METHODOLOGY OF CARTOGRAPHY OF THE STRANDING BY the USE OF the TELEDETECTION "CASE OF THE AREA OF BOUSAADA- ALGERIA"

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Summary

For several years, Algeria has sought to answer the threat of the dryness and the progression of the desert in the internal zones of the country, until saved there by these plagues. Besides some work and publications relating to the surfaces affected by wind erosion, multi-field projects intended for the comprehension of the processes of degradation which result from the bad management from the grounds and that of the water resources, two rare resources in arid areas. Also, it seems urgent to us to see imperative to intervene before the situation be come irreversible. It is within this framework, the study being the subject of this communication, aims at showing the possibility of follow-up by remote sensing of the stranding phenomenon of the city and the arable lands of the Bousaada area. This study is based on the multi temporal analysis of the evolution starting phenomenon from the data images with average resolution (32 m) of the Algerian satellite Alsat1 and Landsat 7 ETM+. The charts derived sets of themes relate to surface qualities of the grounds, the percentage of the biomass and the various indices of sensitivity of degradation ground.

1. INTRODUCTION

Desertification and the stranding are like the change climatic or of biological diversity, the world phenomena and not only regional or local (CCC., 1998). The phenomenon of the desertification which threatens today the stability of the African countries already weakened by the wars and threatens in particular food safety of the African continent. If 120 countries in the world are threatened by the desertification, it should be known that African two thirds of the continents are deserts or arid grounds. According to "Futura Sciences", Africa comprises the vast wide ones of arid arable lands, of which nearly the three quarters suffer from degradations to differing degree. Algeria which counts close to ¾ of her territory under the influence of these phenomena, is classified among the countries which sees the degradation of these grounds on a high level (PNUE, 1993). Currently threats weigh on the fragile zones of North and in particular on the level of the steppe or already more half of its surface (20 million hectares) is threatened by the desertification and the stranding.

Efforts were made, here and there (green stopping, palisades etc) but these actions remains dispersed and constitute often only one response to emergency cases and specific problems, as they remain limited have regard to extended from the zones to protect and complexity from the factors blamed. (figure1). Delimitation of the Algerian steppes (Nedjraoui 1992).

The acceleration of these plagues involved impact negative as well from the economic point of view as social of all the zones being through the Saharian Atlas and especially the Saharian Atlas Eastern (Ghazi. Sd), from where the choice of the zone of study of Me doukel

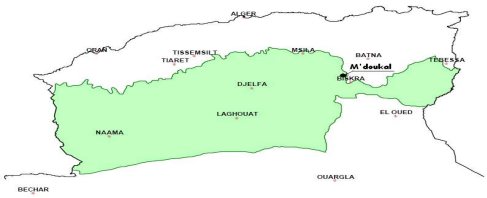

Figure1. des steppes algériennes Delimitation (Nedjraoui 1992).

which is confronted with a certain number of problems to knowing:

• Appearance of first relief's sand a front the of Hodna plain;
• Zone of accumulation and trapping of sand;
• The stranding of the infrastructures of communications and the enclavement of certain agglomerations;
• The threat of the arable lands by the progression of the dunes;
• the exude of the population.

1. PRESENTATION OF THE STUDY AREA

The Bousaada surface is 36.900 ha, this area appertain to the M'sila area (figure N° 2), which is a agro-pastoral area being located in the high steppe plains. It belongs on the semi-arid arid climatic floor. It is characterized by generally irregular and insufficient rains, the annual average of precipitations rather weak, generally lies between isohyets 100 and 300 mm/year (KADIK, 1982) the thermal amplitude day is very important, it can reach 35°C (ZEDAM, 1985).

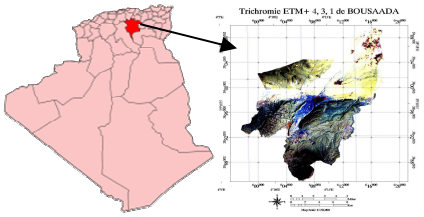

Figure N° 2: situation of the study area

The winds of the area are variable with a speed and an orientation which depends especially on the local conditions of topography (Djebel, Moubakhera Dj Maalleg. and Dj Kennfaou.), the frequencies of the dominant winds are of 13 percents in Western North, which explains the shape of the wind buildings in situ, and their orientations towards North (Benazzouz, 1994). It also forms part of the sedimentary basin (quaternary) whose substrate is composed of rocks limestone's gypsies is covered with a thick bed of clay and sandy silt (Halitime, Sd).

The geomorphological landscape of the zone is characterized by the presence of three distinct zones:

- the East part is represented by wind accumulations which form dunes in forms of the barkhanes, nebkhas and veils sandy, these dunes are separated by small depressions from a gradient which varies between 0,5 and 2 percents;
- the Northern part is characterized by a depression which represents the chott El Hodna.
- The Southern part is formed by a not very broken relief where maximum altitude is represented by Djebel Moubakhera 1052 meters, Djebel Maalleg 1343 meters and Dj. Kerdada 947 meters.

The resources of agriculture are limited if one compares them with the populations which live there. As for the grounds, they often present crusts limestone's or gypsies and are salted most of the time and prone to erosion and a secondary salinisation (Aubert, 1960).

2. AIM OF THE STUDY

The principal objective of our study is to use the synoptic capacity of the satellite image, and of are capacity spectral and multitemporelles, to produce spatiocartes expressing at a time given the distribution space of the various levels of degradation of the vegetation as well as the dynamics of the sand dunes by different types of digital processing's of images. In our study, we thus propose:

- a cartography of the orography of the area;
- a cartography of the variations of the degradation of vegetable cover;
- a cartography of wind dynamics.

3. METHODOLOGY

The methodology used (figure 2), it is that of the visual analysis by photo-interpretation. It is based on the regrouping of the similar topics by their reflectances, their colors, their forms, their textures like their structures. Other treatments are also applied to the satellite images (indices of vegetation NDVI, index of brightness IB, the index of naked ground Sn and index of basic nature Nf). The data used are those of the satellites Landsat 7 (image ETM+ of Mars 2000) and of Alsat 1 of March 2005. Treatments are carried out on the images, namely:

- The index of brightness which takes into account the albedo of surface to dissociate the grounds with vegetable covers of the mineral extents. This index is built starting from the channels red and close infra red (PIR) according to the following formula:

$$\textbf{Index of Brightness} = \sqrt{R^2 + PIR^2} \qquad \textbf{(1)}$$

This index is sensitive to the brightness of the grounds. The wet grounds present sometimes salts on the surface. When they very wet where are covered with water the latter appear on the images with a very dark color.

- Index of naked ground It is an index of the zones without vegetation, highlighting dune or rock natural surfaces (NICE, 1997).

$$\textbf{Sn= (1/3.TM3-2/3TM4) -127} \qquad \textbf{(2)}$$

- Index of nature of the bottom Nf, it possible to make the distinction or the transition between two different mediums (A. Grotte, 1992) and is calculated by:

$$\textbf{Nf = (TM2) 2 /TM3} \qquad \textbf{(3)}$$

- The index of vegetation standardized, also called NDVI is a new channel built starting from the channels red and close infra red (PIR). The index of vegetation standardized emphasizes the difference between the visible band of the red and that of infra red.

$$\textbf{NDVI= (TM4-TM3)/(TM4+TM3)} \qquad \textbf{(4)}$$

This index is sensitive to the quantity and the strength of the vegetation. It highlights the levels of vegetation chlorophylle. The spectral response of a dense vegetable cover is strong in the infra-red close relation (because of the chlorophyllian activity) and weak in the wavelength of the red, whereas the spectral response of a very sparse cover is opposite (strong influence of minerals compared to the chlorophyllian activity). Another index of vegetation at calculated (5) it mainly makes it possible to separate the topics chlorophylle (vegetation) from the minerals (sand dunes).

$$\textbf{NVI = (TM5-TM3) /TM5+TM3)} \qquad \textbf{(5)}$$

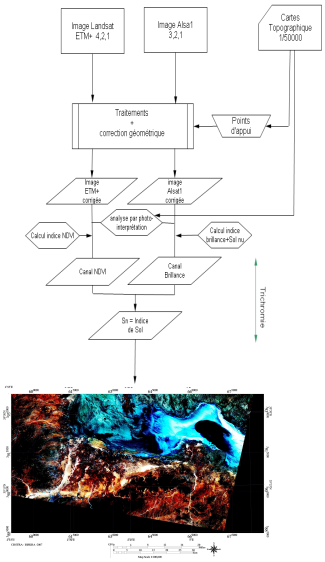

Figure 3. general Flow chart of the study.

5. Results and discussions

1. Application of the NDVI on image ETM+ of Landsat 7: The application of the first index of vegetation standardized (formula 1) on image ETM+ of Landsat 7 us to licence to have a better discrimination of the vegetation, because the cover rate is higher 30%, the radiometric signal recorded by the sensors of the satellite in the fields of visible and of the PIR is not influenced to a significant degree by the subjacent ground. In this case, the classes of vegetations were identified to allow the localization of the degraded zones, naked zones and of the covered zones. The calculation of the second NVI (formula 2) on image ETM+, one finds there (figure) the strong degree of cover of the dunes of North, with still sharp sandy face meadows of the town of Bousaada. One recognizes there also the site of old dunes at the place.

2. Application of the index of basic nature (Nf) This index us with licence to distinguish the various levels of depth of the chott El Hodna and the transitions between medium different of the hydromorphic chott and grounds and halomorphic grounds close to the chott.

3. Application of the index of brightness on the image Alsat 1: Conversely the application of the index of brightness (IB) and of the naked ground (Sn) on the image Alsat 1, us made it possible to chart the naked grounds, the sandy veils as well as the structural forms of the glacis and the alluvial cones. These classes describe wind dynamics with a better discrimination between the sandy grounds, the naked grounds. These last classes were considered in order to cover the whole of the variations met on the ground:

- old forms with the wind materials which are represented by sandy beaches with the foot of Djebel (yellow color);
- old forms with the gypseous wind materials, which comprise the micro dunes and the microphones nebkhas (yellow color clearly);
- the current forms occupy an important surface which skirts the line of the chotts.

4. Composition coloured starting from indices. Each index represents one, even two particular fields (mineral, vegetable, naked ground etc…) other than the others. Their appearance in level of gray into favoured legibility but in limited the comparison (exaggerations of brightness of the pixels). The crossing of the rough images of indices, in three-colour process seems raised this constraint, and allowed us to have the whole of the topics quoted previously (figure 4). Several three-colour processes of indices were carried out, various categories of objects (mineral and vegetable) were characterized separately. A first three-colour process carried out by TM 5, NDVI and index of brightness, us with licence to make separation enters the wet grounds close to Chott and also between the forest belts close forest and steppe, also it allowed us limited dunes. A second three-colour process will associate the NDVI, IS and IB the result can be interpreted by the knowledge of the levels allocated with each index, R.V.B which made it possible to make the distinction between the naked grounds and the sandy formations and between the introduced cultures (cultivation of cereals and truck farming) and the steppe formations (table N° 1).

Forme structurale	Couleur Observée sol	Sol	Indices IB&Sn	Formation éolienne	Forme	Dimension L l H	Composition	NDVI	couleur observée végétation	Végétation
Djebel		Mx Brutes	fort très fort	Placage éolien ancien Placage éolien actuel	dunes fossilisées dunes actuelles	10 km 5 km	sableuse et gravelleuse sable vif	moyen		dégradée
Glacis		Mx brutes	moyen	Micro dunes et micro nebkha	matériaux éolien gypseux			moyen		dégradée touffe, jujubier
Cône de déjection		Matériaux grossiers et Blocs	très fort fort	Placage éolien actuel Placage éolien ancien	accumulation voile éolien	6 m 2m	sable	moyen		
Terrasse alluviale		alluvions nus	moyen moyen fort fort fort à moyenne fort	Rebdous Voile éolien vêtu Voile éollen nu Nebkha Erg dunes actuelles dunes fossilisées berkhane	sable vif amas de sable Croissant allongée	6m 3m 30m 50m 1m 50cm 10km +eurs m 5m	sable	très fort moyen moyen		arbustive, touffe, jujubier Tamarix, céréaliculture steppe à armoise, artrophytum atriplex, salsola, retam,tamarix dégradées
		sol halophyle	très fort					moyen		salsola vermiculata atriplex halimus

Table N° 1. chromatic interpretation of three-colour process

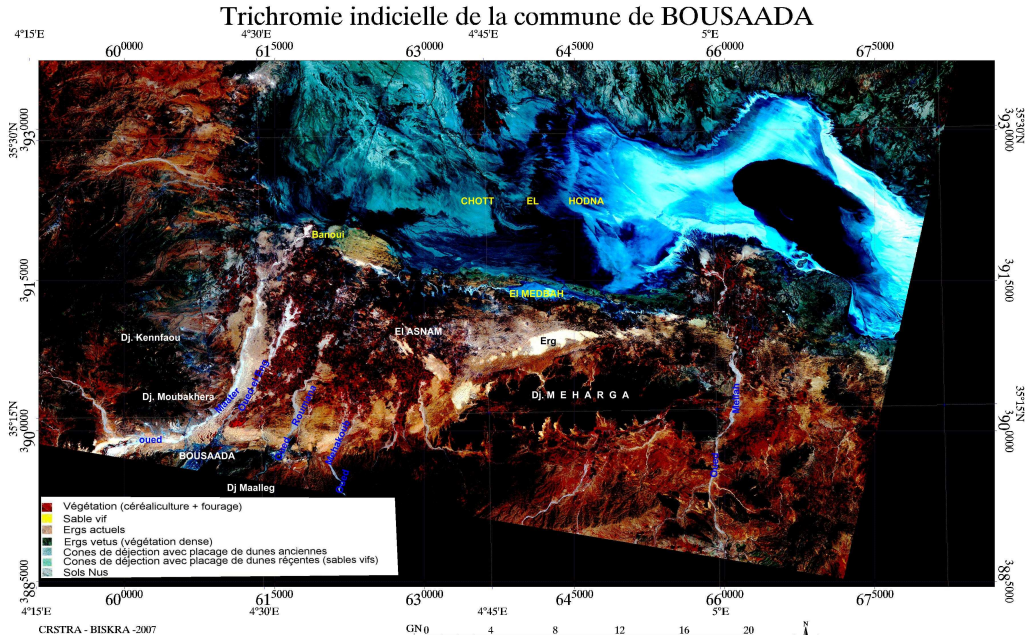

Figure N° 4 : Trichromie IB, Sn, NDVI

6. CONCLUSION

The contribution of Spatiocarte, in the follow-up of the ecosystem and the perception of the ecological agro changes according to the anthropic practice (ploughing and overgrazing), is not any more to show. The presence of dunes and their mouvement are a constant threat in our area thus obstructing the human establishments and activities. The dunes threaten by their progression the arable lands, the courses, the points of water, the roads and the infrastructures. The interest general of this study, was to see the contribution of the space imagery and of are synoptic, multitemporelle, and numerical capacity in the cartography of wind dynamics, its width, the direction of evolution of sands. Vulnerable zones and the role of orography in the fixing of sand and a means of fight against the stranding (figure 5).The satellite tool was presented initially in the form of a source of information complementary to the other work already completed (pedology, geology and geomorphology) on the area and to the field reality. Its numerical nature enabled us to make many handling and a combination in order to succeed has a delimitation of the mineral-bearing zones of those vegetalized or timbered. The figure N° 4 is the output these various, it constitutes here only one approach set of themes which will have thus to be supplemented by other information MNT spectral signatures (radiometer of ground) and thorough observation of the flora of the area and grounds.

Figure N° 5: orography role in the sand fixing

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