Estimation of Land Cover Change in Brazilian Amazon using Landsat TM Satellite Images

Abstract

A representative area of Manaus (Brazil) was evaluated using two geo referenced Landsat TM images from August 1990 and May 1992 with TNTmips; four classes of interest were identified and their spatial distribution evaluated through supervised classification method in three samples using two band combinations and cloud masking, the resulting maps were filtered for enhancement and noise reduction. The results showed the dispersion of located areas of forest recovery at a rate of 0.3% and of forest degradation at a rate of 0.65% annually, confirming the cited complexity of the problem concerning its causes, tendencies and variability on time and space.

Justification

Global rates of deforestation:69,000km2 (1980) - 165,000km2 1989).(WRI,1990), 50 - 70% of which is in Brazilian Amazon (20,000 fires/month,Skole, 1997). The actual plan of agrarian reform is to settle 100,000families/year (historical average:25,000).(Groppo, 1996). Problem is still not well known, there is a lack of accurate measurements (rate, extents, spatial patterns) and misunderstanding of causes.
Land Cover Conversion affects hydrology, climate, bio geo chemical cycles, habitat.

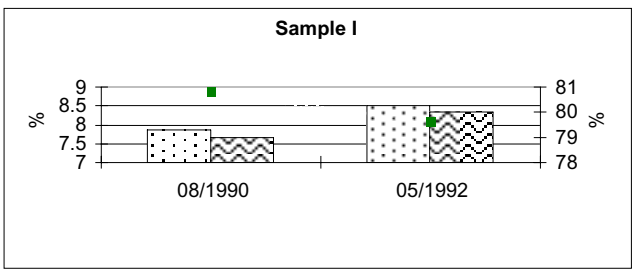
Region	Current extent	Rate of annual deforestation
America	4 million square kilometers	0.19 million square kilometers
Asia	2 million square kilometers	0.22 million square kilometers
Africa	1.8 million square kilometers	0.05 million square kilometers

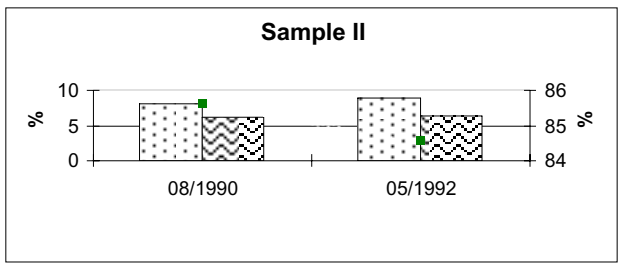
Equipment and Materials

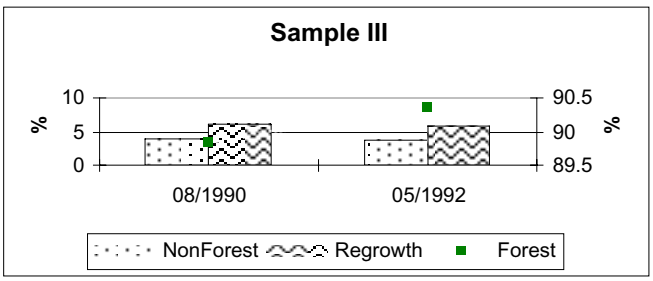
Pentium Processor OASYS V – 5133D6.
Microsoft Windows 95 software system.
TNT Professional mips software version 6.3, resolution: 1018 x 715, depth: 24 bit. (Furst, 1998).
Color bubble jet printer Canon BJC- 420J.
Planimetric maps scale:1/100,000.
02 CD ROM Landsat satellite image (Aug 1990 and May 1992).

Procedure

1) *Georeference* and *Resampling* of rasters.
2) Determination of land use classes on natural color image (RGB 1-2-3) ~ *reference raster* .
3) Determ. of Training Data Set (RGB 4-5-7).
4) Determ.of classif. method (*Stepwise Linear*).
5)Change detection by *classified images comparison (Change Matrix* and *land cover change map* construction for each sample*)*.
6) Image enhancement (*Modal* and *Median* 3x3 filters).







	1990		1992	
	OA (%)	KHAT (%)	OA (%)	KHAT (%)
Sample I	87.71	46.79	87.06	45.32
Sample II	92.43	68.07	87.91	43.89
Sample III	88.87	25.9	79.09	29.20

Accuracy results of supervised classification

Results Discussion

For the area evaluated in sample I during the lapse of 21 months, the Forest class area declined in 1.23% at expense of almost equal increment of Non Forest (0.64%) and Regrowth (0.69%) class areas; the Regrowth class comprehends abandoned Non Forest areas and Forest areas that are commencing to be degraded.

In sample II the Forest class area decreased in 1.05% at expense of mainly an increment of Non Forest class areas in 0.89% and a slight increment (0.17%) of the Regrowth class,

In sample III an increment of 0.51% was detected for the Forest class because of an almost uniform decrease of Non Forest (0.23%) and Regrowth (0.28%) classes.

This results reflects a conclusion obtained by Alves and Skole (in press) while analysing annual time series of data acquired in a test site that showed that the rate of deforestation can change dramatically from one year to the next, suggesting that average annual estimates over several years might miss important events.

The results also confirm those encountered in a exploratory regression analysis on patterns of deforestation/afforestation in the state of Para, Brazil (Mc Cracken *et al* 1999), where farms with similar area in forest and similar composition in land-cover classes are more likely to have higher rates of deforestation the further they are from the major city in the area (compare results from sample II and sample III), an intriguing result. The coefficients associated with distance indicate a curvilinear relationship between distance and annual area deforested.

Conclusions

Landsat TM images are suitable for detecting land cover change of major types of land use with high accuracy; more sub classes can be detailed if field inspection is possible. The use of bands 1,2 and 3 proved to be useful for making the training data, and bands 4, 5 and 7 for classification with Stepwise Linear classifier.

* The statistical report is useful to determine the best classifier, but since many of them give similar Overall Accuracy and KHAT values, is necessary to compare the scatter plot diagrams and the final appearance of classified maps.

* The comparison of classified images of two dates proved to be useful for change detection analysis, it provides more information than other techniques such as *images algebra*, *rationing* or *principal components.*

* The rates of secondary growth (regrowth or forest regeneration) can be as high as those of deforestation in some areas and is commonly distributed around the Non Forest class areas. Higher rates of change are explained by a diffuse fragmentation of the class into many small areas; low rates are associated with the occurrence of relatively large, homogeneous areas.

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