

## CHARACTERIZATION OF THE AREAS IN SUCCESSION PROCESS (REGROWTH) IN THE AMAZON REGION

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### ABSTRACT

The objective of this work is to characterize areas in a succession process (regrowth), in the Amazon region, using multitemporal analysis of TM acquired in 1985, 1988, 1992 and 1995 through digital image processing techniques and spatial analysis. The methodological procedures used try to identify the year in which the clear cut took place, in areas mapped as regrowth in the 1998 TM image, and now are in a succession process, in function of its spectral response. We will try to quantify and characterize its contribution in the carbon fluxes using the methodology proposed by International Panel on Climatic Change (IPCC).

### 1 - INTRODUCTION

The need for periodic analysis of a large area such as Amazon, is possible because of the current progresses in space technology and computer science. The information provided by orbital remote sensors makes possible the investments in monitoring program like PRODES (INPE,1996), that has been studying systematically the deforestation in Amazon since 1978, and consequently has a large volume of analogical and digital information. The digital data are arranged in a database and can be used as an input data for new studies in this region.

According to Nelson (1998), a great part of the deforested area in Amazon is covered by secondary forests, observed in satellite images. When an agricultural or pasture area is abandoned, it starts to accumulate carbon in the soil and in the vegetation above the soil. The forest growth process is characterized by presenting high photosynthetic rates, absorbing CO<sub>2</sub> from the atmosphere. The assessment and quantification of growth process areas and the possibility of identifying the age of those areas, can support the biomass estimates, and fluxes of carbon accumulation. The studies relative to carbon flux in tropical forests are complex. In that sense, studies that seek the characterization and knowledge of the dynamics of areas in a succession process are important. We consider as suggest by IPCC 8ton/ha /y for regrowing tropical humid forest.

### 2 - STUDY AREA

The study area is located between the coordinates W 63°07'00 " / S 11° 05'00 " and W 61° 09'00 " /S 09°05'00 " , in Rondônia state, in the Lansdat-5 TM (Path/Row, 231/67). This area belong to the so called " arch of the deforestation ", that is an area comprising the Amazon forest and has been presenting high deforestation indices along the years. These areas present basic characteristics of the occupation occurring in the Amazon region, such as selective wood exploration or total removal of the primary forest. The TM images were defined in an interval of 3 years, 1985,1988,1992,1995 acquired from June to August, the dry period in the study region.

### 3 - METHODOLOGY

#### 3.1 - Identification of the regrowth polygons

The regrowth areas (Figure 1) were obtained by the BADDAM (Digital database of Amazon) project, by a mask that isolate in the TM image (path/row, 231/67) acquired on September 12,1998 the theme

identified as deforestation until 1997. Then, the Linear Mixing Model generated the vegetation, soil and shade fraction images from 1998 TM data. Image segmentation and classification procedures were applied, using as base the image vegetation fraction, followed by the revision and edition by visual interpretation. It was identified 7 possible regrowth classes, but only two of them were considered typical regrowth areas.

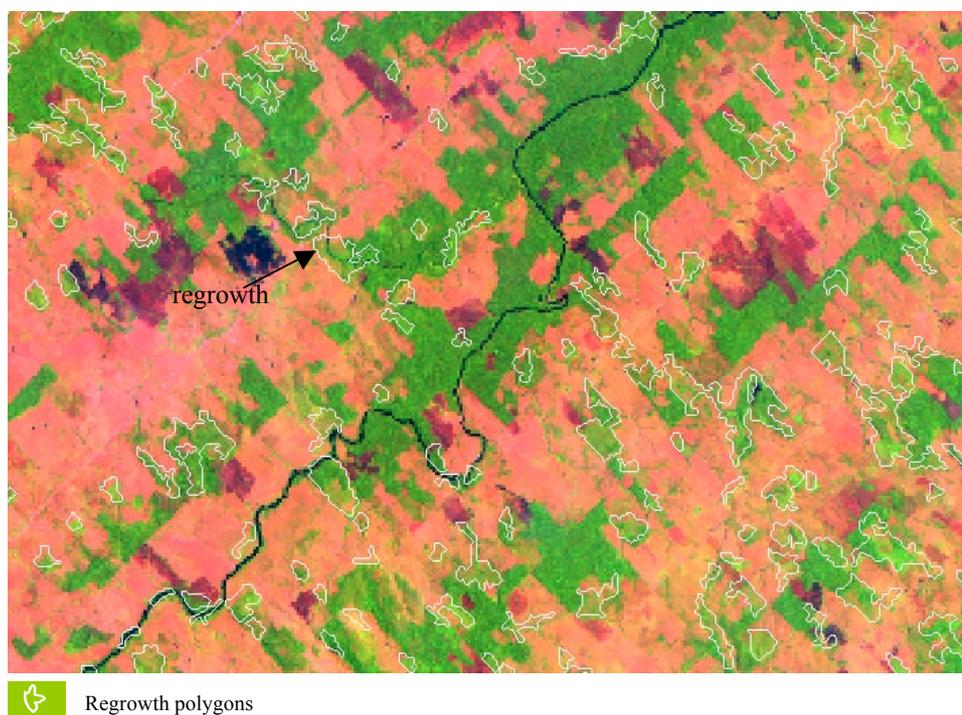


Figure 1 – Image TM 1998 (3,45,BGR)

The channel 5 of sensor TM (1.55-1.75 $\mu$ m) was selected for image processing because of the high soil reflectance in its spectral range. Firstly, it was cut out in the 1995 image the area of interest (regrowth Polygons) to reduce the time of segmentation processing. Following, it was applied the classification procedures, where it was discriminated the deforestation and forest classes. The class forest was used for masking the following image, the year of 1992 and so forth to the year of 1985. After images processing, it was performed the spatial analysis, based on conditions established by boolean expressions.

### 3.2 - Image Segmentation

According to Batista (1999), the Image segmentation method is a technique of grouping data in which only the adjacent spatially areas can be a group. Initially the segmentation process labels each pixel as a different areas. It calculates a similarity approach for each equal areas spatially adjacent. The similarity approach is based on a statistical hypothesis that test the average among the areas. Later on, it divides the image in a group of sub-images and then beginning the union between them, starting from a defined aggregation threshold (area threshold and similarity threshold). This procedure presented satisfactory results, in which some alterations in the area and similarity thresholds for the dates of 1995/1992 and 1985/1988, respectively, (10x10) and (8x4), due to continuous decrease of the area of the images in the previous processes (Figure 2).



Figure 2 – Image segmented with regrowth polygons

### 3.3 - Classification

The segmented image classification aimed at associating each polygon to a label describing the land cover type. In this case, two classes were considered: forest and deforestation (Figure 3). An unsupervised classification algorithm was used from which more than a class associated to the forest areas and only one class associated to deforestation were obtained, except for the 1995 classification in which 2 deforestation classes were presented.

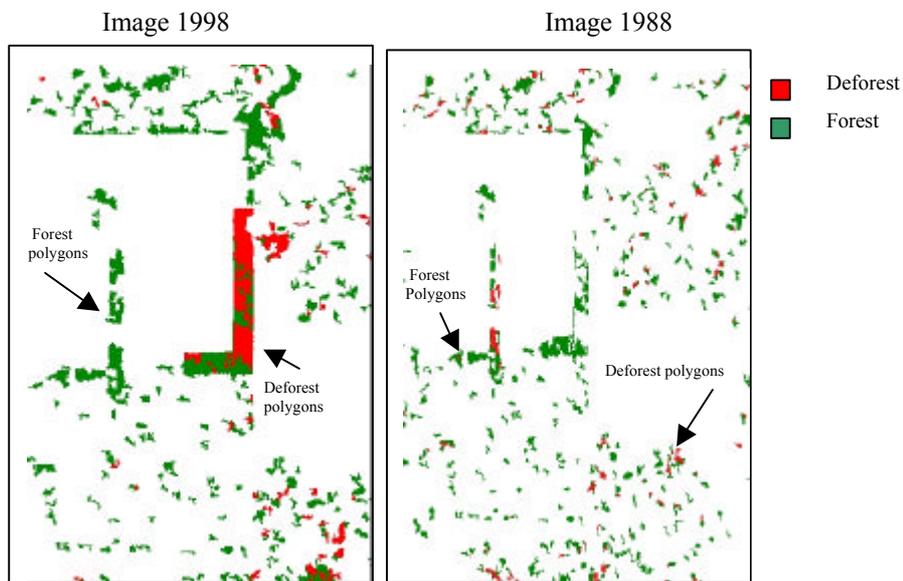


Figure 3 – Images segmentation classification

#### 4 - RESULTS

Table 1 summarizes the segmentation and classification results. It was observed the largest deforestation occurred in 1995 and 1998, agreeing with the tendency showed by the PRODES in those years. Although It was expected to obtain the classification for all the polygons identified as regrowth areas, this did not happen in a large part of the region. We believe that these non-classified areas were deforested before 1985 and since then they have been in a growth process.

Table – 1 Images segmentation and Classification results

IMAGES 231/67	AREA KM <sup>2</sup>		% relationship between area deforested and total analyzed*	Total deforested	Total non- classified area
	Deforested	Total analyzed /year			
1995 – 03/08	436	1764	24,7	851	913
1992 – 07/06	71	1327	4		
1988 – 30/07	315	1255	17,8		
1985 – 22/07	29	937	1,6		

\* 1764km<sup>2</sup>

The quantification of these areas in order to contribute to the carbon flux calculation was not performed because the results of the analysis indicated that some areas were deforested more than one time as shown in Figure 4. These polygons were deforested in 1988 possibly for pasture. It was observed that from 1989 to 1994 these areas were in a regrowing process. But in 1995 suffered new intervention. Therefore They cannot be considered as an old regeneration areas.

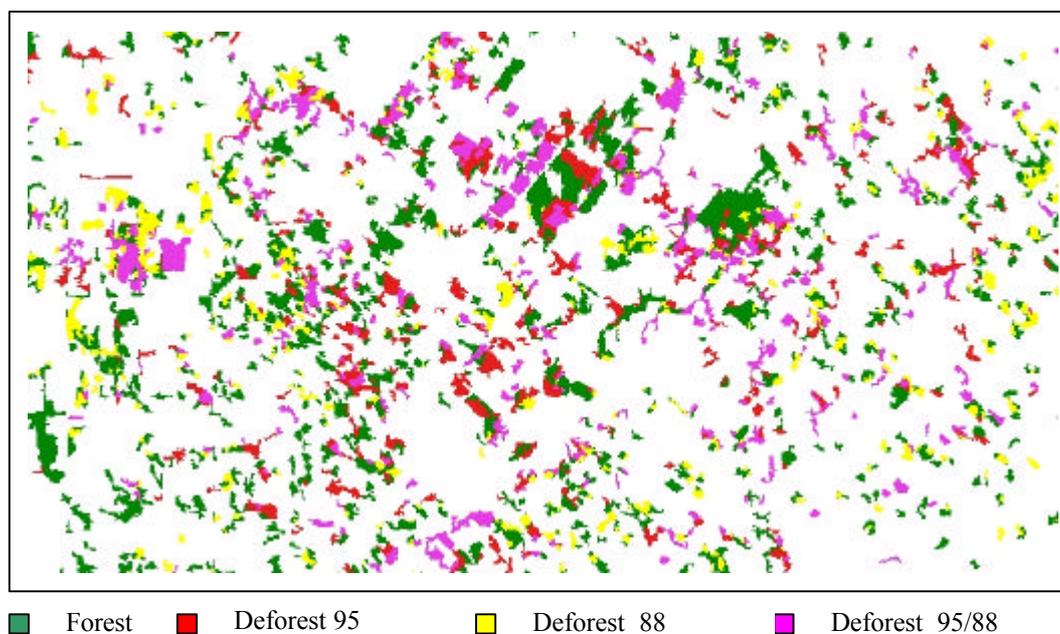


Figure 4 – Analysis of regrowth polygons plans 1998/1988

## 5 - CONCLUSION

The methodology procedures were considered efficient to identify the year which the forest clear cut took place. However, the interval of 3 years proposed in this analysis was insufficient to identify most of the areas as shown in Table 1. Consequently, it was possible to quantify and characterize the areas into a 3 year interval of regrowth age. For a more detailed study we suggest an yearly TM analysis.

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