.3%)	(34.1%)	(12.9%)
17/03/2017	126.6	1767.7	180.2	1219.8	4918.6	1339.2
	(25.9%)	(16.9%)	(21.4%)	(28.5%)	(28.2%)	(43.9%)
21/08/2017	86.3	4627.3	387.1	1737.1	2108.2	409.9
	(17.7%)	(44.4%)	(46.4%)	(40.7%)	(12.1%)	(13.4%)
Total count	487.1	10415.6	840.6	4265.8	17389.2	3044.3

estimation the rate of movement sand dunes, although detection of calcareous and saline soils particularly in areas with low vegetation cover (Sheikh Hasan, Hamza, 2006).

Experimental and Results

Climate Factors Study

The climate is one of the most important components of the natural environment, and it has a significant impact on other components such as water vegetation, Soils and moving desert. The importance of studying climatic conditions, they are important foundations that constitute the full picture of the nature prevailing in the area to be study.

The climate of Iraq characterized by continental characteristics, as it is warm, dry in summer and cool in winter. The climate in the study area is an important variable, and climate information has adopted by ECMWF (European Centre for Medium-Range Weather Forecasts). In this study monthly, average data have adopting of some weather variables that include Temperature, Evaporation and Total Precipitation (http://apps.ecmwf.int).

The temperature is the most important element of the climate that directly and indirectly affects other climatic elements. All changes in other climate elements are relate to temperature values. They control of the variability of the atmospheric pressure values, which effect on Speed and direction of wind and the movement of air masses and associated characteristics of precipitation and drought. In general, the study area characterized by a long dry hot summer (May - October) and the lowest temperature is 9.71 ° C in January, and the highest temperature is 37.85 ° C in July during the extended period (1987-2017), shown Figures 4.

Evaporation is process is an important element in determining the wa ter budget, Evaporation is affect by several factors: solar radiation, air temperature, Wind speed, Evaporation is consider from the climatic phenomena of arid and semi-arid regions affecting the values of rainfall. Evaporation rates increase during the hot season, the highest evaporation rate in July was 468.96 mm, and the lowest rate in January was 69.23 mm.

Total Precipitation is the main factor in the recharge of rivers, lakes and groundwater in arid and semi-arid areas. The greater the amount of Total

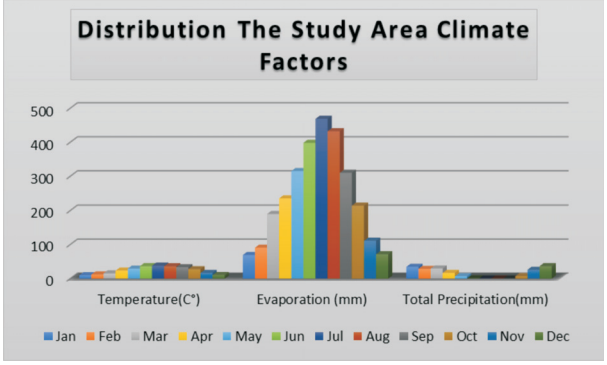

Fig. 4. Illustration: Monthly temperature, Evaporation and Total Precipitation averages for the study area for the period 1987-2017 years.

Precipitation, the more positive it is to increase the rates and the rise of surface and groundwater levels, and increases the accumulation of moisture content in the soil. The rainy season starts in October and lasts until the end of May. The highest monthly total Precipitation was in December to 36.47 mm this month, and the lowest average monthly Total Precipitation was 0.1mm in June and is completing suspended between July and September (http://apps.ecmwf.int).

Satellite Image Analysis

The classification process can be defined as the process of transforming the image into thematic map, including information about the phenomena in the area to be classified, where the pixels are distributed to groups or classes based on the criteria of the spectrum to digital numbers of these pixels, where it can be identified on pixels with similar spectral characteristics, which are assumed to follow the same class.

The process of image classification is the most important step in the analysis processing of digital images as they are the final outcome of these processes and the classification process can be divided into two parts (Ola Adil Ibrahim, 2018).

Supervised Classification

It is a classification process based on the spectral characteristics of the land covers for the area to be classifying through a satellite images covering the region, this method of classification requires the identification. By selected areas for each type of land cover in the area concerned, and these areas called training sample each species, which expected to be present in the study area in this method.

This method based on Bay's rule if we consider of the phenomena on the surface of the earth with the letter C.

$$C=C_i, C_j, \ C_k \ldots C_{nc} \quad \ldots (1)$$

Where *nc* total number of classes, if we take a pixel with vector X to a gray level, the probability of belonging vector X to class C_i given;

$P(C_i X)$

If the probability is known to each class, it is possible to determine class Which belongs to pixel with vector X by comparing the possibilities, this can be expressed mathematically by equation;

$$P(C_i \mid X) > P(C_j \mid X) \quad \ldots (2)$$

By rule provides for $P(C_i)$ Is the probability of class C_i and $P(x)$ is the proportion of affiliation pixel to class C_i thus, the equation becomes as follows;

$$P(x) = \Sigma\, p\,(X \mid C_i) * P\,(C_i) \quad \ldots (3)$$

In this equation we need valuable knowledge $P(C_i \mid x)$

$$P(C_i \mid X) = \{1/\,[(2\pi)1/2\,\delta_i]\}\, ex[-(X-\mu_i)2\,/\,(2\,\delta_{i2})] \quad \ldots (4)$$

Where: μi which is the mean for the C_i and δi which is the standard deviation of C_i class data [10].

Unsupervised classification

In this place, do not use in this classification training sample, and do not need prior information about the study area, and does not require knowledge of the number of land covers, but algorithms are used to group image elements with similar spectral properties in the form of spectral classes, then determine the identity of the land cover that represents image elements with similar spectral properties.

The resulting classes from unsupervised classification are spectral classes, and since these spectral classes are based on the natural groupings of the image units, their identity will not be known at the beginning, then the analyst should identify these spectral classes depending on reference maps or field visits (Ola Adil Ibrahim, 2018), shown Figure 3 and 4, and see Table 3.

Inverse Distance Weighted (IDW) interpolation

This technique is one of the most applied techniques in GIS, it is assuming that a point to estimate is influenced most by nearby points, hence each ob-

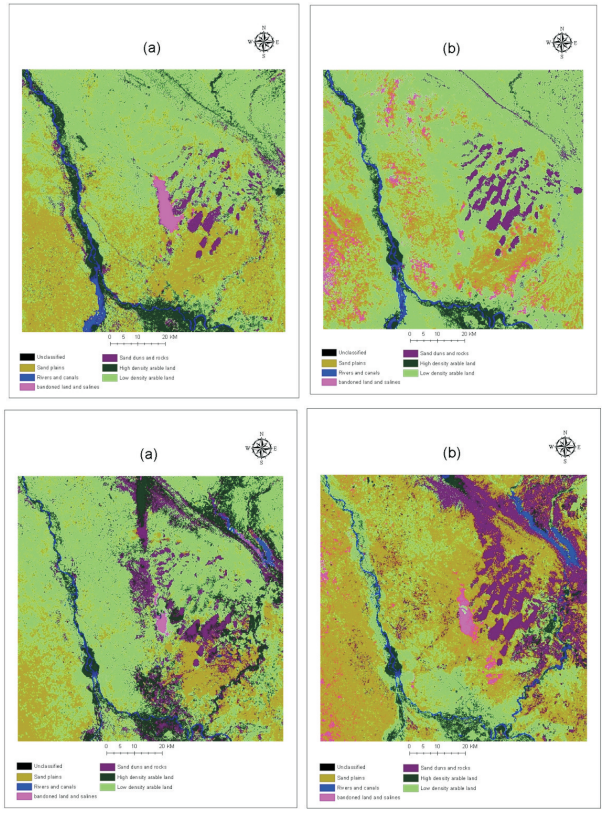

Fig 7. illustration, the study area topography by the features extracted from using reclassification process of a and b first row images for periodic march and august 1987 years, and the same months for 2017 years.

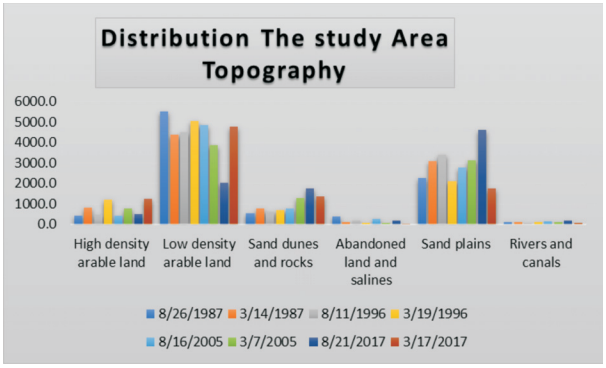

Fig 4. Illustration, topographies of study area for the period 1987-2017 years.

served point has an associated weight that is inversely proportional to the distance to the point to be estimated and its mathematical formula (Fouad and Gheidaa, 2017);

$$Z(x,y) = \sum_{i=1}^{n} wi\ fi \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2-12)$$

… (5)

Where;

n is the total number of observations, f_i are the observed values, and w_i is the weighted associated with each observation point, relative to an observation at (x, y).

Weights are calculated using the following weight function;

$$W_i = h_i^{-p} / \sum_{i=1}^{n} h^{-p}_{\ i} \quad \ldots (6)$$

Where;

ρ is the power parameter that defines the rate of the reduction of the weights as distance increases, h is the distance between the observation point and the point to be estimated;

$$h_i = \sqrt{(x - x_i)^2 + (y - y_i)^2} \quad \ldots (7)$$

Where; (x, y) and (x_i, y_i) are the coordinates of the interpolation point and the scatter point [7], shown Figure 5, 6, 7 and 8.

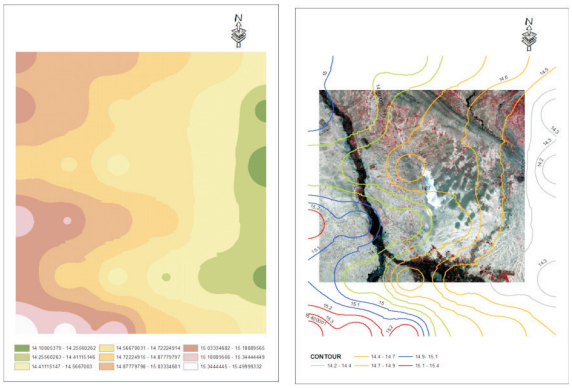

Fig 5. Illustration sample, the interpolation techniques appied the study area and determinedthe contour lines,

Conclusion

Interest Remote Sensing (RS) and Geographic Information System (GIS) for the study area monitoring will be study effect different climatic factories (temperature, Evaporation and Precipitation) on this region without reach it, by use the satellite landsate imagery process for four decade period 1987-2017 years. Then determined the categories identity of

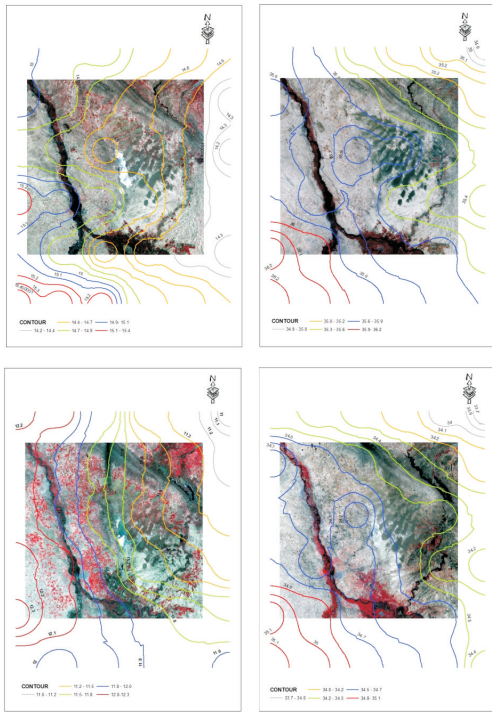

Fig 6. Illustration, temperatures degree for march and augut for 1987 and 2017 years by representation the contour of interpolation techniques.

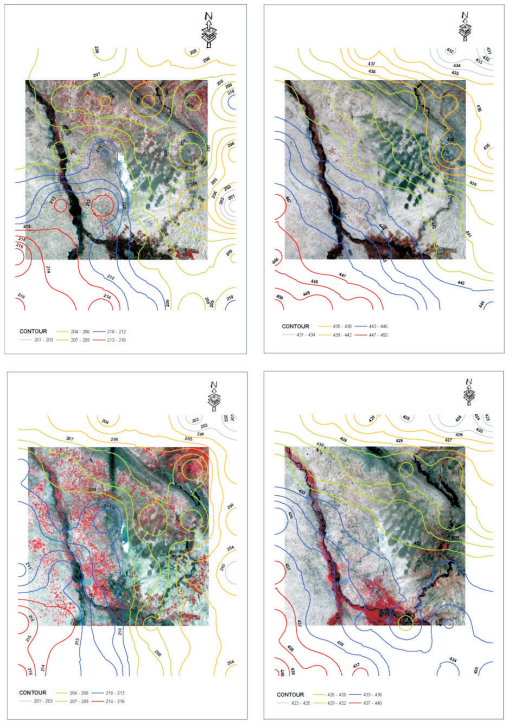

Fig 7. Illustration , evaporation for Marh and August for 1987 and 2017 years by representation the contour of interpolation techniques

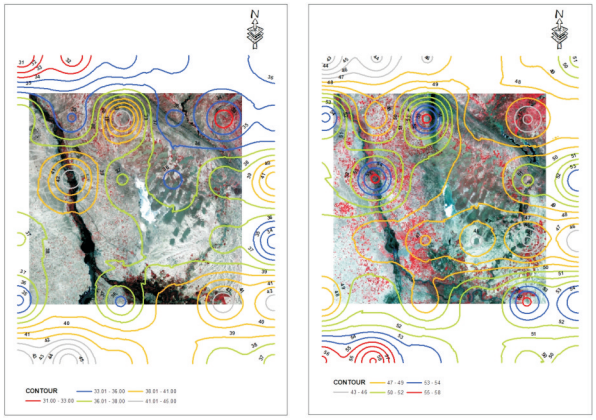

Fig 8. Illustration, temperatures degree for march and augut for 1987 and 2017 years by representation the contour of interpolation techniques.

the land cover that represents the study area images elements with real world corresponding, and the effect magnitude on the Al-shari Lake in salah Al-deen territory, that finding the climate factories were obvious effective, however, the temperatures with steam process are inversely Precipitation process in end result. from Table 3, that the account of water pixels statistical value in classification techniques process was 37.8% in March of 1987 year with 16.18 C° opposite of with 36.11 C° in August which was the water 18.5%. Compare with the same factor 1n 2017 year find the water 25.9% and 17.7% sequence.

Moreover, the same miner above, for topography variable also they are effective for these climatic factors, instance, the abandoned with saline land and sand dunes with rocks are inversely relationship with the waters quantities, and, that the low and high density arable are direct proportion with waters quantities.

Therefore, representation this of climatic factors variable by predict mapping using the interpolation techniques and contours line in order to learn or study and acknowledge the unknown area by known fixed points (weather stations) that represented climatic factors variable (temperature, Evaporation and Precipitation). These process might be performance improvement to find arable regions and assistance to decrease the abandoned with saline regions. In Addition to increase vegetation types covered regions in order to decrease evaporation quantities and atmospheres mitigation.

References

Al janabi, Mahmood Hasan., 2008. *Hydrochemistry of the unconfined aquifer and the relationship of unsaturated zone sediments on ground water quality in Tikrit-Samara.* PhD Thesis, Department of geology Science, College of Science, University of Baghdad.

Fouad K. Mashi, 2018, monitoring AL-Hammar Marsh Topography and Climatic Applied Satellite Modis Imagery. *Indian Journal of Natural Sciences*, ISSN:0976-0997, 8 (47) : 13704-13714.

Fouad, K. Mashee Al Ramahi and Zina Khalil Ibrahim Al Bahadly, 2017. Estimation of Suaeda aegyptiaca Plant distribution regions at Iraq using RS & GIS Applications. *Iraqi Journal of Science*. 58 (2A) : 767-777, DOI:10.24996.ijs.2017.58.2A.20.

Fouad K. Mashee, Gheidaa S. Hadi, 2017. Study the Wet Region in Anbar Province by Use Remote Sensing (RS) and Geographic Information System (GIS) Techniques. *Iraqi Journal of Science.* 58 (3A) : 1333-1344, DOI: 10.24996/ijs.2017.58.3A 18.

http://apps.ecmwf.int

Jay Lee and David Wong, 2001. *Statistical Analysis with ArcView GIS.* New York: Wiley.

Lillesand, T.M. and Kiefer, R. W. 1994. *Remote Sensing and Image Interpretation*, 3rd Edition. New York: john Wiley & Sons.

Mitchell, Andy, 2005. *The ESRI Guide to GIS Analysis*. Volume 2. ESRI Press.

O'Sullivan and Unwin, 2003. *Geographic Information Analysis.* Wiley.

Ola Adil Ibrahim, 2018. Determination of Radon Pollution Regions in Baghdad City Using Remote Sensing and Geographic Information System. Fulfillment of the Requirements for the Degree of Master of Science in physics (Remote sensing and image processing), University of Baghdad, College of Science, Department of physics.

Sheikh Hasan, Hamza, 2006. A Comparison of Interpolation Techniques for Spatial Data Prediction. Master Thesis, Computer Science, College of Science, University of Amsterdam.