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VEGETATION SURVEY IN AMAZONIA USING LANDSAT DATA

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14. Abstract/Notes

The objective of this study is to analyze vegetation of the pilot area selected which is among the various program-areas of the Project for Rural Integrated Development (PRID) for Amazonas State. This study was done using automatic Image-100 analysis of LANDSAT data, through the MAXVER classification algorithm. In the pilot area, four vegetation units were mapped automatically in addition to the areas occupied for agricultural activities. The vegetation units are: upland dense forest; forest in humid areas; secondary vegetation and flood plains. Results from the print-out were verified in the ground observations and good correspondence was noted. The Image-100 classified results together with a soil map and the auxiliary information from RADAR images, permitted the establishment of the final legend with six classes. They are: semi-deciduous tropical forest; low land evergreen tropical forest; secondary vegetation; tropical forest of humid areas ,... predominant pastureland and flood plains. In addition, the automatic analysis separated two water types based on their sediments indicating different geological and geomorphological aspects. The physico-chemical conditions of water are associated with the agricultural productivity. When combined, this information facilities the planning for agricultural activities of upland and humid areas, and through these activities the rational utilization of the available resources in the Amazonas State.

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VEGETATION SURVEY IN AMAZONIA USING LANDSAT DATA*

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ABSTRACT

The objective of this study is to analyze vegetation of the pilot area selected which is among the various program-areas of the Project for Rural Integrated Development (PRID) for Amazonas State. This study was done using automatic Image-100 analysis of LANDSAT data, through the MAXVER classification algorithm. In the pilot area, four vegetation units were mapped automatically in addition to the areas occupied for agricultural activities. The vegetation units are: upland dense forest; forest in humid areas; secondary vegetation and flood plains. Results from the print-out were verified in the ground observations and good correspondence was noted. The Image-100 classified results together with a soil map and the auxiliary information from RADAR images, permitted the establishment of the final legend with six classes. They are: semi-deciduous tropical forest; low land evergreen tropical forest, secondary vegetation; tropical forest of humid areas, predominant pastureland and flood plains. In addition, the automatic analysis separated two water types based on their sediments indicating different geological and geomorphological aspects. The physico-chemical conditions of water are associated with the agricultural productivity. When combined, this information facilities the planning for agricultural activities of upland and humid areas, and through these activities the rational utilization of the available resources in the Amazonas State.

1. INTRODUCTION

To advance the socio-economic development of the Amazonas State, the government implanted the Project for Rural Integrated Development (PRID). This program will be sponsored by World Bank and the State Commission of Agricultural Planning consultants. This project proposes the study of various program-areas with the aim of giving an orientation to the occupation and better use of the natural resources. Recognizing the need to efficients survey the resources of that extensive region, the technical group of the PRID project decided to use Remotely Sensed data from the Multispectral Scanner Subsystem (MSS) of LANDSAT.

This work is a part of the PRID and therefore has the objective of surveying the vegetal cover in the pilot area, through the automatic analysis of digitized MSS data. The study of the vegetation is a fundamental step in planning the rational interaction of man and land.

2. STUDY AREA

The pilot area (Figure 1) is located between $2^{0}40'$ to $3^{0}00'$S Latitudes and

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57°00' to 57°20'W Longitudes in the Barreirinha program-area which is a part of the Project for Rural Integrated Development for the Amazonas State. This pilot area was chosen because it is representative of the general area and also has a priority in the developmental plan for that region.

3. METHODS FOR AUTOMATIC ANALYSIS

The interpretation of data recorded on CCT tapes (246 path/62 row on July 15, 1978) was executed by the Image-100 System of the Instituto de Pesquisas Espaciais (INPE). The Image-100 is one of several processors used for the extraction of remotely sensed information with unique spectral characteristics (Schaller and Towles, 1975).

The methodology developed for the Image-100 system to discriminate the types of vegetative cover included: projection of the scene on the image monitor and application of the program "noise" to eliminate defects; delimitation of the pilot area at the scale of 1:100,000, and application of the program "single-cell" to evaluate the spectral responses of the classes which could be mapped; application of the MAXVER algorithm, developed by Velasco et al (1978), to obtain spectral parameters of each class, together with the covariance matrix and the classification matrix which permitted the evaluation of the superposition among all the classes. The classification results were shown in DICOMED format and the print-out at the scale of 1:20,000. The classification results on the image monitor was also enhanced using the program "Theme Uniformization" a 3 x 3-pixel spatial filter (Dutra, 1982).

4. RESULTS AND DISCUSSION

Based on the supervised classification using the "MAXVER" classifier algorithm, it was possible to discriminate the following classes of vegetation: upland dense forest, flooa plains, forest of humid areas, secondary vegetation and predominant pastureland. The spectral signatures of these classes can be seen in Table 1.

Due to the different spectral characteristics of the surface water observed in MSS images, it was possible to discriminate two other classes: "white" water and "dark" water according to the typology created by Sioli (1967) during studies of limnology, carried out in the Amazonia region.

Figure 2 shows the spatial distribution of the mapped classes obtained by using the "MAXVER" classifier, while Table 2 shows the areal extent of each class.

It can be verified in Figure 2, that the surface water studies may help the agriculture planning in this region once the higher concentration of agriculture activities is located near the areas of "white" water. According to Junk (1979) rivers with "dark" water have a low capacity of biological production due to the low pH and fertility and high concentration of humus. "White" water is geochemically richer than "dark" water.

The print-out (scale 1:20,000) obtained from the automatic classification was checked with ground observations and a very high correlation was found. The combined information from soil map, radar image and LANDSAT data permitted the defining of the final legend: semideciduous tropical forest, low land evergreen tropical forest, secondary vegetation, tropical forest of humid areas, predominant pastureland and flood plains.

The knowledge of the physiognomy and floristic composition of vegetation obtained by the ground observations are important source of additional information in this kind of work. The forest species like Bertholletia excelsa, Pouteria sp., Diplotropis purpurea, Dipterix odorata and Ocotea sp. were in

the upland regions. In areas subjected to flooding the presence of Montrichardia arborescens is very common and, more specifically in flood plains the presence of Euchinochlos polystachya, Paspalum rupens, Panicum zizanoides, Paspalum fasciculatum. In agricultural areas of uplands Hevea brasiliensis and cassava plantations are found, while in low lands, the major crops being cultivated are beans, corn, "juta" and "malva".

The study of Hueck (1972) provides information about the forest composition in the Amazonia region. This information permitted a better understanding of the typology employed in this study.

The land-use in the humid tropics is discussed by Molion and Bentancurt (1980). They call attention to the consequences of deforestation and the destruction of the vegetal surface layer (serrapilheira). This first planting and pastures causes a transformation of the soil into a nutrient deficient mass.

5. CONCLUSIONS

The methodology used in the automatic analysis of LANDSAT data permitted the mapping of the vegetal coverage of the region as well as the characterization of the crop areas.

The knowledge of the spatial distribution of the vegetation units can permit the monitoring of the occupation process. It will also be possible to indicate the best areas for pastureland and cropping.

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Table I. Spectral Parameters of Classes Obtained from the MAXVER Program

C L A S S	MSS CHANNELS			
	4	5	6	7
"DARK" WATER	17.99	9.49	4.37	2.49
"WHITE" WATER	24.79	22.29	11.25	4.16
UPLAND DENSE FOREST	22.67	14.89	54.60	65.36
PREDOMINANT PASTURELAND	25.77	17.50	74.87	85.73
FLOOD PLAINS	30.98	23.35	71.80	76.54
FOREST OF HUMID AREAS	20.25	12.21	19.01	17.92
SECONDARY VEGETATION	28.69	21.71	57.21	59.68

Table II. Area Occupied for Each Class Obtained through Image-100 System.

C L A S S	AREA (HA)	PERCENTAGE
"DARK" WATER	1,996.48	10.19
"WHITE" WATER	770.09	3.93
UPLAND DENSE FOREST	8,339.50	42.55
PREDOMINANT PASTURELAND	2,005.37	10.23
FLOOD PLAINS	1,426.25	7.28
FOREST OF HUMID AREAS	1,518.10	7.74
SECONDARY VEGETATION	3,197.85	16.31
NOT CLASSIFIED	346.36	1.77
STUDY AREA	19,600.00	100.00

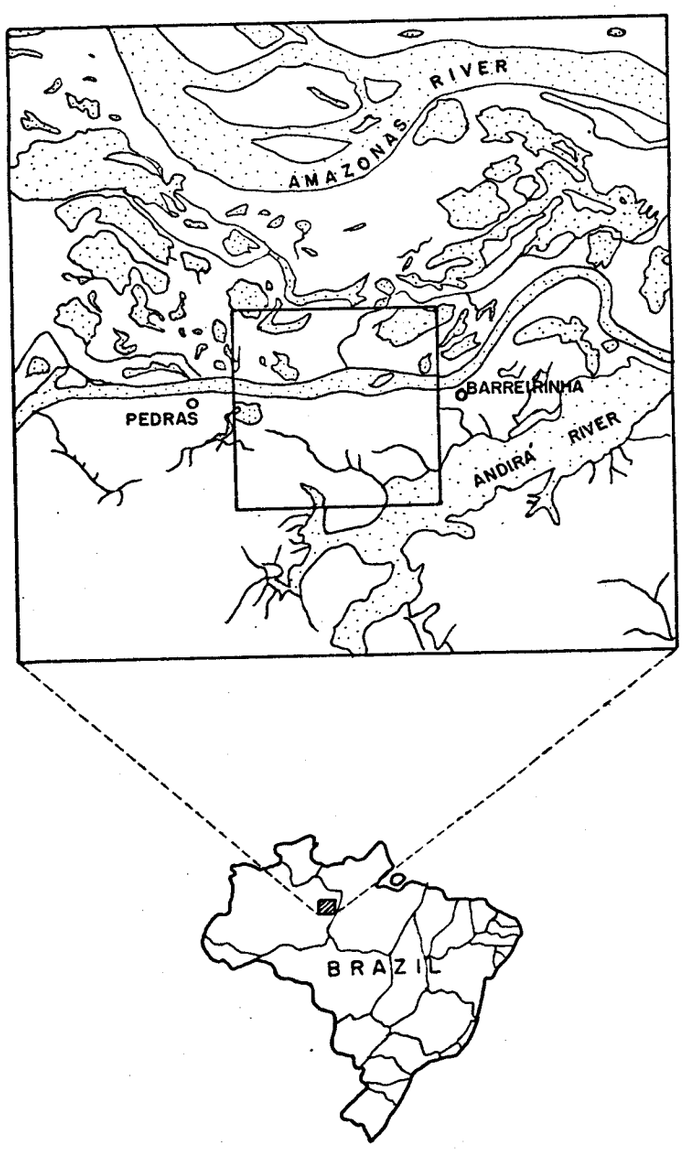
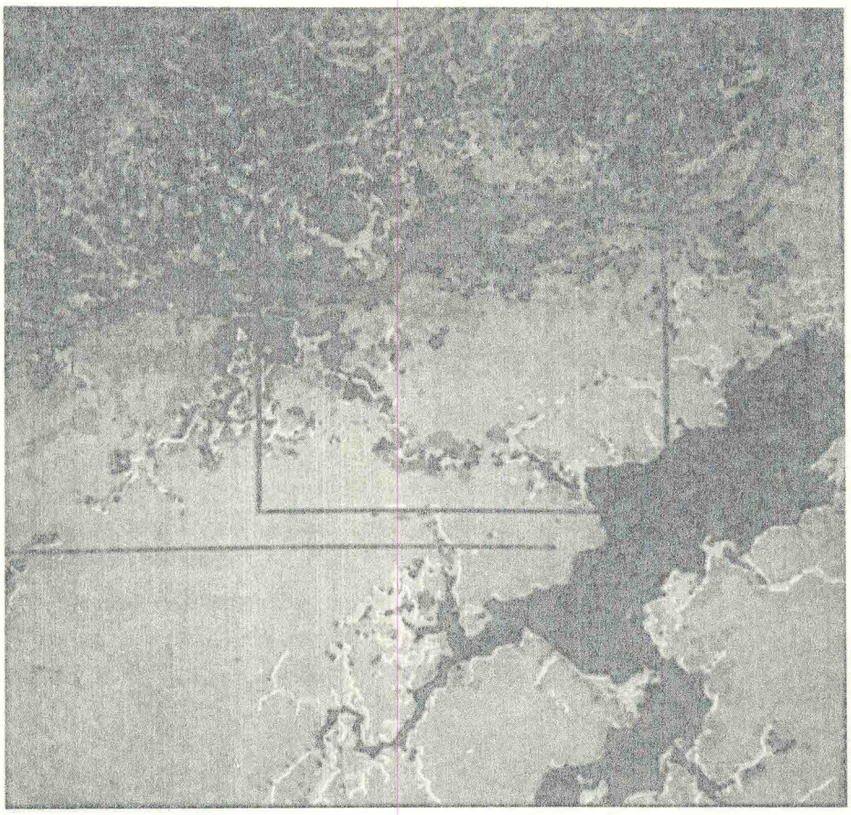


Figure 1. Localization of the study area.



"DARK" WATER

"WHITE" WATER

UPLAND DENSE FOREST

PREDOMINANT PASTURELAND

FLOOD PLAINS

FOREST OF HUMID AREAS

SECONDARY VEGETATION

Figure 2. Automatic classification obtained from the MAXVER algorithm.