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ACCURACY ASSESSMENT OF THEMATIC MAPPER AND ASTER SATELLITE DATA FOR MAPPING OF SOIL SURFACE CONDITIONS (EL-DABAA REGION , NORTHERN COATS ,EGYPT)

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ABSTRACT

The supervised classification of multitemporal ETM+ (2001) and ASTER data (2010) showed that the land cover types , of Dabaa region , are sandy dunes (18.10 %) crusted soil (32.31%) non crusted soil surface (28.99%) cultivated land (15.35%) ,and urban area (5.25%).The crusted soil surface represents the largest theme with an area of 19541.96 hacter. The confusion matrix enabled to determine the omitted (under estimated) and committed (over estimated) pixels of the different information classes . The interpretation of confusion matrix indicted that (a) generally, the mapping categorical accuracy ranged form of 72.9 % to 95.5 % , and from 63.8 to, 82.1% in the for ASTER and ETM+ data , respectively (b) the information class of non crusted soil surface , mapped by ASTER data , had the lower value of categorical accuracy with value of 72.9 % , while sandy dunes had the higher one (95.5 %) , (c) having an overall accuracy of 93 % , the ASTER data proved higher soil mapping accuracy than ETM+ data . This higher overall accuracy of ASTER (2010) data, relating to this of ETM+ (2001) , may due to errors in reference data . The errors in reference data such as incorrect class assignment, change in cover type between the time of imaging and the time processing the reference data, lead some of correctly classified pixels to may be incorrectly assessed as being misclassified.

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Basing on spectral behavior of some soil surface properties, two remotely soil surface indices were derived; a spectral crust index (CI) and soil surface brightness index (BI). A spectral crust index (CI) had been developed, based on the normalized difference between the red and blue spectral digital data .CI = 1- (Red –Blue) / (Red + Blue). The application of (CI) index , to the soils of the northern coast , classified the soil surface into three classes ; non crusted (15.29 %) , moderately crusted (62.24 %) and crusted soil surface (22.47%) . The crust - mapping potentiality, of (CI) index , indicated that it has an accuracy of 68.75%. The Soil Brightness (BI) was calculated, as square root of the summation of ETM+ bands (3, 5 and 7) to map the different classes of soil surface $CaCO_3$ content. The (BI) index (BI) classified the studied region into three classes; relatively riched (less than10 %), riched (10-15 %) and highly riched(>15 %) - $CaCO_3$ content soil surfaces. This index proved relatively high potentiality, of mapping soil $CaCO_3$ content, with accuracy also of 68.75 %.

Keywords: ETM+ , ASTER , confusion matrix, land cover types, over all accuracy , spectral behavior , remotely soil surface indices, a spectral crust index , surface brightness index , and soil $CaCO_3$ content.

INTRODUCTION

Enhanced Thematic Mapper Plus (ETM+) are the most frequently used data sets at a regional scale due to their relatively lower cost, longer history and higher frequency of archive. Information regarding the land covers over time and space is a fundamental requirement for environmental monitoring in order to prevent from detrimental environmental impacts before it becomes irreparable. The Advanced Space-borne Thermal Emission and Reflection Radiometer (ASTER) instrument is included on the Earth Observing System (Manandhar , R , 2012)

Land use and land cover of some areas of the north western coast were remotely sensed mapped through some studies, such as Osman, M. M (2011) This due to the fact that land use and land cover is dynamic in nature and is an important factor for the comprehensive

of the interaction and relationship of human activities and environment (Irfan ,H ,2012)

The over all accuracy different techniques -mapping of ETM + were widely determined by scientists. Manso et,al (2009) enhanced the ETM + mapping accuracy by combining spectral mixture analysis and object –object based classification . Lin and Li (2011) found that the overall accuracy , of ETM + mapping of some hilly regions (China) ,had the value of 80.25 % . Oruc, et. al (2012) calculated the overall accuracy of the different techniques of ETM - classification ; parallelepiped , minimum distance , maximum likelihood and object –oriented classification .These techniques had the overall accuracy of 64.57 % , 62.57% , 66.86 % , and 81.30 % ,respectively .

Calcareous crust is a common and wide spread soil surface property in arid and semi- arid region Distinction should be made between calcareous crusted and non crusted soils because of its negative effect on seeds germination. However, despite the previous effect of calcareous crust , and its largely occurrence in in arid and semi-arid region , a few of related researches were elaborated to map soil crusting phenomena. Some remotely sensed soil surface can be derived for detailed maps of soil surface properties, Salisbury and D'Aria (1992), and Weber,et.al (2012) . In arid and semi arid region, calcareous crusted – soil are usually formed by participation compaction, while biogentic crust (organic or microphtic crust) is related to the activity of algae and some types of bacteria. This crust affects of soil spectral behavior which can be mapped by spectral crust index (CI) Karnieli , K. (1997) cited (Abd El-Hady,2011)

$$CI = 1 - (NIR - BLUE) / (NIR + BLUE)$$

The conducted research has the following objectives to (a)) map and detect changes land cover of the studied region (b) assesse the accuracy of mapping of soil surface conditions by ETM + and ASTER Data ,and (c) present the approach of mapping calcareous soils by remotely sensed soil surface indices

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MATERIALS AND METHODS

(1) Soil Sampling Design and Laboratory Analysis :

Three sets of satellite data ; ETM + data (28-3- 2001) and Aster (25 -9- 2010) , were downloaded from Land Cover Facility (2012) **.** The variation of the radiometric transects of ETM + digital data guided to design the soil sampling. Forty eight soil surface samples were localized by Globe Positioning Satellite (GPS). Field observations were recorded to represent a database of ground checks. These forty eight zones – test were classified into subclasses ; non crusted , moderately crusted and crusted soil surface .Then , the samples were collected and prepared for determination of $CaCO_3$ content by Collin's calcimeter method , (Jackson , 1967).

(2) Processing of Satellite Digital Data :

(a) Supervised Classification of +ETM and ASTER Satellite Data:

Statistical Determination of the most informative bands: The subimages of the studied region were cut form the whole scenes of ASTER and ETM+ data (ERDAS ,2010) .The most informative bands of ETM+ were determined by the optimum index factor (OIF) as introduced by Abd El-Hady, et al (1992). The powerful statistic of this factor is due to the fact that its value is the ratio of two important statistical parameters ; standard deviation and correlation coefficient:

OIF =Sum (Sd) from A=1 to A = N / Sum (r) from A=1 to A = N

Where : Sd = standard deviation , and r = correlation coefficient

These statistic parameters of spectral bands were calculated by using remote sensing software (ERDAS , 2010)

- **Thresholding and Classification:** Nine zones –test were selected to represent themes observed ground themes of the studied region. The patterns of these zones – test, were used as spectral nucleus to aggregate the pixels into spectral information classes by applying a supervised classification , for ETM+ bands (3,5 and 7) and ASTER three bands of visible-near-infrared region-VNIR (between 0.520 and 0.860 µm) , ERDAS (2010)

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(b) Derivation of New Remotely Sensed Soil Surface Indices:

Two remotely sensed soil surface indices were be derived to map accurately soils conditions:

- Spectral crust index (CI), where CI =1- (NIR – BLUE) / (NIR + BLUE) Karnieli K. (1997) cited (Abd El-Hady, 2011) . This index was derived to map the crusted , moderately and slightly calcareous soil surfaces

- Soil Brightness (BI),where (BI) = square root of sum of SpoT bands (SX1,2,3) , Abd El-Hady,et.al (1999). This derivate contributes into further classification of varied $CaCO_3$ content - soil surfaces that may be expressed by brightness parameter .

© Map Generalization

All produced maps were submitted to the final processing (a) map generalization (b) dynamic link of information layers (c) annotation & map composition , and (d) Results export (hard copy & printing)

(3) Accuracy Assessment of Remotely Sensed Soil Surface Mapping

The remotely sensed soil surface maps that elaborated by supervised classification of original ETM +and ASTER data , and remotely sensed soil surface indices were assessed by two methods ; accuracy matrix and) ground check.

(a) Accuracy matrix technique: The accuracy assessment was elaborated for ETM and ASTER data classification , where 315 zones- test (each zone test contains 5*5 pixel) , Abd El-Hady,et al (2004) and ERDAS (2010) . Different formulas were applied to assess the accuracy of classified images:

- **Omission errors:** $O_i = \frac{X_{ii}}{X_{+i}} * 100$, where:

O_i → error of omission ,Xii → number of omitted pixels classified incorrectly because of omission (columns in confusion matrix)
X+i → total number of pixels in the Referenced class

- **Commission errors :** $C_i = \frac{X_{ii}}{X_{i+}} * 100$, where:

C_i → error of commission

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X_{ii} → number of committed pixels classified incorrectly because of commission (rows in confusion matrix) , X_{i+} → the total number of pixels in the classified class

- **Producer's and User's accuracy :** $\bar{O} = \frac{X_{ii}}{X_{+i}} * 100$**,** where:

$\bar{O}$ → producer's accuracy , X_{ii} → number of pixels classified correctly

X_{+I} → total number of pixels in the Referenced class

- **User's accuracy :** $\bar{C} = \frac{X_{ii}}{X_{i+}} * 100$, where:

$\bar{C}$ → user accuracy , X_{ii} → number of pixels classified correctly
X_{i+} → the total number of pixels in the classified class

- **Overall accuracy :** $P_o = \sum_{i=1}^{k} X_{ii.} * 100$, where:

P_o → overall accuracy , X_{ii} → number of pixels classified correctly
N → total number of pixels

- **Overall Kappa Statistics :**

$$K = \frac{(N * \sum_{i=1}^{k} x_{ii.}) - \sum_{i=1}^{k} (x_{i+} * x_{+i})}{(N * N) - \sum_{i=1}^{k} (x_{i+} * x_{+i})} * 100$$

Where : K= Overall Kappa Statistics

N = total reference pixel number , xii = number of corrected classified pixel (class i) , xi+ = total pixel in row I , and x+i= total pixel in column i

(b) Ground check - accuracy technique : Filed trips observations and laboratory results were related to the maps of (CI) and (BI) remotely sensed indices of calcareous soil surfaces . Zones – test that are correctly and non-correctly mapped are marked as true (***) and false (++) , respectively . The ratio of correctly mapped zones – test

to whole number of the test was calculated as an indicator of mapping accuracy.

RESULTS AND DISCUSSION

(1) ETM+ (2001) – Land Cover Mapping :

The standard deviation of the different bands and their inter-correlation matrix were calculated in order to determine the Optimum Index Factor (OIF) ,table (1) .The OIF determined the most informative bands to exclude the other redundant bands and arise the image information. This statistical factor is confirmed of the results of the interrelationships of image bands. The OIF ranked OIF values showed that ETM + (3,5 and 7) combination have the highest value of OIF (24.78). This means that the combination of these three bands has higher potentiality to map the soil surface variations of the studied region.

Table (1) Optimum Index Factor (OIF) of ETM + (2001) bands

Bands Comb.	Summation		OIF	Rank	Bands Comb.	Summation		OIF	Rank
	StDev.	Inter correl.				StDev.	Inter correl.		
3-5-7	31.84	1.29	24.78	1	1-3-5	30.87	2.16	14.29	11
4-5-7	28.63	1.35	21.19	2	1-2-7	24.44	1.78	13.76	12
3-4-7	30.34	1.52	19.90	3	2-4-5	29.50	2.17	13.60	13
2-3-7	29.92	1.54	19.44	4	2-3-4	31.21	2.38	13.12	14
1-3-7	28.08	1.50	18.77	5	1-4-7	24.86	1.93	12.88	15
3-4-5	33.14	1.80	18.42	6	1-3-4	29.37	2.28	12.89	16
2-5-7	28.21	1.55	18.19	7	1-2-3	28.95	2.26	12.78	17
2-3-5	32.71	2.14	15.30	8	1-4-5	27.65	2.35	11.79	18
1-5-7	26.36	1.78	14.77	9	1-2-5	27.23	2.52	10.82	19
2-4-7	26.71	1.82	14.67	10	1-2-4	25.73	2.67	9.65	20

The supervised classification of multitemporal ETM+ (2001) and Aster (2010) data mapped the land cover of the studied regions that composes of five types of land covers (Fig 1 ,2). Aster (2010) data – mapping determined quantitatively these cover ; sandy dunes (18.10 %) , crusted soil (32.31%) non crusted soil surface (28.99%) , cultivated land (15.35%) ,and urban area (5.25%).The crusted soil surface represents the largest theme with an area of 19541.96 hacter (Fig , 1,2) and Table (2) . Regardless of the type of satellite data , The

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comparison , between ETM+ (2001) and Aster (2010) maps , enabled to detect land cover ten years -changes .This comparison illustrated that (a) increasing sand dunes area by 2.45% that may due to the increasing of the activities of aeolian erosion , (b) contrary, the crusted soil surface reduced by 3.78 % because of the increasing of non crusted soil surface and urban area by 0.60 % , 0.18 % and 0.55 %, respectively , and (c) the areal changes of the other themes are remain under one percent (Table , 2) .

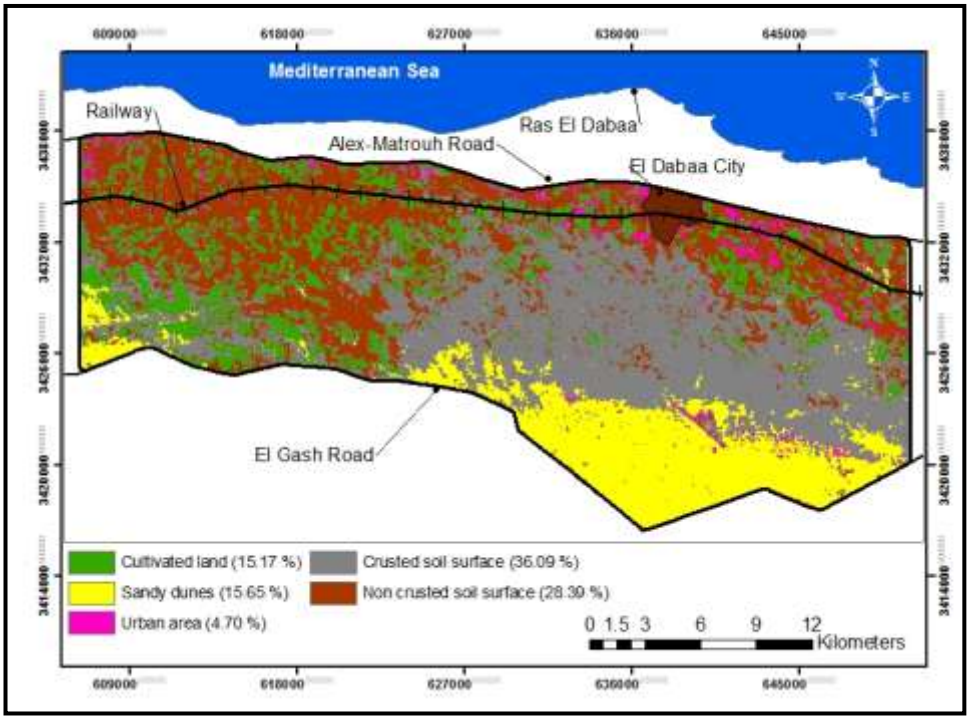

Fig (1) ETM+ (2001) - remotely sensed map of land cover (El-Dabaa Region)

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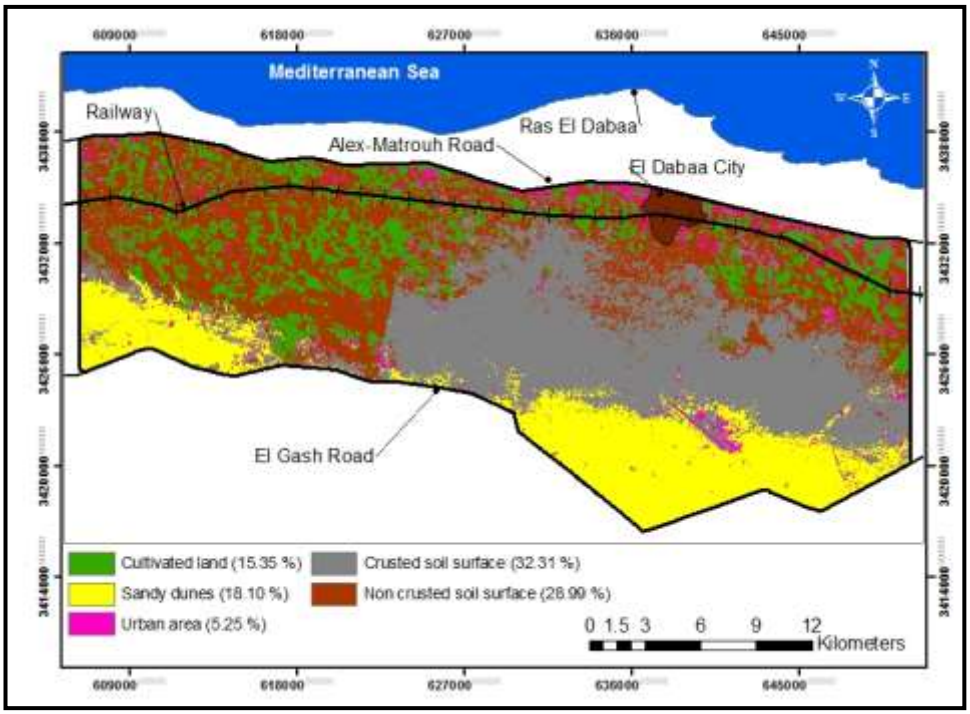

Fig (2) ASTER (2010) - remotely sensed map of land cover (El-Dabaa Region)

Table (2) ETM+ (2001) and ASTER (2010) mapped -land cover

Information Classes (Ground Themes)	Satellite Data				Detected Change (%)
	ETM+ (2001)		ASTER (2010)		
	(ha)	(%)	(ha)	(%)	
Sandy dunes	9464.43	15.65	10949.93	18.10	+2.45
Crusted soil surface	21833.45	36.09	19541.96	32.31	-3.78
Non crusted soil surface	17174.85	28.39	17535.37	28.99	+0.60
Cultivated land	9178.15	15.17	9285.814	15.35	+0.18
Urban area	2840.81	4.70	3178.758	5.25	+0.55
Total	60491	100	60491	100	

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(2) Accuracy Assessment of ETM+ Data

The confusion matrix of 5 x 5 information classes was calculated to assess the classification accuracy of ETM+ data (table , 3). In this matrix the column contains the omission errors, while the errors of commission are shown in the rows. Therefore, confusion matrix enabled to determine the omitted (under estimated) and committed (over estimated) pixels of the different information classes . The interpretation of confusion matrix indicted that:

- Table(3) referred that 315 zones –test were randomly selected to assess the classification accuracy of +ETM , while the categorical accuracy of information classes was tested by different number of zones-test. Mapping accuracy of sandy dunes ,crusted soil surface , non crusted soil surface , cultivated land and urban area , as information classes , were assessed by 57 , 104 , 54, 88 and 12 zones –test , respectively .
- As example , crusted soil surface class illustrated that for 89 zones test (89×9×9 pixels) only were correctly classified as members of the of this class.
- The second row showed that 8 zones test (8×9×9 pixels)were omitted to be classified in lower information class (sandy dunes) . The correctly classified pixels, of all information classes are represented by along the diagonal of the confusion matrix
- According of confusion matrix data, overall accuracy (*Po*) had the value of 86 % that was calculated as follows :

$$P_0 = \sum_{i=1}^{n} X_{ii} * 100$$

Po= (273/315)*100 = 86 % , while the overall Kappa Statistics had the value of 0.82% :

$$K = \frac{(N * \sum_{i=1}^{n} Xii) - \sum_{i=1}^{n} (Xi + * X + i)}{(N * N) - \sum_{i=1}^{n} (Xi + * X + i)}$$

$\sum_{i=1}^{n} (Xii)$= 49+89+49+75+11=273

$\sum_{i=1}^{n} (Xi + * X + i)$= (57*51)+(104*99)+(54*67)+(88*85)+(12*13)=24457

And finally ,K= ((315*273)-24457) / ((315*315)-24457) = 82%

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Table(3) Confusion matrix for ETM + (2001)

Land Cover Types	Land Cover Types					Total Zones Test
	Sandy dunes	Crusted soil surface	Non crusted soil surface	Cultivated land	Urban area	
Sandy dunes	49	8	0	0	0	57
Crusted soil surface	2	89	6	7	0	104
Non crusted soil surface	0	0	49	3	2	54
Cultivated land	0	2	11	75	0	88
Urban area	0	0	1	0	11	12
Total	51	99	67	85	13	315

The number of the omitted and committed pixels was related to all pixels to calculate the percentage of these errors. The summation of this percentage represented the erroneously classified pixels. Hence, we consider that categorical accuracy expresses the differential mapping potentiality , table (4).The table showed that :

- The producer's accuracies ranged between 73.1 % to 96.1%, the lowest producer's accuracy was recorded in the case of non-crusted soil surface class, while the highest producer's accuracies were for sandy dunes class. The user's accuracies ranged between 85.2 % (cultivated land) to 91.7 % (urban area .
- Generally, the mapping categorical accuracy ranged form of 63.8 % (sandy dunes) to 82.1 % (non crusted soil surface) . The higher values of omission and commission errors were occurred during the classification of non crusted soil surface spectral class (36.2 %). These errors were reduced to 17.9 % in case of for sandy dunes.

Table(4) Producer and user's accuracies for ETM+ (2001) classification

Land Cover Types	Omission Error	Commission Error	Omission and Commission Errors	Producer's Accuracy	User's Accuracy	Categorical Accuracy
Sandy dunes	3.9	14.0	17.9	96.1	86.0	82.1
Crusted soil surface	10.1	14.4	24.5	89.9	85.6	75.5
Non crusted soil surface	26.9	9.3	36.2	73.1	90.7	63.8
Cultivated land	11.8	14.8	26.6	88.2	85.2	73.4
Urban area	15.4	8.3	23.7	84.6	91.7	76.3

(3) Accuracy Assessment of ASTER Data

Confusion matrix of the supervised classification of ASTER (2010) data was calculated to determine its mapping accuracy (Table , 5). The table showed that

- 315 zone test (each zone test contains 9*9 pixel) were tested to assess the accuracy of ETM+ and ASTER data classification, while the categorical accuracy of sandy dunes, crusted soil surface, non-crusted soil surface, cultivated land and urban area spectral classes was tested by 67, 100, 60, 75 and 13 zones - test, respectively.
- The first column (table, 5) assessed the classification producer's accuracy for sandy dunes spectral class. This column indicated that for each of 66 zone test only 65 were correctly classified as members of the sandy dunes spectral class. Omission errors, of the sandy dunes spectral class, raised from under estimation of 1 zone test that were grouped to crusted soil surface class. These omission errors represent pixels that the classification technique has failed to classify them into their proper class. So, this accuracy measure is often called" producer's Accuracy ".
- In contrary, the last row (table ,5) assessed the classification User's accuracy for urban area spectral class. This row indicated that

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for each of 13 zone test only 12 were correctly classified as members of the urban area spectral class.

- According of confusion matrix data , the overall accuracy (*Po*) :

$$P_0 = \sum_{i=1}^{n} X_{ii} * 100$$

Po= (294/315)*100 = 93 % , and the overall Kappa Statistics (K) :

$$K = \frac{(N * \sum_{i=1}^{n} Xii) - \sum_{i=1}^{n} (Xi + * X + i)}{(N * N) - \sum_{i=1}^{n} (Xi + * X + i)}$$

$\sum_{i=1}^{n} (Xii)$= 65+95+51+71+12 = 294

$\sum_{i=1}^{n} (Xi + * X + i)$= (67*66)+(100*97)+(60*58)+(75*80)+(13*14) = 23784

K= ((315*294)-23784)/((315*315)-23784) = 91 %

Table (5) Confusion matrix for ASTER 2010

Land Cover Types	Land Cover Types					Total Zones Test
	Sandy dunes	Crusted soil surface	Non crusted soil surface	Cultivated land	Urban area	
Sandy dunes	65	2	0	0	0	67
Crusted soil surface	1	95	2	1	1	100
Non crusted soil surface	0	0	51	8	1	60
Cultivated land	0	0	4	71	0	75
Urban area	0	0	1	0	12	13
Total	66	97	58	80	14	315

Table (6) indicated that the numbers of the omitted and committed pixels were related to all classified pixels to calculate the percentage of these errors. The summation of this percentage represented the erroneously classified pixels. Hence,

we consider that categorical accuracy expresses the differential mapping potentiality .The table indicated that :

- The producer's accuracies ranged between 98.5 % to 85.7 %,the lowest producer's accuracies were for urban area class, while the highest producer's accuracies were for sandy dunes class. The user's accuracies ranged between97.0 % to 85.0 %; the lowest user's accuracies were for non-crusted soil surface class, while the highest user's accuracies were found for sandy dunes class
- Generally, the mapping categorical accuracy ranged form of 95.5 % to 72.9 % in spectral classes sandy dunes and non crusted soil surface, respectively. The higher values of omission and commission errors was for non crusted soil surface spectral class (27.1 %) and lower value of omission and commission errors was 4.5 % for sandy dunes spectral class .

Table (6) Producer and user's accuracies for ASTER 2010 classification.

Spectral Class	Omission Error	Commission Error	Omission and Commission Errors	Producer's Accuracy	User's Accuracy	Categorical Accuracy
Sandy dunes	1.5	3.0	4.5	98.5	97.0	95.5
Crusted soil surface	2.1	5.0	7.1	97.9	95.0	92.9
Non crusted soil surface	12.1	15.0	27.1	87.9	85.0	72.9
Cultivated land	11.3	5.3	16.6	88.7	94.7	83.4
Urban area	14.3	7.7	22.0	85.7	92.3	78.0

The higher overall accuracy of ASTER (2010) data, relating to this of ETM+ (2001) may due to errors in reference data . The errors in reference data such as incorrect class assignment, change in cover type between the time of imaging and the time processing the reference data, lead some of correctly classified pixels to may be incorrectly assessed as being misclassified.

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(4) Mapping Accuracy of Remotely Sensed Soil Surface Indices

(a) Ground check - accuracy assessment of mapping soil crust by spectral crust index (CI)

This soil surface crusting index was derived to differentiate the theme of crusted soils surface into three sub classes ; non crusted (15.29 %) , moderately crusted (62.24 %) , and crusted calcareous soil surfaces (22.47 %) , Fig(3) . The accuracy of the produced map was assessed by ground check . The map of zones –test location was over laid to verify their mapping accuracy (table ,7) . The footnote of the table indicated that the soil surface crusting index (CI) had the mapping accuracy of 68.75 %

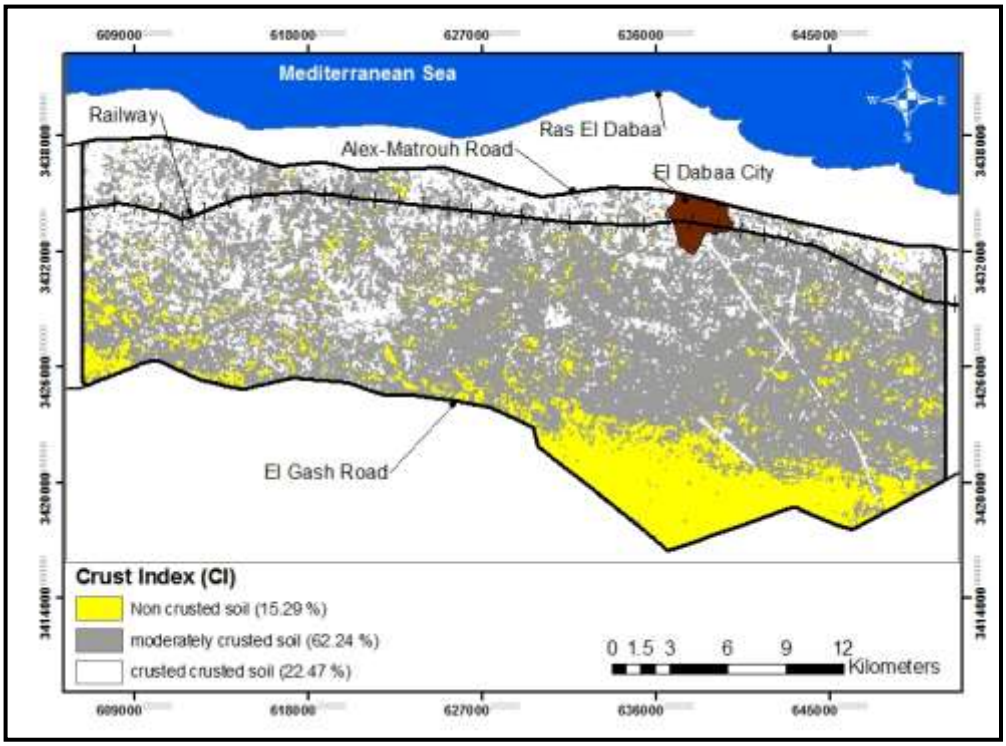

Fig (3) Spectral crust index - remotely sensed map of soil surface calcareous crust

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(b) Ground check - accuracy assessment of mapping soil $CaCO_3$ content by soil brightness index (BI)

This derivate contribute into further classification of varied $CaCO_3$ content - soil surfaces that are expressed by brightness parameter. It is supposed that the variation soil brightness may be associated with soil carbonates content. So , the study area , depending on content of $CaCO_3$, was further classified into three classes; class one contains CaCO3 less than 10 %, class two contains CaCO3 from 10 to 15 % , and class third contains $CaCO_3$ more than 15 %.These classes occupied about 1.12 % , 41.11 % and 57.77 % , of study area , respectively , table (8) and (Fig ,4). The footnote of the table indicated that the soil brightness index (BI) had $CaCO_3$ content - mapping accuracy of 68.75 % . This moderate mapping accuracy may be interpreted by problems of pixel spectral mixture (sm) and heterogeneity of zones–test.

Table (8) Ground check - accuracy assessment of mapping soil $CaCO_3$ content by soil brightness index (BI)

Zones-test No.	True or False	$CaCO_3$ %	Zones-test No.	True or False	$CaCO_3$ %	Zones-test No.	True or False	$CaCO_3$ %
1	***	22.6	17	***	18.3	33	***	20.3
2	***	20.3	18	++	22.9	34	++	23.3
3	***	23.1	19	++	21.1	35	***	22.9
4	++	19.2	20	***	17.5	36	***	25.2
5	***	19.1	21	***	22.5	37	++	9.6
6	***	24.3	22	***	11.0	38	***	19.0
7	***	17.9	23	***	23.2	39	***	13.9
8	++	16.4	24	***	22.6	40	++	18.3
9	***	22.9	25	++	12.5	41	***	18.8
10	++	18.3	26	***	21.8	42	***	21.8
11	***	11.1	27	***	21.0	43	++	23.2
12	***	11.3	28	***	17.2	44	***	18.2
13	***	11.9	29	++	11.1	45	***	23.2
14	++	22.2	30	***	16.8	46	++	8.2
15	++	21.4	31	***	15.6	47	***	21.1
16	++	14.7	32	***	22.6	48	***	17.9

True = *** , False = ++Total checked zones-test = 48 , True checked zones-test = 33 , False checked zones-test = 15 , Ground check – accuracy assessment = 68.75 %

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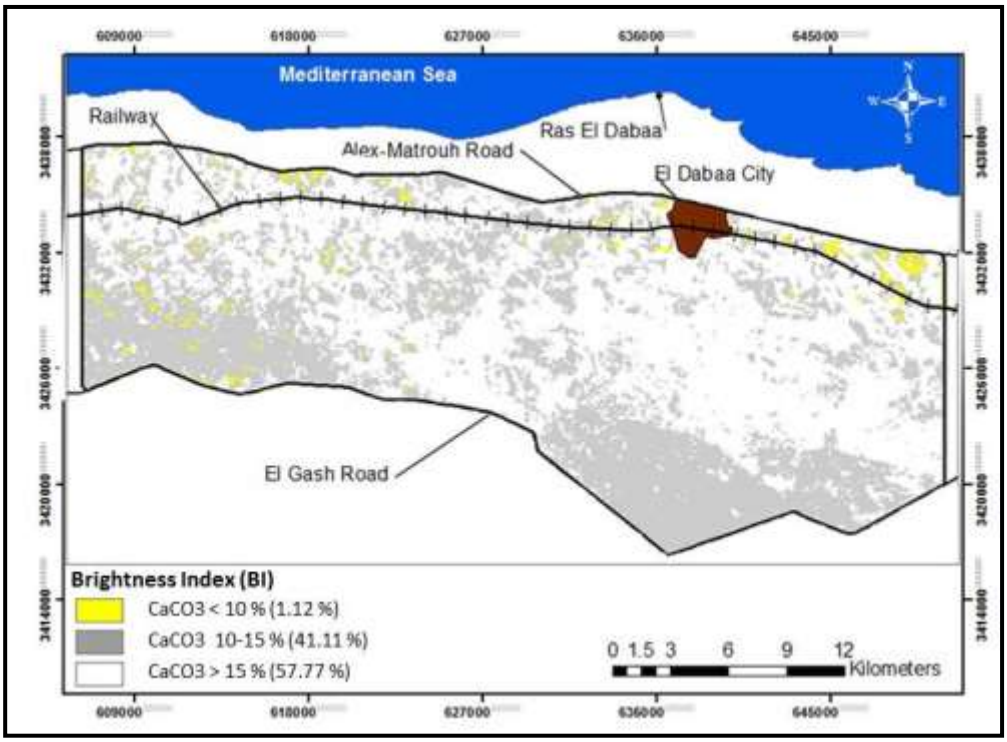

Fig (4) Soil brightness index (BI)- remotely sensed map of $CaCO_3$ content

CONCLUSIONS

The ten years - land cover changes, of El-Dabaa regiont (Egypt) , are so minor that they are less that 3% . ASTER satellite data have high an overall accuracy of 93 % to map land cover of the arid and semi arid .This derivation of remotely sensed indices contribute into further classification of crusted and varied $CaCO_3$ content - soil surface .Remotely sensed mapping soil indices has a moderate high accuracy of 68 % that may be enhance by solving the problems of pixel spectral mixture (sm) and heterogeneity of zones–test . More accurate studies are required to sensed soil mapping.

Finally, the study outputs represent significant remotely sensed input layers for national/regional digital soil databases.

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الملخص العربى

دقة رسم خرائط حالات سطح التربة بأستخدام بيانات الأقمار الصناعية من نوعى Thematic Mapper و ASTER (منطقة الضبعة – الساحل الشمالي – مصر)

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أظهرت نتائج التقسيم (Supervised Classification) لبيانات الاقمار الصناعية من نوعى (ETM, 2001) (ASTER, 2101) أن أنواع الغطاء الأرضى land cover types لمنطقة الضبعة هي : الكثبان الرملية (18.10٪) - سطح التربة المغطى بالقشرة الصلبة (32.31٪) - سطح التربة الخالي من القشرة الصلبة (28.99٪) - الأراضي المزروعة (15.35٪) - والمناطق الحضرية (5.25٪). وقد أعطى سطح التربة المغطى بالقشرة الصلبة أعلى نسبة مساحة (19541.96 هكتار). . وقد أوضحت نتائج تقدير دقة التقسيم ما يلى : (أ) تراوحت دقة رسم خرائط الصفوف من 72.9٪ الى 95.5٪، و من 63.8 إلى، 82.1٪ في حالة بيانات ASTER و ETM ، على التوالي(ب) أكتسبت الوحدة الخرائطية لصف سطح التربة الخالي من القشرة الصلبة أقل قيمة دقة (72.9 %) بينما أعطت الوحدة الخرائطية للكثبان الرملية أعلى قيمة (95.5%) وذلك لبيانات (ASTER) (ج) تميزت الخريطة المنتجة بأستخدام بيانات (ASTER) بدقة كلية overall accuracy أعلى من نظيرتها المستخرجة ببيانات (+ ETM) أعتمادا على السلوك الطيفي spectral behavior لبعض خصائص التربة السطحية تم استنتاج دليلين لسطح التربة: دليل القشرة الصلبة (CI) و دليل سطوع سطح التربة (BI) soil brightness index ، وبتطبيق دليل القشرة الصلبة تم تقسيم منطقة الدراسة الى ثلاثة صفوف : تربة خالية من القشرة الصلبة (15.29%) و تربة متوسطة القشرة الصلبة (62.24%) وتربة ذات قشرة صلبة (22.47%) ، رسمت هذه الصفوف فى خريطة دليل القشرة الصلبة ذات دقة تقسيم (68.75 %) كما أدت الدراسة الى تقسيم منطقة الدراسة بناء على دليل سطوع سطح التربة الي ثلاثة صفوف: تربة تحتوى على كربونات كالسيوم أقل من 10% وتربة بها كربونات كالسيوم من 10%الى 15% وتربة محتواها من كربونات الكالسيوم أعلى من 15%. امتلكت خريطة دليل سطوع سطح التربة دقة تقسيم (68.75%)