APLICATION OF DIGITAL ELEVATION MODEL INTEGRATED WITH LANDSAT-TM5 IMAGES THROUGH IHS TRANSFORMATION FOR SOIL CARTOGRAPHY

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Abstract

The present study aims with the development and improvement of the metodology concernig the obtention of soil maps also the employment of most eficient tools to soil survey and cartography. The fisiographyc units obtained by the aerial photographs interpretation, after adjusts and transposing to the base map, could be digitalized and serving as a framework to the following interpretations. In this second phase, the images used for the interpretation process are generated from the TM-Landsat data integration with the digital elevation model (DEM) through IHS Transformation technique. The results have shown that the employment of this metodology in two phases, improve the quality of the final cartography products as well as the homogeneity of the mapping units.

1 Introduction

The *image interpretation* applied to survey and soil cartography has been utilized for several years. The physiographic analysis method for soil studies, commented and idealized by Buringh
(1960), applied and specially perfected by Gossan, Buttler and Vink, has been used in many soil operations and studies. as it is shown, for example, in Hilwig, 1974; Carter and Stone, 1974; Valério Filho *et al*, 1984; Koffler, 1976; Montoya, 1977: Garcia, 1982, Donzeli *et al*, 1983 and Rocha, 1992, between numerous other studies. This method of investigation has been specially applied in soil surveys to the levels of semi-detail and recognition. optimizing quality as execution costs. The last decades, specially the last few years, making use of

orbital images, as an example the TM-Landsat and SPOT, promoted a significantly improvement to the cartography products produced to the soil studies, mainly having in mind the possibilities of technical integration for geoprocessing with the classical photography areas interpretation. Other products obtained since the contour line digitalization, as an example the digital elevation model (DEM) has conciliate better final quality to the cartographycal products and facilitating the integration with the orbital images through the digital processing techniques with the IHS transformation, in example, producing new possibilities in terms of images interpretation for soil studies.

This study has the objective of perfection the physiographical analysis methodology, looking for the attainment of soil maps, employing the technical integration of classical photointerpretation of Buringh (1960) associated with geoprocessing techniques.

For this purpose it were interpreted areas with aerial panchromatic photography at the 1:25.000 scale, whose standard individually physiographic units and diferent paterns were digitalized at a geographic information system (SGI - SITIM 340) developed by INPE - National Institute of Espacial Research, having as basis the digital mosaic of the own aerial photographs, registered just right to image treating system. The soil information (layer "soil") was then back utilized as support to the image interpretation using a enhancement image technique called IHS Transformation. The procedure adopted anticipate then the adoption of two phases of interpretation.

2 General description of the studied area

The study was developed at the Candoi county, located at Paraná State, Brazil South Region, between the geographical coordinates 52°00' - 52°10' of longitude and 25°32' - 25°38' of south latitude. The area presented great geomorphological variability, with two large landscape units. One at the west region and the other to the lest portion. The west part has various levels of erosion, with a dimension grade highly advanced. To the lest portion the erosion surface are more preserved and the predominating relief is soft curly and curly. The geology is represented by Basaltic materials, with small inclusions areas of Siltitos and Arenitos Finos. The climate, as Koepen Classification, is Cfa at the lowest zones and Cfb at the highest portions. The mean altitudes of the areas studied varies from 600 to 1000 meters above sea level.

In the area occur various classes of soils, standing out the Latossolos Roxo and Bruno

(ACROHUMOX) and Litólicos soils (HAPLUMBREPT and HAPLUDOLL). In more restricted areas occur the Cambissolos (HAPLUMBREPT). These soils are, in great majority, derived from meteorized products of Basalto.

3 Material and methods

3.1 Material

Panchromatical aerial photographs, scale 1:25.000, 23cm x 23cm, f=153 mm.
Estereoscope - Topcon
Plain altimetrical maps, scale 1:50.000
Orbital image TM-Landsat, band 5, 4 and 3
Image Treatment System - SITIM, 340
484DX2 - 66 MhZ computer
Digicon A1 digitalizer table
Deskjet printer
GPS - Trimble

3.2 Methodology

The studies started with the interpretation of aerial photography by the classic method of physiographic analysis (***first phase***). In the next step these information was digitalized and integrated in a geographic information system. Than, the interpretation of TM images, directly from video screen using codified images and a engancemente image technique called IHS Transformation (***second phase***).

The digitalization of soil information obtained from the interpretation of aerial photography, having as basis the digital mosaic of the own aerial photographs at the geographical information system.

At the SITIM (image treatment system) was done the registration process (geometrical correction) of the satellite image. The produced image since the digital elevation model (DEM) was transported to the SITIM as a new band. This procedure facilitate the integration of the DEM with the satellite image. The image was submitted to the Principal Components process, being the first component (Band C1) utilized for the integration process. The satellite image with three bands at the colored composition 5R4G3B was transformed to the color space of IHS (intensity, hue and saturation), then giving three new bands - I, H and S. The Band I is replaced with the principal first component (C1), H is replaced with the DEM and S is replaced with the band I. Then the new composition obtained is inversely transformed to the original space, giving new R, G and B bands.

Colored composition resulting from the bands R, G and B can be obtained verifying the gain as for altimetrical information that is observed by the image color. It is noticed the espctro variation of the color with the altitude.

All bands (3, 4, 5, C1, I, H, S, R, G, B) were treated with linear contrast enhancement and later transported to the SGI, being inserted to the project as information class. Various combinations were then analyzed and being selected two to executing the interpretation work: GRB and GRC1, but the first showed better results.

The interpretation process was done directly in the video screen. The generated lines in the process were adjusted, identified and polygonalized to obtain a new soil map. After the conversion of all information to the raster format, the plains were crossed through the cross tabulation algorithm.

4. Results and discussion

The aerial photography interpretation (first phase) facilitate the identification of 11 physiografical units. The field work and research of prior studies (EMBRAPA, 1984) reveal the existence of 4 units of mapping.

The results obtained through the interpretation of the two phases can be visualized in the figure 3.

It was also observed that the soils more developed pedogenetically occur at the lest portion of the area and last developed to the west portion.

The results obtained with the combination of the two phase interpretation, the first one with stereoscope and the second with the digital treatment, showed a best adjustment of the mapping units and a cartographycally representation more adequate. Thus, the products can be observed in different forms, that means, at a digital mosaic (Fig. 1), with cartographycal adjustment (registered) showing the soil lines, separating the units. The other product is the digital image (IHS) which also facilitate the materialization of separating lines between the soil units (Fig. 2) and one product in the vectorial form where the units are shown in different colors (Fig. 3).

The best adjustment observed from the combination of the interpretation in two phases evidenced a best adjustment of the soil units inside the landscape, having also a greater facility of understanding of soil-landscape relations, most important to achieve the semi-detailed study of the soils.

The field investigations done with GPS showed that had a good execution on the individualization and identification of standards physiografics units with the interpretation in two phases, facilitating the understanding and notion of the assemblage of the spacial distribution of soils inside the landscape. The use of GPS was important principally to investigate areas with a more complex soil occurrence.

Fig. 1

Fig. 2

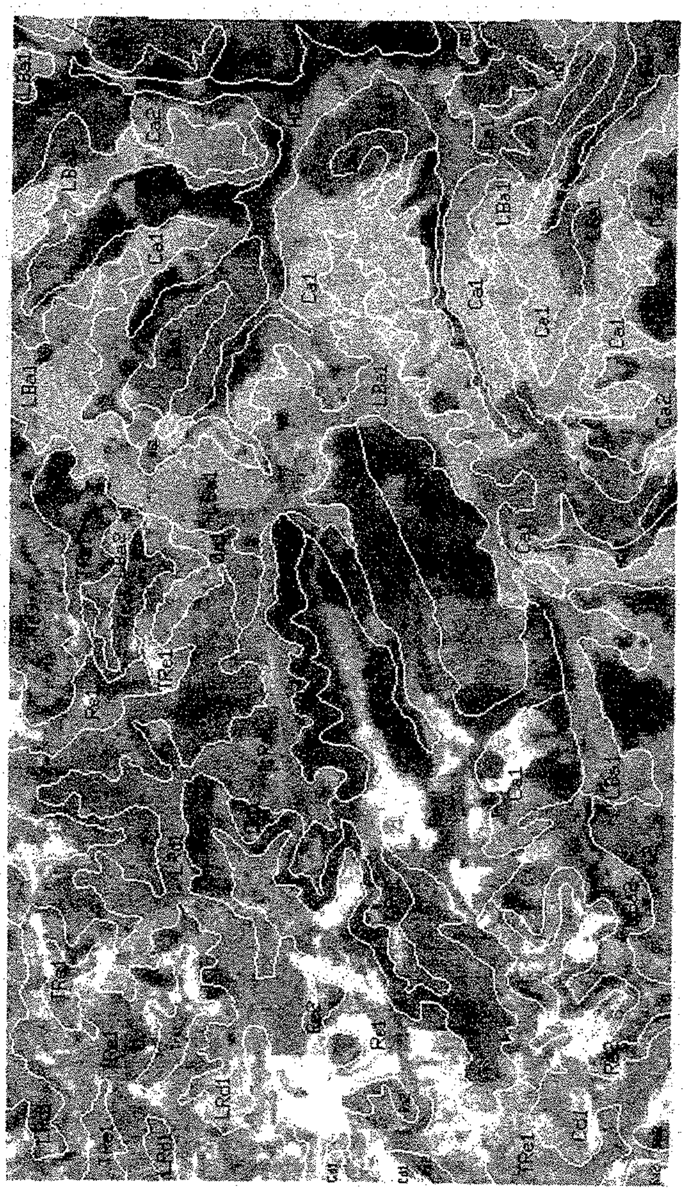
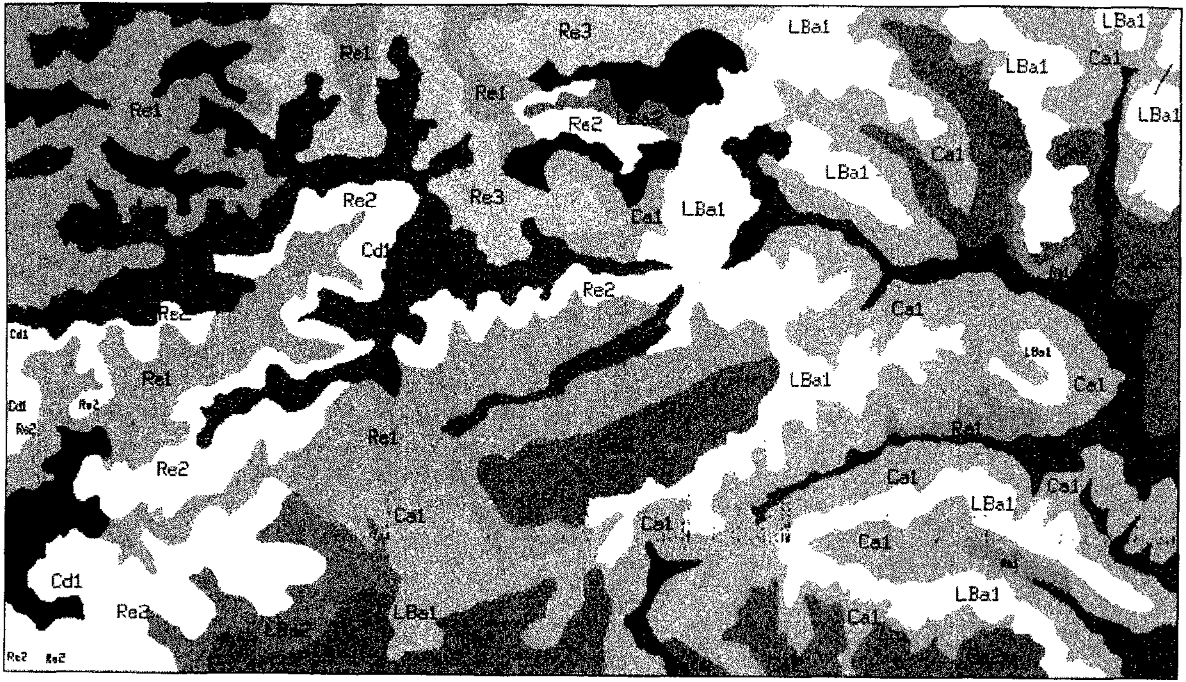


Fig. 3



5 Legend (*Soil taxonomy*)

LBa1 - Latossolo Bruno álico A proeminente textura argilosa fase camo subtropical (*Acrohumox*)

LBa2 - Latossolo Bruno álico A proeminente textura argilosa fase floresta sultropical perenifolia (*Acrohumox*)

LRd1 - Latossolo Roxo distrófico A proeminente textura arqilosa fase floresta subtropical perenifólia relevo suave ondulado (*Acrohumox*)

TRe1 - Terra Roxa Estruturada eutrófica A chernozêmico textura argilosa fase floresta subtropical perenifolia relevo ondulado (*Argiudoll*)

Ca1 - Cambissolo álico Tb A proeminente textura argilosa fase campo subtropical relevo ondulado substrato rochas do derrame do Trapp (*Haplumbrept*)

Ca2 - Associação Cambissolo álico Tb + Solos Litólicos álicos ambos A proeminente textura argilosa fase floresta subtropical perenifolia relevo ondulado e forte ondulado substrato rochas do derrame do Trapp (*Haplumbrept* + *Entic Haplumbrept*)

Cd1 - Cambissolo distrófico Tb A proeminente textura argilosa fase floresta subtropical perenifolia relevo ondulado substrato rochas do derrame do Trapp (*Dystrochrept*)

Ra1 - Solos Litólicos álicos A proeminente textura argilosa fase floresta subtropical perenifólia relevo forte ondulado e montanhoso, substrato rochas do derrame do Trapp (*Entic Haplumbrept*)

Re1 - Associação Solos Litólicos eutróficos floresta subtropical subperenifolia relevo forte ondulado e montanhoso substrato rochas básicas + Terra Roxa estruturada eutrófica floresta subtropical perenifolia relevo forte ondulado ambos A chernozêmico textura argilosa fase pedregosa (*Ustorthent* + *Argiudoll*)

Re2 - Solos Litólicos eutróficos A chernozêmico textura argilosa floresta subtropical subperenifolia relevo forte ondulado e montanhoso fase pedregosa substrato rochas básicas (*Ustorthent*)

Re3 - Associação Solos Litólicos eutróficos floresta subtropical subperenifolia substrato rochas básicas + Terra Roxa estruturada eutrófica floresta subtropical perenifolia ambos relevo ondulado A chernozêmico textura argilosa fase pedregosa (*Ustorthent* + *Argiudoll*)

HG1 - Solos Hidromórficos gleizados indiscriminados (*Udorthent*)

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