UTILIZATION OF ERTS-1, RADAR AND INFRARED
FALSE COLOR IMAGES FOR THE STUDY OF TYPES
OF VEGETATION AND AREAS OF AGRICULTURAL
EXPLOITATION

by

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UTILIZATION OF ERTS-1, RADAR AND INFRARED FALSE COLOR IMAGES FOR THE STUDY OF TYPES OF VEGETATION AND AREAS OF AGRICULTURAL EXPLOITATION

This is one more report on the use of images obtained with different remote sensors, as means for better surveying earth resources.

The combination of images obtained from spacecraft, with images obtained from aircraft is indicative of the possibilities that lie ahead.

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Fernando de Mendonça

General Director

SUMMARY

This work, of a preliminary character, has for objective the utilization of images produced by the Multispectral Scanning System (MSS), SLAR (Side Looking Airborne Radar), Infrared False Color images and also ground truth information, in a multilevel configuration of data collection, aiming at the mapping and characterization of the various vegetation types and areas with potential for agricultural exploitation.

The area chosen for the work is located in Northeast Brazil and includes the boundary of the states of Maranhão and Piauí, between coordinates 5° - 7^oS, 42° - $43^o30'W$.

A visual analysis of the data, according to the basic concepts of photointerpretation, was done emphasizing texture and tonality aspects in the interpretation of Radar images, and considering the multispectral aspects of the MSS and Infrared False Color images.

Thus it is possible to characterize different vegetation types, establish their boundaries and identify areas favorable to agricultural activities.

In conclusion, and based on the comparison with SLAR and Infrared False Color images, it can be said, as a first approximation,

that it is already possible to evaluate the MSS image potential for the mapping and identification of vegetation resources as also of areas with potential for agricultural activities.

CONTENT

FIGURES

1.0 - INTRODUCTION

The control and conservation of the natural resources of the Earth is vital for the future of mankind. An attempt towards this control and conservation is being made through the NASA-ERTS (Earth Resources Technology Satellite) program.

A significant quantity of images of the Earth has been obtained through satellites in the last few years. Several applications have been found for such images, specially in the earth and atmospheric sciences. During the Gemini and Apolo Spacecraft orbital flights, for instance, photos were taken which have had wide application in several disciplines, including Geology, Cartography, Geography, Meteorology, Forest Engineering, Agriculture, and Oceanography, although those flights had other specific objectives.

The present work intends to show the potentiality of ERTS images. We complemented the information with airborne radar images, infrared (false color) images and some field data, aiming at the setting up of standards for the interpretation of Vegetation Resources and areas with Potencial for Agriculture Exploitation.

Although ours is a preliminary work, founded on basic photointerpretation principles, suported by information from the forementioned images, we will, as a first approximation, try to quantify

the value of ERTS images for the survey of Soil Resources from the
Northeast Brazil region between $5^O - 7^OS$ and $42^O - 43^O30'W$ which
takes, in part, the States of Piauí and Maranhão.

2.0 - <u>MATERIAL AND METHOD</u>

Following sources of information were used:

1 - ERTS Satellite images - scale 1:1,000,000 with enlargements to 1:500,000 and 1:250,000 (channels 5 and 7).

2 - Uncontrolled RADAR mosaic - scale 1:250,000.

3 - RADAR strip of same image - scale 1:250,000.

4 - Infrared (false color) images - scale 1:130,000.

5 - Ground truth obtained in the area in November 1971.

For the preparation of thematic maps (Figs. 3 and 4) basic photointerpretation techniques were used for extracting as much information as possible from the three types of images, as follows:

2.1 - <u>MSS (Multispectral Scanning System)</u>

For the case of ERTS MSS images, interpretation was based on the spectral response of the different channels, shown as gray tones in the several microcosms (units into which the image was divided).

In the channel 5 image (Fig. 1), which best characterizes green areas, the different types of natural vegetation were delineated, as well as the areas of agricultural activities were identified by their regular geometrical forms and lighter gray tones, while those areas having darker grays are occupied by dense vegetation which have greater absorption of radiating energy in the wavelengths between 0,6 and 0,7 µ, spanned by channel 5.

This same channel also provides more information on road networks and localization of towns.

Channel 7 (Fig. 2) (0,8 to 1,1 µ) image best defines hydrologic features due to strong absorption of infrared radiation by water. It was, therefore, used for delineating rivers and for the characterization of areas with high moisture content.

2.2 - SLAR (Side Looking Radar)

On the SLAR images, obtained during the survey of the Amazon Region (RADAM Project), basic parameters used for interpretation were texture and tonality. The resulting map, therefore, outlines the more conspicuous areas intended for a posterior correlation with MSS and infrared false color images for a better characterization of vegetation types.

2.3 - INFRARED FALSE COLOR IMAGES

These images, also obtained during the survey of the Amazon Region (RADAM Project), have provided additional information for the extensive field work carried out in the area in November 1971.

Although these images presented somewhat degraded information due to the problem of "blue scattering", they were extremely useful for the inferences on the different types of vegetation and on the localization of the diminutive cultivated areas.

The acquisiton of information from these images was based on the different magenta levels, at the same time that the analysed targets were associated with the spectral response of the MSS images and correlated with the type of relief presented by the SLAR image.

As final product, two thematic maps were prepared. The first one (Fig. 3) was produced over the channel 5 image (1:1,000,000 scale) with relief information from SLAR and the characterization of the occupied areas from the infrared false colors.

The second map (Fig. 4) was done over SLAR images and, afterwards, associated with the MSS images, all in the 1:250,000 scale, and supported by information from infrared false color images.

3.0 - RESULTS

Several types of features were plotted on the ERTS image and in the case of some of them the RADAR image correlated quite well, while others were not perceptible in the radar, such as those microcosms with boundaries in tracing.

Basically these were the types of vegetation and use of soil areas established through the images:

AREA 1 - Area 1 is characterized by a rather dense savanna vegetation, of the "cerradão" type, with a large number of cultivated areas. It presents good agricultural activity in spite of its rather accentuated relief. A patch, in the shape of a horseshoe near the parallel of 6°, crossed by the high-tension line of the "Boa Esperança" Hydroelectric Company (COHEBE), has been identified. Both in the RADAR and in the infrared images cultivated areas are found near this horseshoe. In the ERTS image this area is unfavorably located, too near the left edge, and this resulted in blurred details.

AREA 2 - This area is characterized by "cerradão" vegetation and small agricultural activity, which is due to relief (shown by vertical arrows) as a limiting factor. In this microcosm we find yet another area well characterized in the ERTS and in the RADAR

images (area 2.1). Patches F and G, which are not well delimited in the RADAR image, but are well characterized in the ERTS images, belong to the type 4 vegetation. The boundary of these areas is not seen in the RADAR images but these areas (F and G) were approximately traced on for the purpose of comparison between the two images under consideration. The vertical arrows indicate the most hilly part of the area.

AREA 3 - Areas characterized by number 3 were classified as "cerrado" vegetation, that is, a less dense savanna type identified by a fine texture in RADAR and a medium gray tone in the ERTS images. The index of each area indicates the variation of their respective reliefs as well as the parts where agricultural activity can be inferred.

AREA 3.1 - This area shows parts covered by "cerrado" with flat relief as well as great agricultural activity in other parts. It comprises the environs of FEITORIA, ÁGUA BRANCA and SÃO PEDRO DO PIAUI. Cultivated areas can be perceived both in the RADAR as in the infrared images. The texture of this area in the RADAR is well characterized (fine texture) and the relief is smooth.

AREA 3.2 - The 3.2 areas differ from the foregoing only by the higher relief.

AREA 3.3 - Areas in 3.3 show the same characteristics as the previous two, differing only in the degree of certainty as to the existing agricultural areas. The area as a whole, is of agricultural potential.

AREA 4 - Microcosm number 4 comprises a large part of the quadrilateral under study and is characterized by vegetation so sparse that the reflectance of the soil has influence on the light gray tone, characteristic of vegetation in the ERTS image under study. In the RADAR image individual areas are not well characterized in terms of relief and texture but some boundaries have been plotted which allow comparisons.
The whole number 4 area can be considered, in a general way, as sparse savanna unfit for agriculture.
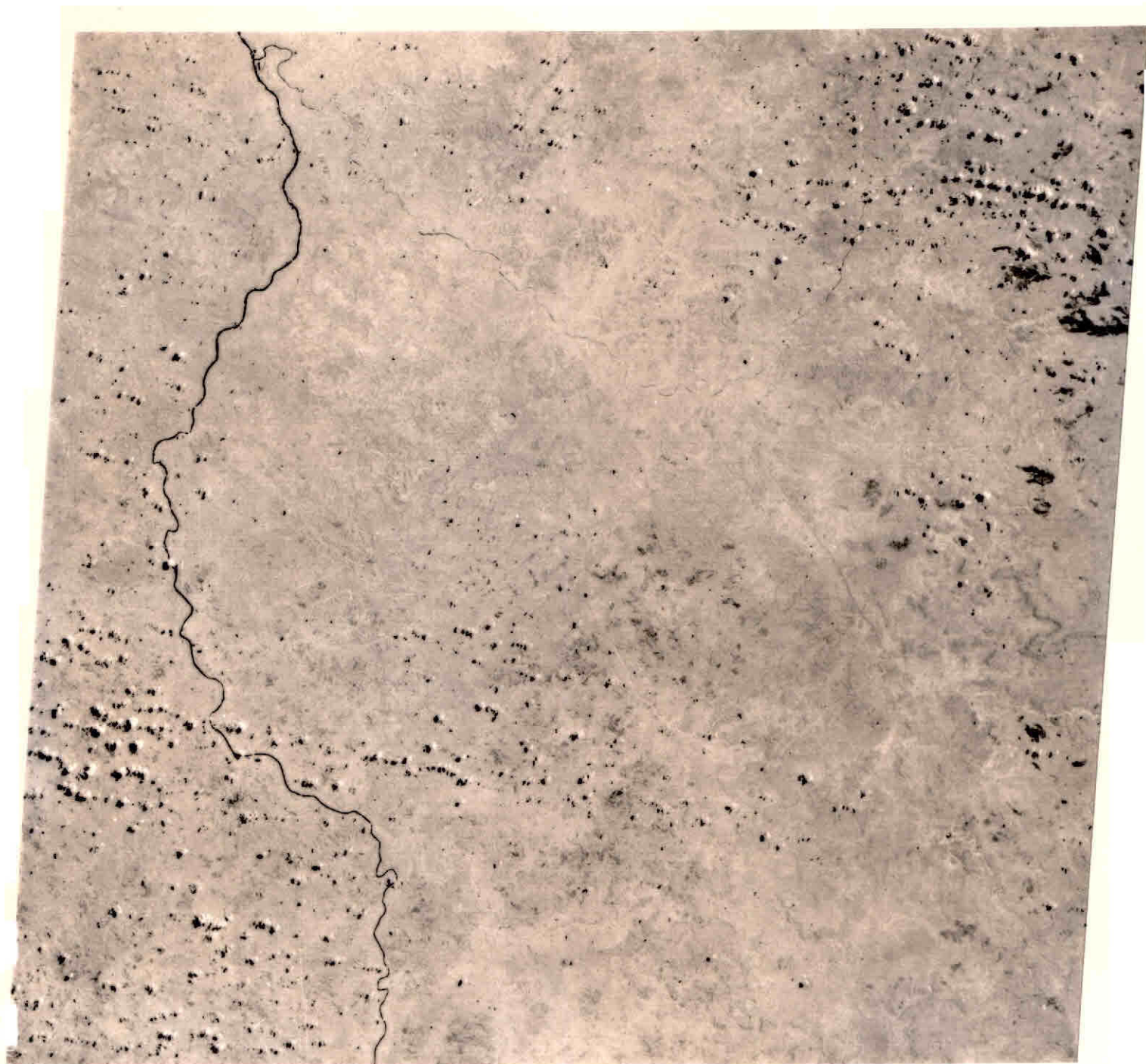
AREA 5 - The area delineated as nº 5 is similar to area nº 1, but shows well the agricultural areas near the Poty river. Sub-area 5.1 is well evidenced, in the ERTS image, as a darker gray spot. Predominating vegetation in the proximity is of "cerradão" type or almost like it. Area indicated by arrow, near this region, probably belongs to group 4, and is perfectly characterized in all the images. The spots marked with letters A to K have sparse vegetation, with varied relief and no agricultural activity. They probably indicate soils of low fertility and appear all over the image quadrilateral.

AREA 6 - These are humid areas which show up well in channel 7. They have fallen outside of the RADAR mosaic which does not fully correspond with the area covered by the ERTS image.
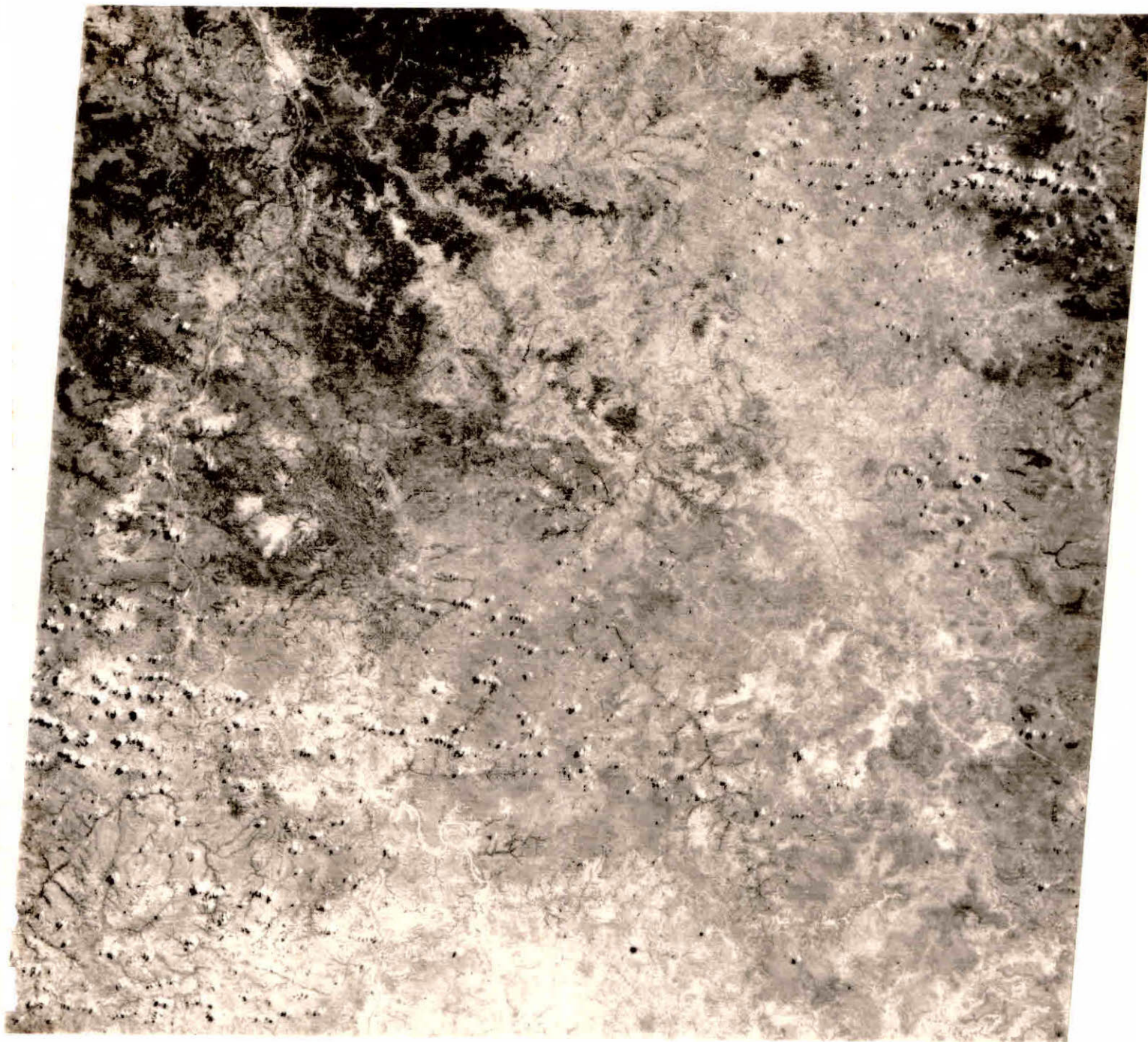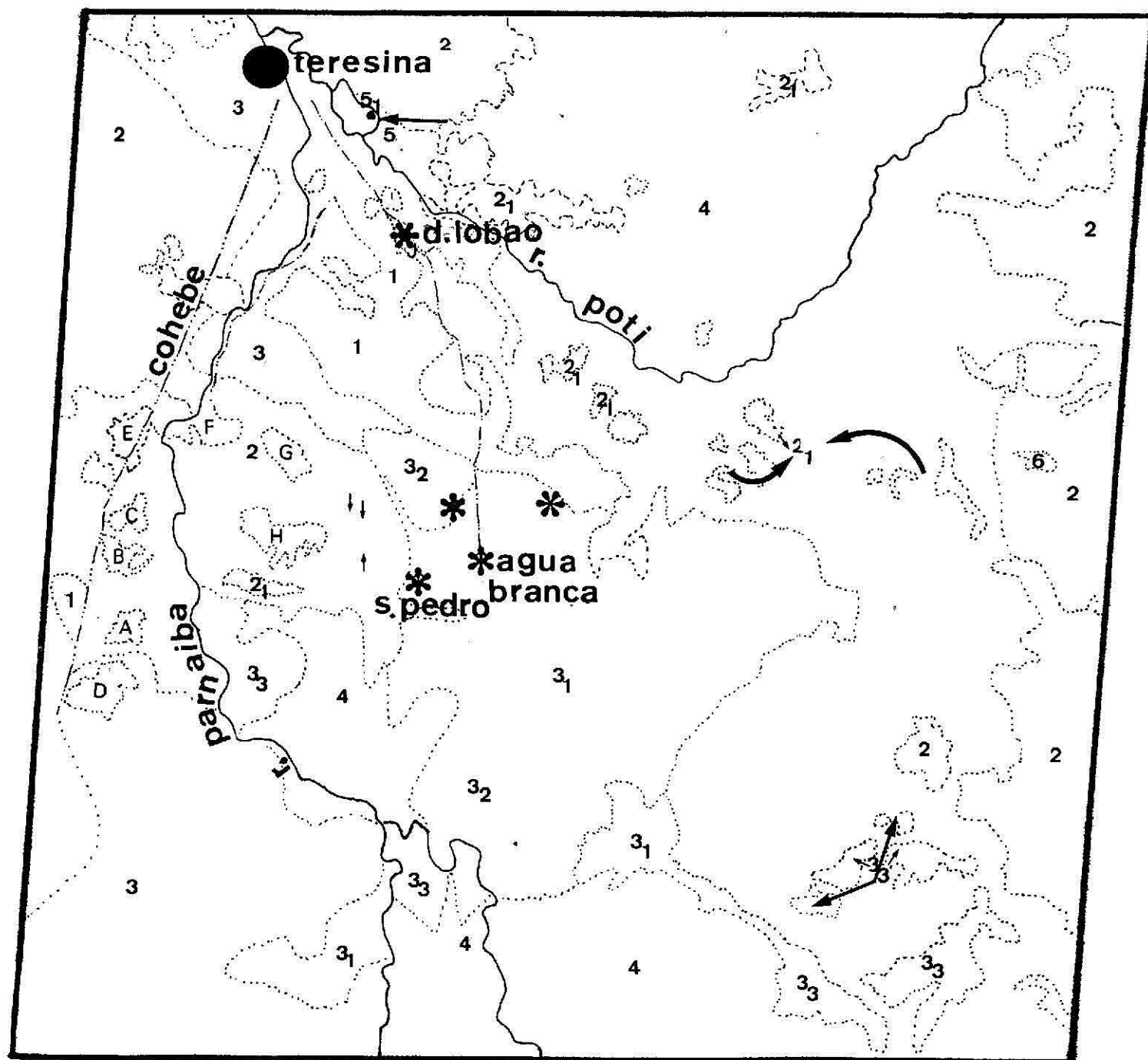
09SEP72 C S05-49/W042-28 N S05-50/W042-23 MSS 5 R SUN EL53 AZ072 188-0666-A-1-N-D-2L NASA ERTS E-1048-12282-5 02

Fig. 1 - Channel 5 ERTS image nº E-1048-12282, scale 1:1,000,000

Fig. 2 - Channel 7 ERTS image nº E-1048-12282, scale 1:1,000,000

erts, 1:1000000

LEGEND

1) "CERRADÃO" WITH CULTIVATED AREAS
2) "CERRADÃO" WITHOUT CULTIVATED AREAS
3) "CERRADO"   1 - FLAT LAND AND CULTIVATED AREAS
                 2 - ONDULATING TO ROLLING LANDS AREAS
                 3 - WITH POSSIBILITIES OF AGRICULTURAL ACTIVITIES
4) "SPARSE CERRADO" WITHOUT AGRICULTURAL ACTIVITY CONDITIONS.

Fig. 3 - Interpretation of ERTS images with the support of Radar Mosaic and
         Infrared False Color images.

4.0 - <u>FINAL CONSIDERATIONS</u>

Based on the foregoing, the following can be concluded:

4.1 - ERTS channel 5 images to the scales 1:1,000,000, 1:500,000 and 1:250,000 allow a good characterization of the large vegetation types of the area under study. A good subsidy in relation to relief and texture was given by the RADAR 1:250,000 images. The joint use of the two types of images makes for a much better interpretation than the use of either one of them in isolation.

4.2 - The additional information obtained from the 1:130,000 infrared images was of great importance in this stage, in which interpretation techniques is not yet fully developed. The infrared images gave details not perceptible in other two types of images studied.

4.3 - Water bodies are equally well characterized both in ERTS channel 7 as in RADAR images. Relief shows up better in the RADAR image but geometrical accuracy is better in the ERTS images.
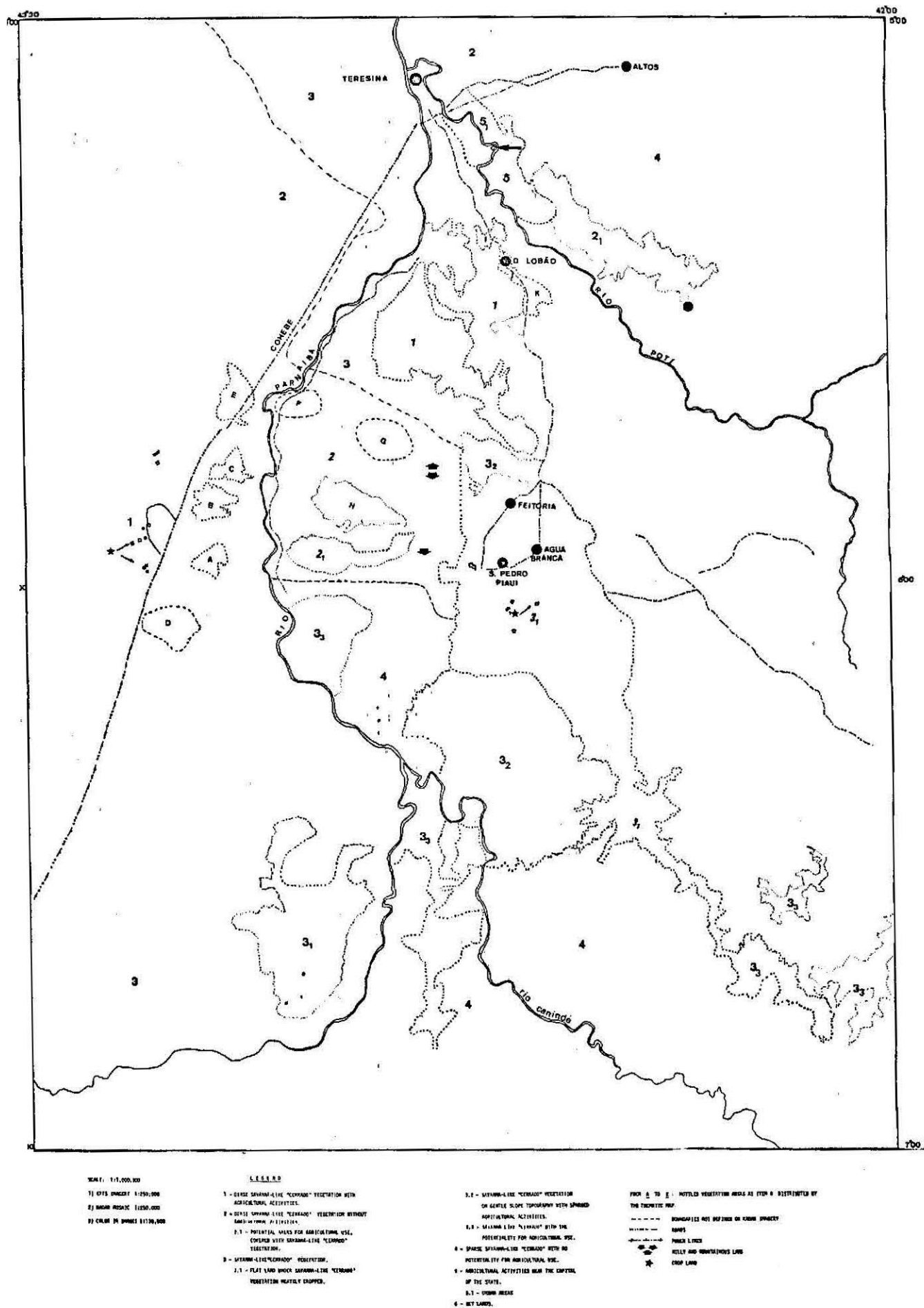
Fig. 4 - Interpretation of Radar Mosaic with the support of ERTS and Infrared False Color images.