Eng. & Tech. Journal, Vol.28, No.22, 201

Using Remote Sensing and Gis Tichenck to Study Soil Chemical Properties for Hour Al-Hammar (South of Iraq)

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Received on: 10/2/2009
Accepted on: 16/2/2010

Abstract:

This work includes the digital image processing (image enhancement and the digital classification techniques) using ERDAS, ver.,8.7, package for Landsat 7 (ETM+), 3-visible bands with resolution (14.25m), acquired in March 2004 .

The field investigation includes GPS device (Global Position System) to determine the coordinates of soil sample location , which coincides with the reports of the laboratory tests (chemical tests), which include organic matter, total dissolved solid, sulphate, and electrical conductivity, due to the effectiveness of these chemical properties on the spectral response of soil, and spectral measurements by using radiometer instrument.

The main results of this study, by using GIS techniques depends on remote sensing data, using ArcView software ver.3.3, a geographical database and information about layers of soil of the overall studied area have been registered and constructed digitally to represent the geotechnical soil characteristics in associated files, and produce digital soil map. It is considered the preferable technique to represent the ground truth regarding the characteristics of soil, in comparison with the traditional method, because they are easy to produce, use, store and update, in addition they save in efforts, time and cost.

Keywords: Studying chemical properties using Remote Sensing &GIS

توظيف تقنيات التحسس النائي ونظم المعلومات الجغرافيه لدراسة الخصائص الكيميائية لتربة هور الحمار (جنوب العراق)

الخلاصة

في هذه المقالة المقاله تم توظيف تقنيات التحسس النائي ونظم المعلومات الجغرافية لدراسة بعض الخصائص الكيميائية التي تؤثر على الانعكاسية الطيفية لتربة هور الحمار (جنوب العراق). حيث تم تحديد موقع منطقة الدراسة و اخذ عينات التربة بأستخدام جهاز GPS (Global Position System)

لتحديد احداثيات مواقع عينات التربة وبعد ذلك اجراء الفحوصات الكيميائية :(فحص المواد العضوية، فحص الاملاح الذائبة ، الكبريتات و فحص التوصيل الكهربائي)، تم اختيار هذه الفحوصات بالتحديد لتأثير هذه الخصائص على الانعكاسية الطيفية للتربة، ومن ثم اجراء الفحوصات الطيفية بأستخدام جهاز الراديوميترو وربط نتائج الفحص بنتائج الفحوصات الكيميائية، بعد ذلك تم اعداد قاعدة بيانات جغرافية لتربة منطقة الدراسة ترتبط مع الخريطة الرقمية لغرض تمثيل بعض مواصفات التربة الكيميائية بواسطة نظام المعلومات الجغرافية GIS بأستخدام الحقيبة البرامجية (Arc View 3.3) .

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https://doi.org/10.30684/etj.28.22.1
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ان اهم الاستنتاجات التي توصلت اليها الدراسة خارطة تصنيف التربة الموضوعية بأستخدام تقنيات GIS بالاعتماد على بيانات التحسس النائي التي تعتبر الافضل لتمثيل الحقيقة الارضية و ذلك فيما يتعلق بدراسة خصائص التربة لمنطقة الدراسة بالمقارنة مع الطريقة التقليدية للسهولة في الانتاج و الاستخدام و الخزن والتحديث بالاضافة الى اختزال الجهد و الوقت والكلفة في تهيأه المعلومات لمتخذي القرار للدراسات البيئية للمنطقة.

1. Introduction

Remote sensing is the science of acquiring, processing and interpreting images that record the interaction between electromagnetic energy and matter[1] .

Usually, remotely sensed data refer to data of the Earth collected from sensors on satellites or aircraft. In general terms, an image is a digital picture or representation of an object. In this study, digital satellite remote sensing data have been processed and manipulated in computerized GIS manner to build-up digital information database in order to support a suggested methodology, which is developed to detect the some of chemical soil's properties that affect on the spectral response of soil in the overall study region.

2. The Study Area

Al-Hammar marsh selected as study area which is lies south of Euphrates river and extends from Nassriya in the west to Basrah suburbs at Shatt Alarab in the south of Iraq, about (300)km south of Baghdad. Its length is about 90 km with width is between (25-30) km[4]. Locally study region extends between latitude (31°00'-31°30') north and longitude (46°24'-47°18') east, as shown in the figure.(1) .

3. Field Work & Chemical Properties:

Some of chemical characteristics that effect on spectral respond to the soil were determined as follow:

3.1 Organic Matter Content (OM):

Organic matter is determined by ashing about (10) grams scoop of the soil sample at 600C° for two hours in a muffle furnace. The loss by weight at the sample during this ignition is calculated as the organic matter. Results are reported as percent organic matter by weight in the soil[5].

3.2Total Dissolved Solid (TDS):

This test describes determining the amount of water soluble salts in soil. The value of resulting test about (3.69%-7.75%) [5].

3.2 Electrical Conductivity (EC):

For measuring the conductivity of soil by using instrument made from Hanna, (N.C.R, 1988) after extracting the (100g) sample of soil with rate 1:1[5].

3.3 Sulphate Content (SO_3):

For measuring sulphate, take (100gm) from sample of soil and adding hydrochloric acid with (10%) concentration, boiling and filtering. Take (450)ml from solution and suspended by barium chloride ($BaCL_4$), (5%, 25gm) concentration with (500)ml dust water, after 24 hours the solution filters and washing by dust water to release from chlorides and burning the samples[6].

4. Data Analysis & Results for Chemical Properties Tests:

Table (1) shows the results of the test:

5. Spectral Reflectance Measurement and Soil properties

To determine the spectral reflectance for different targets (soil samples) by using multi bands radiometer, the wavelength with its three bands is the same wavelength of the bands 1,2,3 of satellite images, which has the range (0.5-0.6)µm-(0.6-0.7)-µm-(0.7-0.8)µm.

Following figures shows that the difference in soil chemical properties has apparent effect on spectral reflection curves, so we see in figure.(2) that the greater the amount of organic content in the upper portion of soil, the greater the absorption of incident energy and lower the spectral reflectance.

Figure.(3) shows that the increasing in conductivity (EC) of soil causes the increasing in spectral reflectance curves, but when the amount of (EC) reaches to (14ms/cm)the spectral curve begins to decreasing.

Figure.(4) shows that increasing the total dissolve solid in soil (TDS) causes the decreasing in spectral reflectance curves, but when the percentage of TDS is greater than (6%) spectral reflectance curve begins to increase.

Figrue.(5) shows that increasing the sulphate content SO_3% causes decreasing in spectral reflectance curves, but when the percentage of SO3 is greater than (6%) spectral reflectance curve begins to increase, because the sulphate begins to accumulate on the surface of soil.

6. GIS &Digital maps

Arc View GIS 3.3 package which is a professional GIS level from (ESRI), has been adopted, according to this program each layer will be presented as a theme depending upon the cartographic features that could be points , lines, or area. Therefore there are three types of layers (point, line, polygons) respectively.

An attribute data table will be created for each layer and each feature in this layer will be linked with a record of this table.

The data collected include qualitative and quantitative descriptions of the location (X,Y coordinates) including (twenty five) samples of soil that are observed by GPS survey, from the study area.

the forming of database has been achieved from the outcomes of the laboratory chemical tests of the soil's selected samples, which include the water content (WC%),percentage of organic matter (OM%), total dissolve solid (TDS), electrical of conductivity (EC), and represented as points, shown in figure. (1) & table (2).

a. Spatial Analysis

Its spatio-analytical capabilities distinguish a GIS from other data processing systems. These capabilities use the spatial and non-spatial data in the spatial database to answer questions and solve problems that are of spatial relevance.[2]

With Arc View's spatial analyst extension, themes can be converted depending on vector features to grids. Also grids can be derived from various spatial analysis operations, and it is added to view as grid themes. These grid cells have been classified in various ways and different colors are chosen for each class, the colors represent the progression of values for a data attribute which is specified.

b. Digital map Presentation

After the data analyzed above, our data are prepared for producing the maps. The relationship between maps and GIS is rather intense. They can be used to communicate results of GIS operations, and maps are tools while working with GIS to execute and support spatial analysis operations [2] ,So the final output maps of the spatial analysis which represent chemical soil characteristics such as moisture content, organic matter content, ,total dissolved solid content, electrical conductivity, and sulphate content are illustrated in figures(6), (7), (8),(9), and (10) respectively:

7. Results & Conclusions:

1. The amount of organic matter in soil will effect on the spectral reflection of soil. So, the increase in organic matter content indicates an increase in absorbed energy and reduction in the reflected energy from soil, and reduction in the radiometer reading.
2. Increasing the total dissolve solid (TDS) in soil causes the decreasing in spectral reflectance of soil, but when the percentage of (TDS) is greater than (6%) the spectral reflectance of soil begin to increase. So, the soil appears lighter when (TDS) increases in soil. So the effect of sulphate (SO_3) is the same above.
3. The increasing of electrical conductivity (EC) content in soil will increase the reflected energy, but when the amount of (EC) reach to (14ms/cm) the reflected energy will decrease.
4. The integration between Remote Sensing techniques RS and Geographic Information System GIS may give more effective results in production of soil classification maps, and prepare best data base with high technique of digital maps presentation for decision makers.

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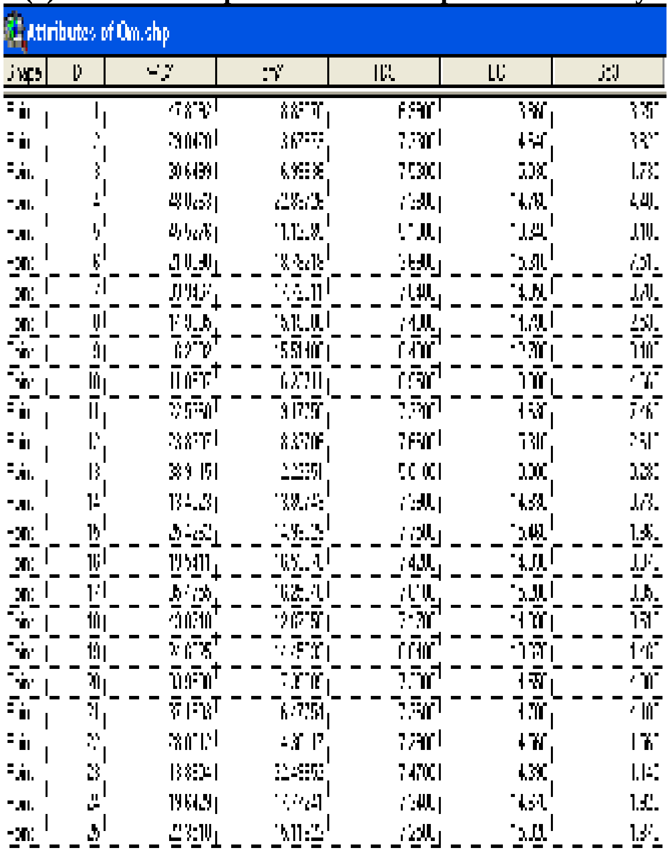
Table (1) refers to the results of the Chemical Properties Tests:

Sample No.	Organic Matter (OM)%	Sulphate (SO_3)	Total Dissolve Solid (TDS)%	Conductivity (EC) ms/cm
1	**18.8307**	3.25	6.99	13.86
2	**13.6767**	3.82	7.33	14.64
3	**16.9963**	1.73	7.53	15.03
4	**22.8372**	4.4	7.38	14.76
5	**11.1208**	0.1	5.10	10.34
6	**18.7821**	7.51	3.69	7.39
7	**17.7231**	3.7	7.04	14.05
8	**15.1980**	2.53	7.4	14.79
9	**15.5140**	0.18	6.4	12.78
10	**16.2371**	4.66	6.95	13.88
11	**19.1775**	7.46	7.32	14.63
12	**18.3270**	2.61	7.66	15.31
13	**12.2235**	0.28	5.01	10.0
14	**13.8574**	0.73	7.39	14.83
15	**14.9302**	1.86	7.75	15.46
16	**16.5397**	0.37	7.42	14.83
17	**16.2594**	3.85	7.61	15.20
18	**12.6785**	3.51	7.17	14.33
19	**14.4533**	1.46	6.84	13.67
20	**17.3920**	4.9	7.3	14.55
21	**16.4775**	4.1	7.36	14.7
22	**14.3011**	1.56	7.29	14.56
23	**32.4985**	1.14	7.47	14.39
24	**17.7724**	1.92	7.34	14.67
25	**15.1182**	1.87	7.25	15.02

Table (2) Chemical Properties of soil Samples for the Study area



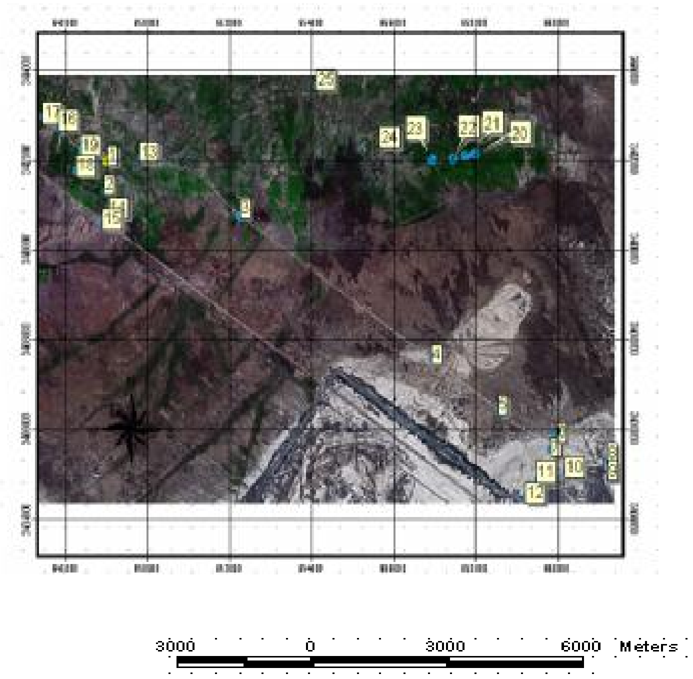


Figure (1) ETM Landsat satellite image show Study Region with points represent soil samples type

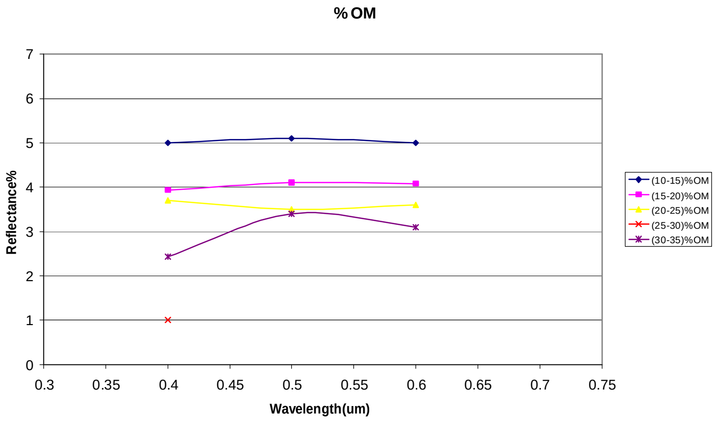


Figure (2) Spectral Reflectance curve depend on O.M%

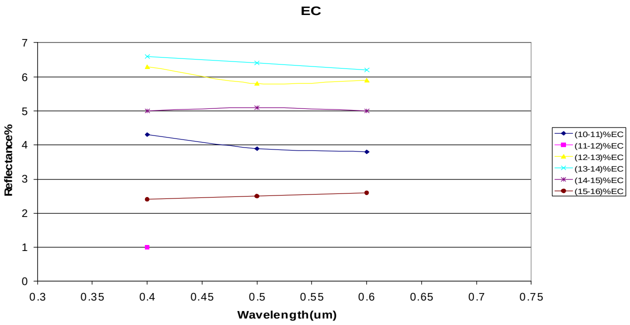


Figure (3) Spectral Reflectance curve depend on EC

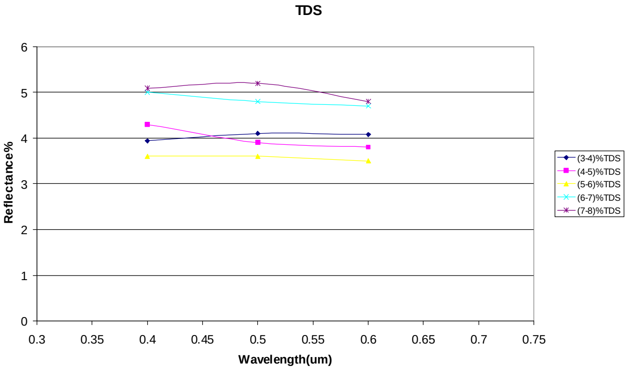


Figure (4) Spectral Reflectance curve depend on TDS

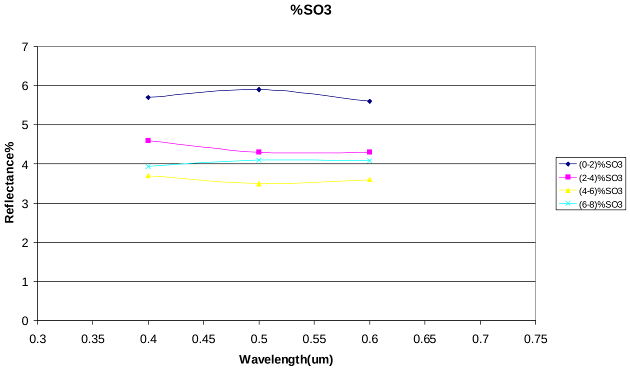


Figure (5) Spectral Reflectance curve depend on SO_3

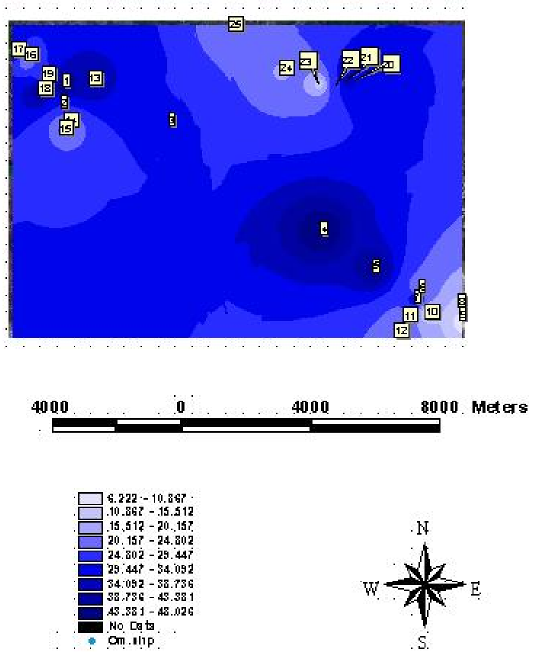


Figure (6) Interpolate Grid of the moisture content for the soil samples

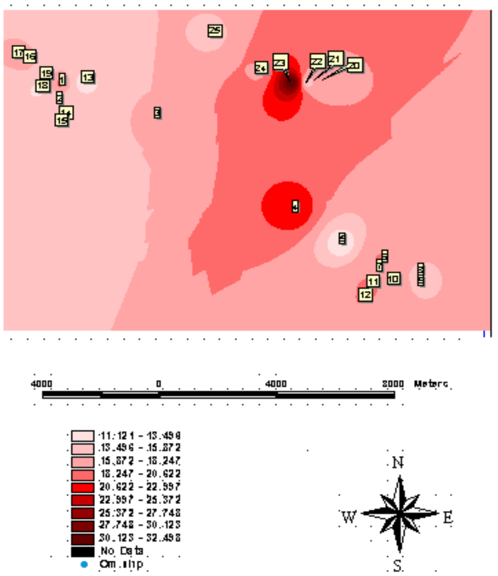


Figure (7) Interpolate Grid of the organic matter content for the soil samples

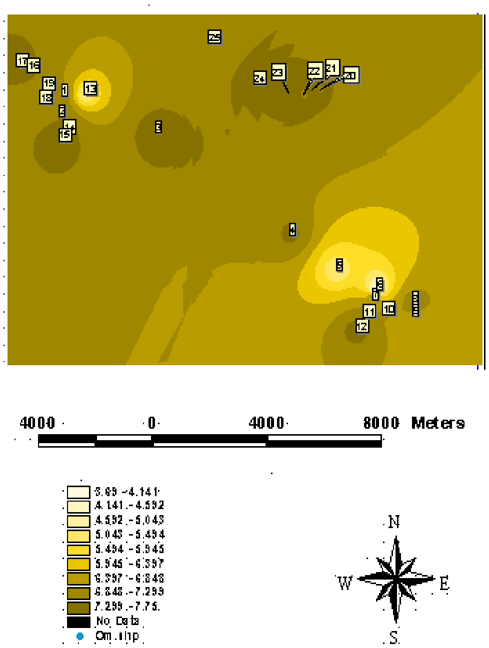


Figure (8) Interpolate Grid of total dissolve solid content for the soil samples

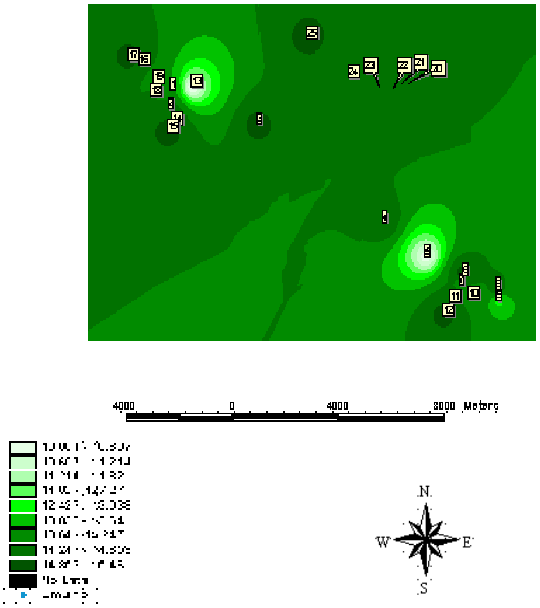


Figure (9) Interpolate Grid of Electrical Condictivity content for the soil samples

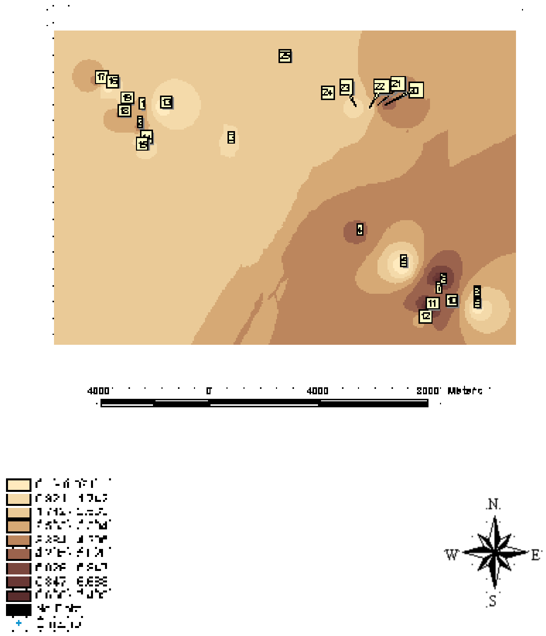


Figure (10) Interpolate Grid of Sulphate (SO_3) content for the soil samples