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ABSTRACT

In August 2010, SAD detected 210 square kilometers of deforestation in the Legal Amazon. This represented a reduction of 23% in comparison to August 2010 when the deforestation totaled 273 square kilometers.

In August 2010, majority (68%) of the deforestation occurred in Pará, followed by Mato Grosso (11%), Amazonas (10%), Acre (6%), and Rondônia (5%).

An extremely significant increase (241%) of the forest degradation (forests intensely explored by wood and/or burning activities) reached 1.549 square kilometers in August 2010 compared to 455 square kilometers in August 2009. This degradation mainly occurred in Mato Grosso (46%) and Pará (38%).

In August 2010, the deforestation detected by SAD in Legal Amazon resulted in a commitment of 3,4 million tons of CO or 12,5 million tons of CO² equivalents. This represents a reduction of 19% in relation to August 2009.

It was possible to monitor with SAD the majority (81%) of Legal Amazon (excluding Maranhão) in August 2010.

Deforestation Statistics

According to the Deforestation Alert System (SAD) of Imazon, the deforestation in August 2010 in the Legal Amazon reached 210 square kilometers (Figure 1 and Figure 2). This represented a 23% reduction in the deforestation of August 2010 in comparison to the deforestation detected in August 2009 when the deforestation totaled 273 square kilometers.

In August 2010, majority (68%) of the deforestation occurred in the State of Pará. Next is Mato Grosso with 11%, Amazonas (10%), Acre (6%) and Rondônia (5%).

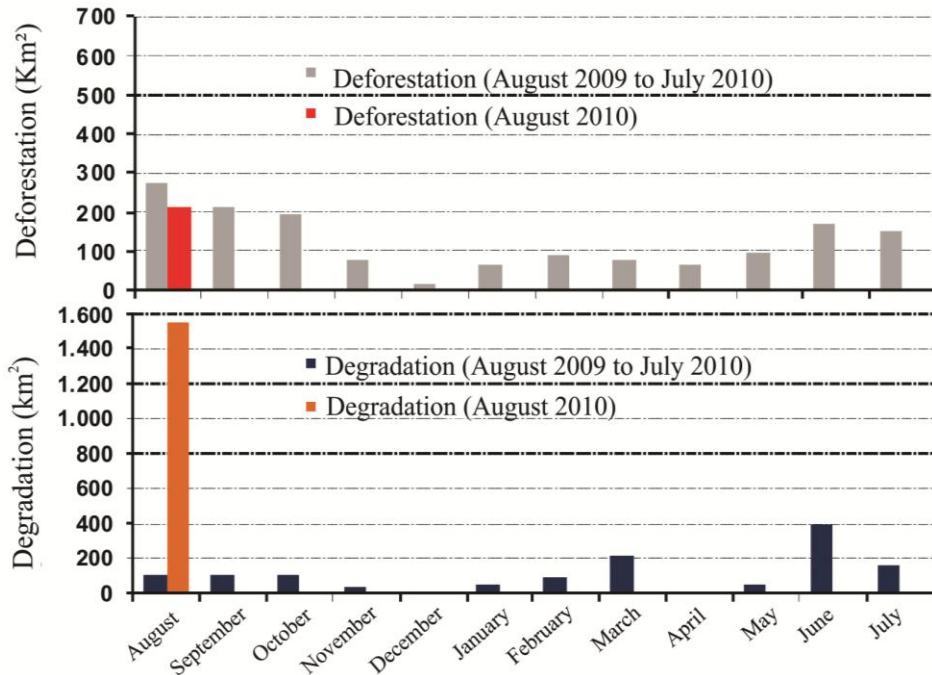


Figure 1. Deforestation and degradation from August 2009 to August 2010 in Legal Amazon (Source: Imazon/SAD).

Figure 2. Deforestation and Forest Degradation in August 2010 in Legal Amazon (Source: Imazon/SAD).

In August 2010, SAD registered 1.549 square kilometers of deteriorated forests (Figures 1 and 2). This corresponds to an expressive increase of 241% in relation to the same period of the former year (August 2009) when the forest degradation reached 455 square kilometers. From this total, 46% occurred in Mato Grosso, 38% in Pará, 12% in Rondônia, 3% in Amazonas and 1% in Acre.

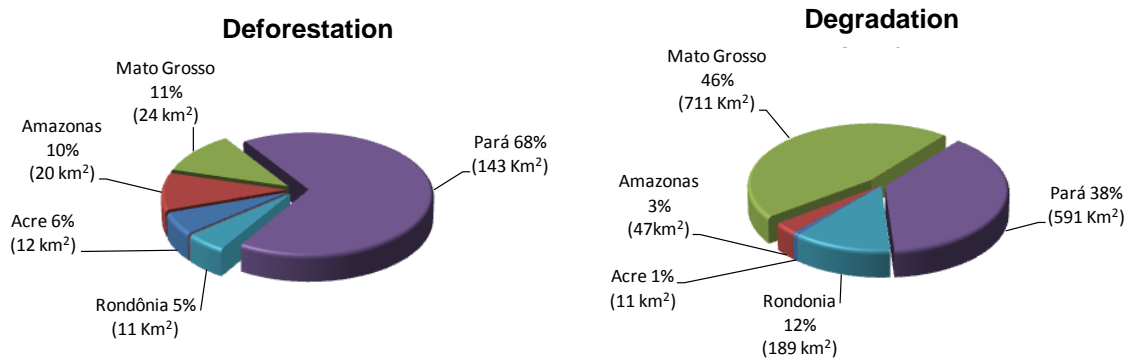


Figure 3. Participation (%) of the States of Legal Amazon in the deforestation and degradation in August 2010 (Source: Imazon/SAD).



In August 2010, the deforestation reduction was more expressive in Pará (-31%), then in Rondônia (- 24%). On the other hand, a deforestation increase occurred in Acre, Amazonas and Mato Grosso (Table1).

In relation to the deteriorated forests, the increase of 241% in August 2010 in relation to August 2009 was extremely expressive in Amazonas (+ 1.651%) and Acre (+ 1.029) and significant in Pará (+ 282%), Rondônia (+ 210%) and in Mato Grosso (+ 192%) (Table 2).

Table 1. Evolution of the deforestation among the States of Legal Amazon from August 2009 to August 2010 (Source: Imazon/SAD).

State	August 2009	August 2010	Variation (%)
Acre	4	12	+ 197
Amazonas	16	21	+ 27
Mato Grosso	23	24	+ 6
Pará	208	143	- 31
Rondônia	14	11	- 24
Roraima	2	-	-
Tocantins	-	-	-
Amapá	6	-	-
Total	273	210	- 23

* The data of Maranhão were not analyzed..

Table 2. Evolution of the forest degradation among the States of Legal Amazon from August 2009 to August 2010 (Source: Imazon/SAD).

State	August 2009	August 2010	Variation (%)
Acre	1	11	+ 1.029
Amazonas	3	47	+ 1.651
Mato Grosso	186	711	+ 282
Pará	202	591	+ 192
Rondônia	61	189	+ 210
Roraima	2	-	-
Tocantins	-	-	-
Amapá	-	-	-
Total	455	210	+ 241

* The data of Maranhão were not analyzed.

Carbon Affected by the Deforestation

In August 2010, the 210 square meters of deforestation detected by SAD in Legal Amazon affected 3.4 million tons of carbon (with an error margin of 1.3 million tons).

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This amount of affected carbon results in 12.5 million tons of CO₂ equivalent (Figure 4). This represents a drop of 19% e in relation to August 2009 when the affected forest carbon was 3.4 million tons. This reduction in carbon affected by deforestation was proportional to the reduction of 23% of the deforestation detected by SAD this month.

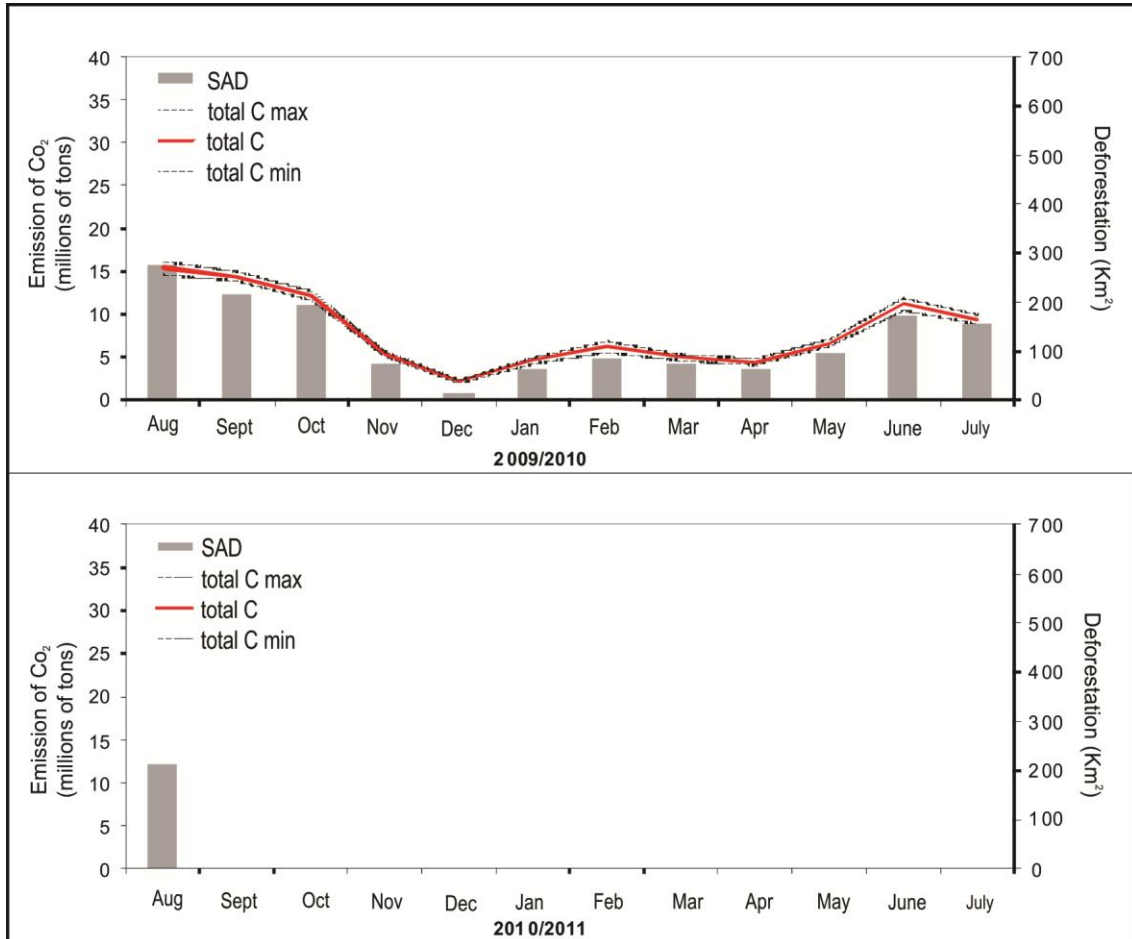


Figure 4. Deforestation and emissions of Carbon Dioxide (CO) equivalent from August 2009 to August 2010 in Legal Amazon (Source: Imazon).

Geography of the Deforestation

In August 2010, the deforestation was expressively concentrated in Pará mainly in the BR-163 influence area (Santarém-Cuiabá road) affecting the cities of Novo Progresso, Altamira, Trairão and Itaituba; and in Terra do Meio, reaching the cities of São Félix do Xingu and Altamira. A more concentrated deforestation also occurred in Porto Velho (Rondônia) and Rio Branco (Acre).

Regarding the land title status in August 2010, the majority (54%) of the deforestation occurred in private areas or in areas under different stages of ownership. The remaining deforestation was recorded in Agrarian Reform Settlements (23%), followed by Conservation Units (19%) and Indigenous Lands (4%) (Table 3).

Table 3. Deforestation per land title category in August 2010 in the Legal Amazon (Source: Imazon/SAD).

Category	July 2010	
	km ²	%
Agrarian Reform Settlement	48	23
Conservation Units	40	19
Indigenous Lands	8	4
Private, Owned & Vacant ¹	114	54
Total (km²)	210	100

Agrarian Reform Settlements

SAD registered 48 square kilometers in the Agrarian Reform Settlements during August 2010. The Settlements most affected by the deforestation were Campos de Pilar (Itaituba; Pará), Tucumã (São Félix do Xingu; Pará), and Rio Juma (Apuí; Amazonas) (Figure 5).

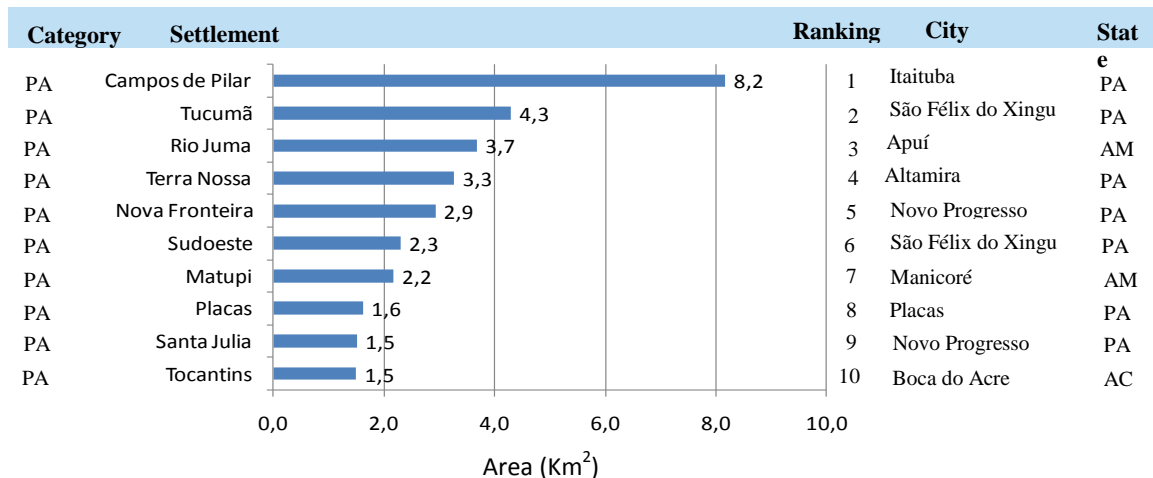


Figure 5. Most deforested Agrarian Reform Settlements in August 2010 in Legal Amazon (Source: Imazon/SAD).

¹ Includes private areas (owned or not) and unprotected public forests.

Protected Areas

The Conservation Units that suffered the most deforestation were APA Triunfo do Xingu (Pará), Rebio Nascente Serra do Cachimbo (Pará) and Florex Rio Preto/Jacundá (Rondônia) (Figure 6).

In the case of the Indigenous Lands, eight square kilometers were detected in July 2010. The most affected were Apyterewa (Pará), Kayabi (Pará), and Cachoeira Seca do Iriri (Pará) (Figure 7).

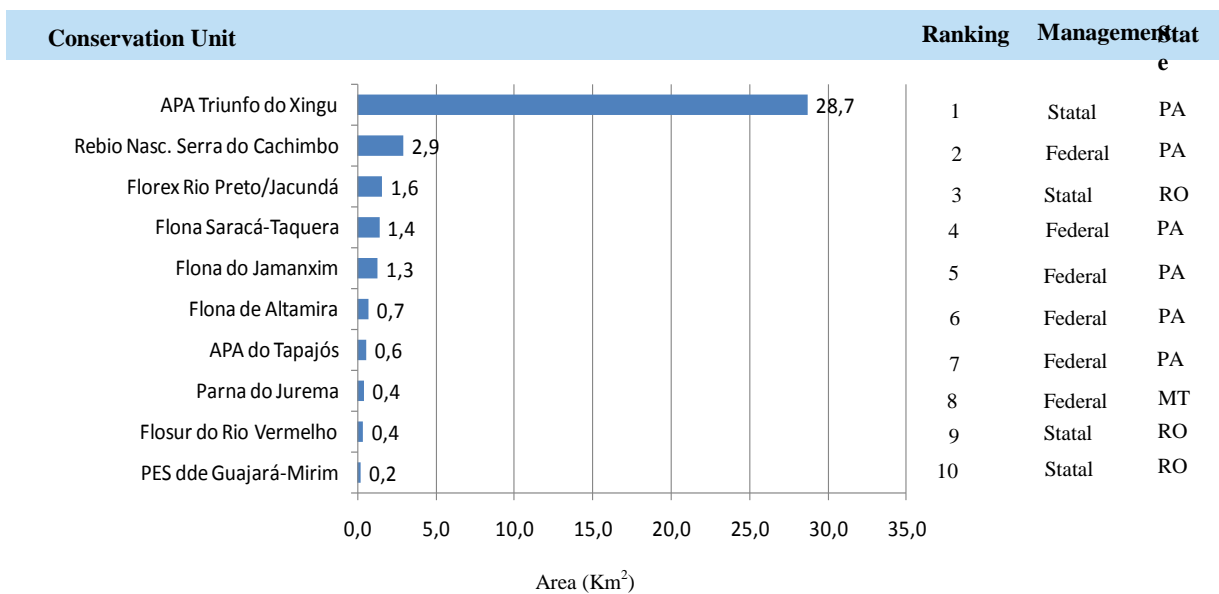


Figure 6. Most deforested Conservation Units in Legal Amazon in August 2010 (Source: Imazon /SAD).

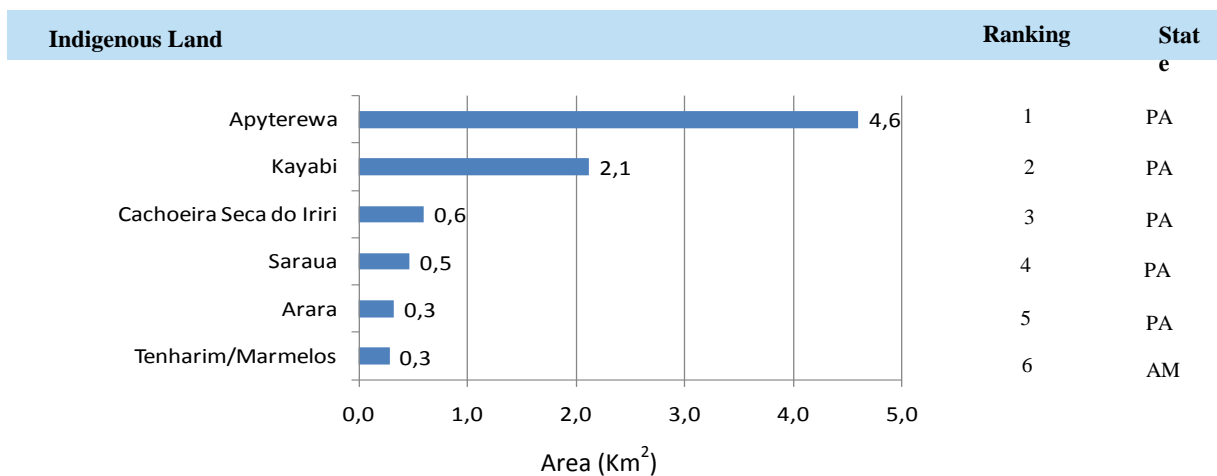


Figure 7. Most deforested Indigenous Lands in Legal Amazon in August 2010 (Source: Imazon /SAD).

Critical Municipalities

In August 2010, first three municipalities most affected by deforestation are located in Pará, with the first being São Félix do Xingu with 44.5 square kilometers, followed by Altamira with 34.7 square kilometers and Novo Progresso with 10 square kilometers (Figure 8 and Figure 9).

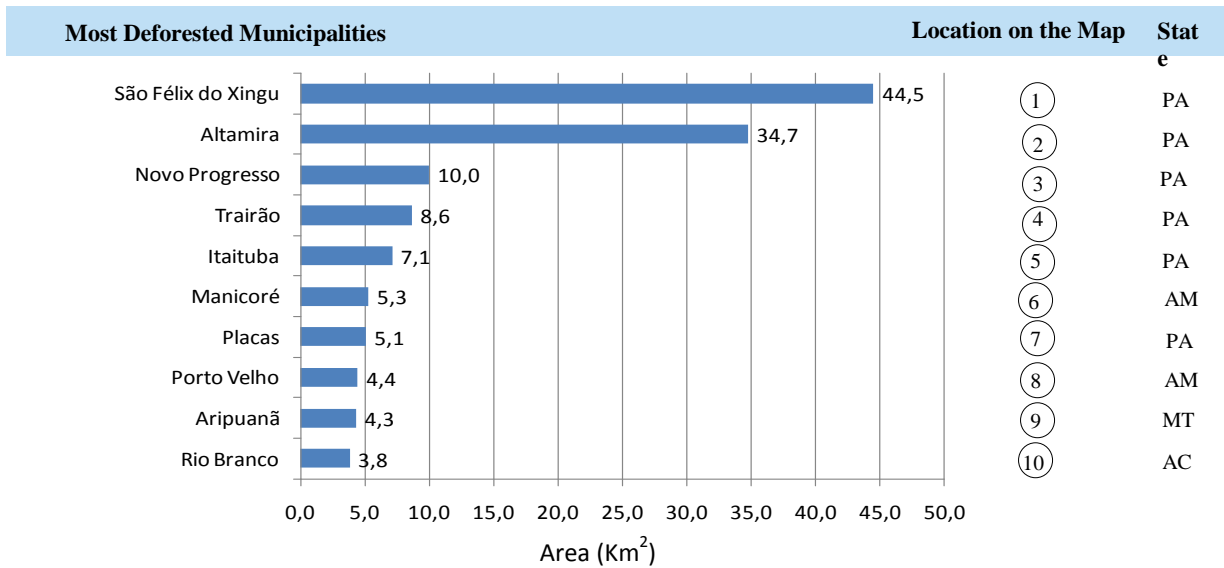
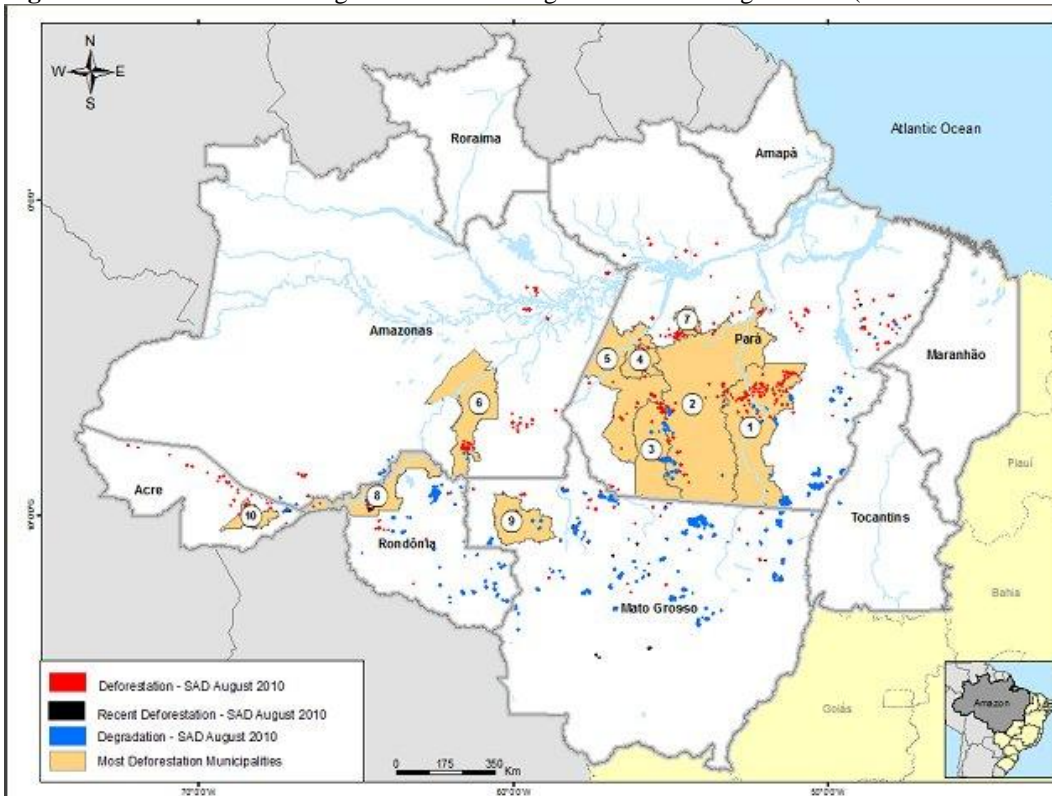


Figure 8. Most deforested Indigenous Lands in Legal Amazon in August 2010 (Source: Imazon /SAD).





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Figure 9. Most deforested municipalities in August 2010 (Source: Imazon/SAD).

Cloud and Shade Cover

In August 2010, it was possible to monitor 81% of the area with forest cover in the Legal Amazon, since only 25% of the territory was covered by clouds (Figure 10). The unmapped region corresponds to the forest area of Amapá, Roraima, and North of Pará and Amazonas.

* The part of Maranhão that is part of the Legal Amazon was not analyzed.

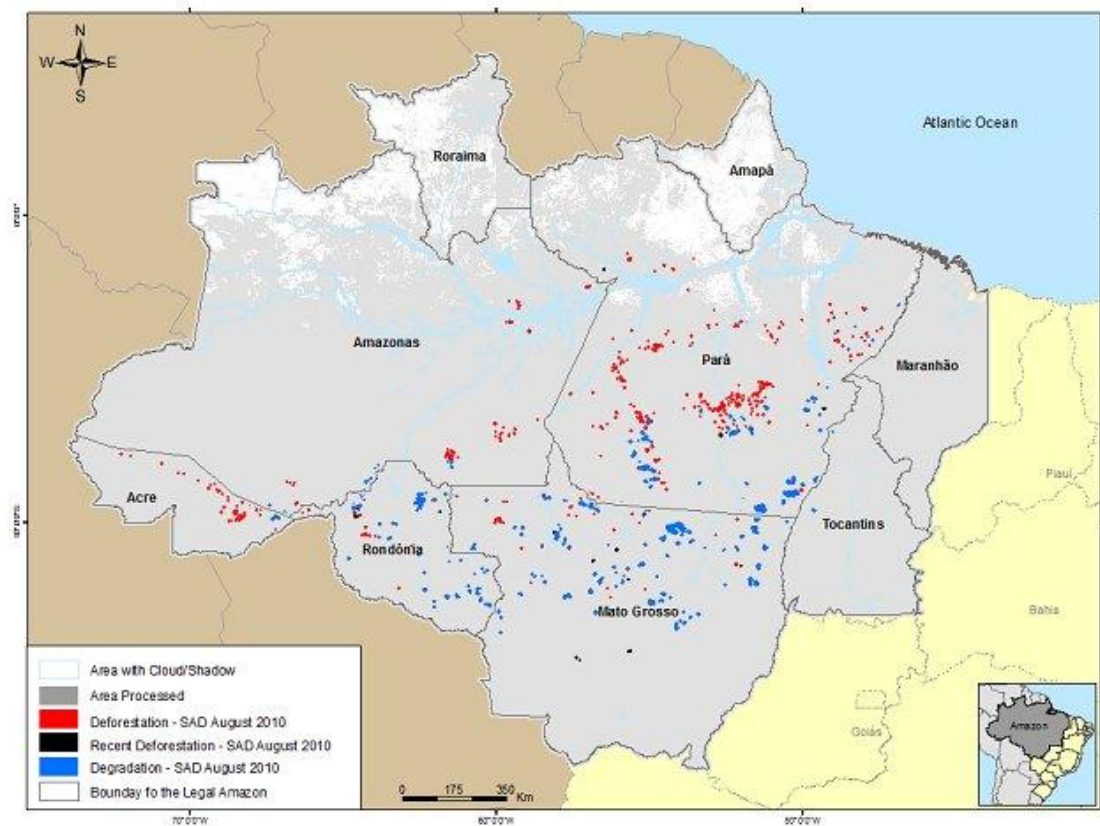


Figure 10. Area with cloud and shade in August 2010 in Legal Amazon.

Validation of the SAD data using Landsat and Cbers Imaging

The SAD data are validated through the use of CBERS and Landsat imaging with finer spatial resolution (20 and 30 meters, respectively). The images available soon after the month analyzed by SAD were used. All the deforestation polygons detected by SAD are checked using the detailed images. Deforestation less than 6.25 hectares, that is, below the detection capacity of SAD, are not included in the statistics, in case they occur in the images with more detailed resolution. However, if false signs of deforestation detected by SAD are confirmed, these are removed from the monthly statistics. The innovation in the SAD validation process is that this methodology was applied almost in real time due to the availability of the CBERS and Landsat satellites images by Inpe (National Space Research Institute).

In August 2010, 89% of the deforestation detected by SAD was confirmed with the Landsat images (Figure 11). Only 11% were not confirmed due to the unavailability of Landsat and CBERS images at that time.

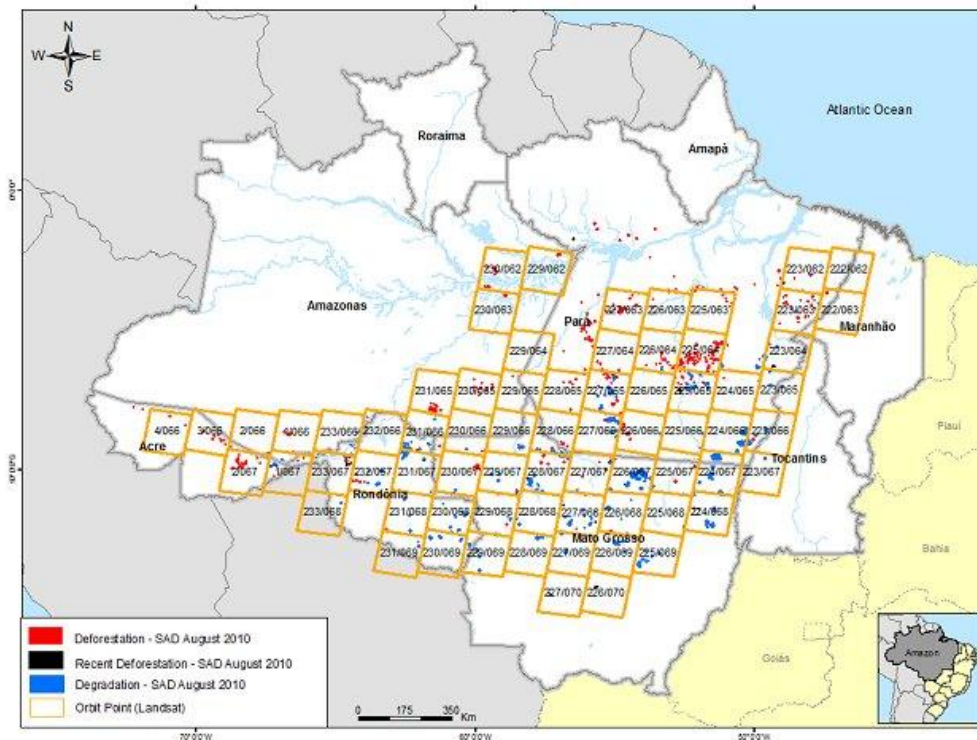


Figure 11. Landsat scenes used in the validation of the deforestation polygons detected by SAD in August 2010.



Section I: SAD 3.0

Since August 2009, SAD presented some innovations. First, a graphic interface was created to integrate all the image processing programs used in the SAD. Secondly, we began computing the deforestation in areas that were covered by clouds in the previous months under a new class. Lastly, the deforestation and degradation were detected with pairs of NDFI images in a change detection algorithm. The main methodology continues to be the same as SAD 2 as shown below.

SAD generates temporary MODIS images daily from the products MOD09GQ and MOD09GA for cloud filtration. A fusion technique for different spectral resolution bands, that is, with pixels of different sizes, was then used. In this case, the 5 bands scale with a pixel of 500 meters of the MODIS was changed to 250 meters. This allowed the improvement of the spectral pixel mixture model, providing the ability to estimate the abundance of Vegetation, Soils and Non-Photosynthetic components (NPV) (Vegetation, Soil and Shade) to calculate the NDFI with the equation below:

$$\text{NDFI} = \frac{(\text{VGs} - (\text{NPV} + \text{Solo}))}{(\text{VGs} + \text{NPV} + \text{Solo})}$$

Where VGs is the Vegetation component normalized for shade given by:

$$\text{VGs} = \text{Vegetation} / (1 - \text{Shade})$$

NDFI varies from -1 (pixel with 100% of exposed soil) to 1 (pixel with > 90% with forest vegetation). Therefore, we have a continuous image showing the transition of the deforested areas, passing through degraded forest until it reaches forests without signs of disturbance.

This month the detection of the deforestation and degradation had different NDFI images of consecutive months. Therefore, a reduction in the NDFI values between -200 and -50 indicated possibly deforested areas and between -49 and -20 with signs of degradation.

SAD 3.0 Beta is compatible with the previous versions (SAD 1.0 and 2.0) because the deforestation detection threshold was calibrated to generate the same type of response obtained by the previous method.

SAD is already operating in the state of Mato Grosso since august 2006 and in Legal Amazon since April 2008. This bulletin presents the monthly data generated by SAD from August 2006 to August 2010.

Section II: Carbon affected by the deforestation

Since January 2010, the affected carbon (that is, the forest carbon subject to emissions due to burning and decomposition of forest biomass waste) estimates from the deforestation detected by SAD in Legal Amazon was reported.

The carbon estimates are generated based on the combination of SAD deforestation maps with simulations of the spatial biomass distribution for the Amazon. A carbon emission estimation model called Carbon Emission Simulator (CES) was developed based on the stochastic simulation (Morton et al, in prep.). One thousand (1000) spatial biomass distribution simulations in the Amazon were generated using a geostatic model (Sales et al., 2007), and these biomass simulations were transformed into C-stocks using biomass conversion factors for C from literature, according to the formula below:

$$C_t = \sum C(S)_t$$

$$C_t(S) = S_D \times \left[(BVAS - BPF) \times (1 - fc) \times (t == 0) + (BAS_0 \times pd \times e^{(-pd \times t)}) \right]$$

$$BPF = ff * AGLB$$

$$BAS_0 = bf * AGLB$$

where:

t: time (month)

C_t : Carbon emitted in month t.

$C_t(S)$: Carbon emitted from a deforested polygon at time t.

S_D : Deforested area:

BVAS: Biomass aboveground at the deforested region S_D .

BPF: Biomass from forest products removed from forests before the deforestation.

fc: coal fraction (3 to 6%).

BAS_0 : Underground biomass before deforestation.

pd: monthly decomposition parameter of the underground biomass after deforestation (0.0075).

$pd \times e^{(-pd \times t)}$: Monthly decomposition rate of underground biomass after deforestation.

To apply the CES model using the SAD data, only the carbon affected by the deforestation was considered, which is the fraction of forest biomass made up of carbon (50%) subject to instant emissions caused by forest fires from the deforestation and/or future decomposition of the remaining forest biomass. Also, the CES model was modified to estimate the forest carbon affected by the deforestation on a monthly scale. Lastly, the simulations enabled the estimation of the affected carbon uncertainty, represented by the standard deviation (+/-2 fold) the simulations of the carbon affected each month.

Apply the value 3.68 to convert the carbon values for CO equivalent.

References:

D.C. Morton¹, M.H. Sales², C.M. Souza, Jr.², B. Griscom³. Baseline Carbon Emissions from Deforestation and Forest Degradation: A REDD case study in Mato Grosso, Brazil. In preparation.

Sales, M.H. et al., 2007. Improving spatial distribution estimation of forest biomass with geostatistics: A case study for Rondônia, Brazil. *Ecological Modelling*, 205(1-2), 221-230.



Notes:

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Data Source:

The deforestation statistics are generated from the SAD data (Imazon);

INPE Data - Deforestation (PRODES)

<http://www.obt.inpe.br/prodes/>

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State Public Ministry of Pará

State Public Ministry of Roraima

State Public Ministry of Amapá

State Public Ministry of Mato Grosso

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