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SUMMARY

In June, 2010, SAD detected 172 square kilometers of deforestation in the Legal Amazon. That represented an increase of 15% in relation to June, 2009 when deforestation totaled 150 square kilometers.

The accumulated deforestation for the period of August, 2009 to June, 2010 totaled 1,333 square kilometers. In comparison with the previous period of August, 2008 to June, 2009 (when deforestation totaled 1,234 square kilometers), there was an 8% increase.

In June, 2010, the majority of the deforestation occurred in Pará (67%). The remainder occurred in Amazonas (13%) then Mato Grosso (10%), Rondônia (8%), Acre (1%), Roraima (0.5%) and Tocantins (0.5%).

The accumulated deforestation for the period of August, 2009 to June, 2010 resulted in

the commitment of 85 million tons of CO₂ equivalent, which are subject to direct and future emissions due to burning and decomposition events. That represents an increase of 3% in relation to the previous period (August, 2008 to June, 2009) when the forest carbon affected by deforestation was around 87 million tons of CO₂ equivalent.

The degraded forests (forests intensely exploited through logging activity and/or burning) in the Legal Amazon totaled 402 square kilometers in June, 2010. Of that total, almost all (97%) occurred in Pará.

In June, 2010, it was possible to monitor 75% of the area with forest cover in the Legal Amazon.

Deforestation Statistics

According to the Imazon's Deforestation Alert System (*Sistema de Alerta de Desmatamento - SAD*), deforestation in June, 2010 in the Legal Amazon reached 172 square kilometers (Figure 1 and Figure 2). That represents an increase of 15% in deforestation for June, 2010 in relation to deforestation detected in June, 2009 when deforestation totaled 150 square kilometers.

The accumulated deforestation for the period

of August, 2009 to June, 2010, corresponding to eleven months for the official calendar for measuring deforestation, reached 1,333 square kilometers. That represents an 8% increase in accumulated deforestation for that period (August, 2009 to June, 2010) in relation to the same period in the previous year (August, 2008 to June, 2009) when deforestation reached 1,234 square kilometers.

In June, 2010, the majority (67%) of the deforestation occurred in the State of Pará (67%). Next comes Amazonas with 13%, passing Mato Grosso (10%) and Rondônia (8%), states that have historically presented deforestation rates considerably higher than those for Amazonas. The remainder occurred in Acre (1%), Roraima (0.5%) and Tocantins (0.5%) (Figure 3).

¹ The official calendar for measuring deforestation begins in the month of August and ends in the month of July.

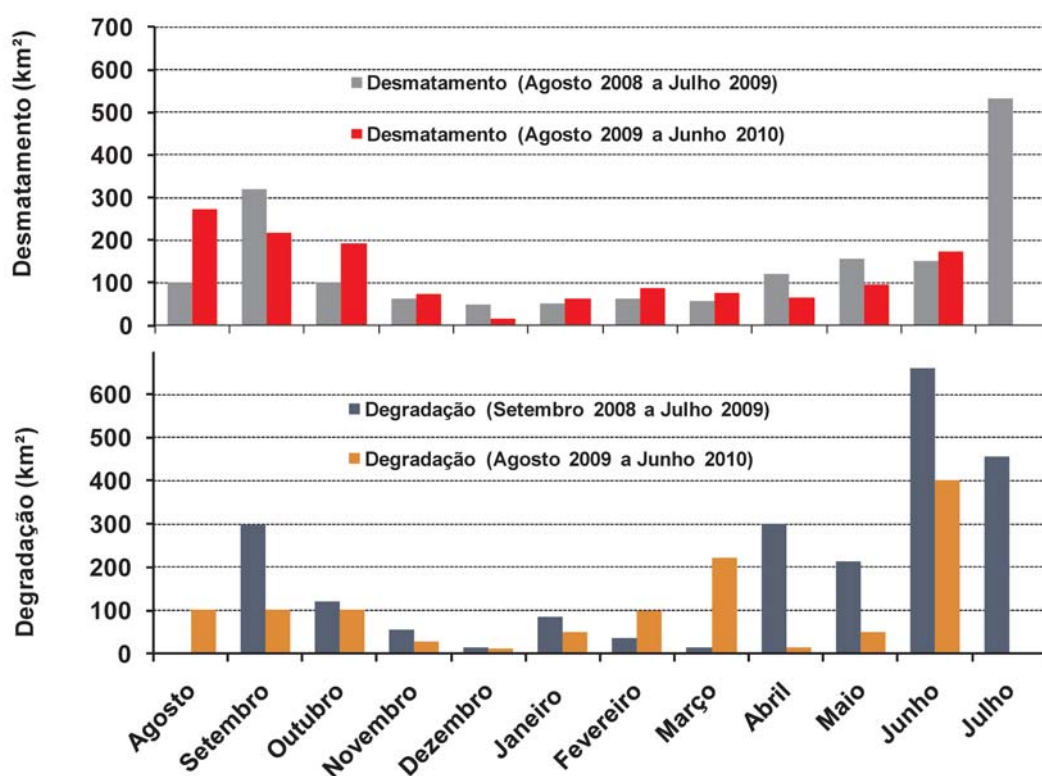


Figure 1. Deforestation from August, 2008 to June, 2010 and degradation from September, 2008 to June, 2010 in the Legal Amazon (Source: Imazon/SAD).

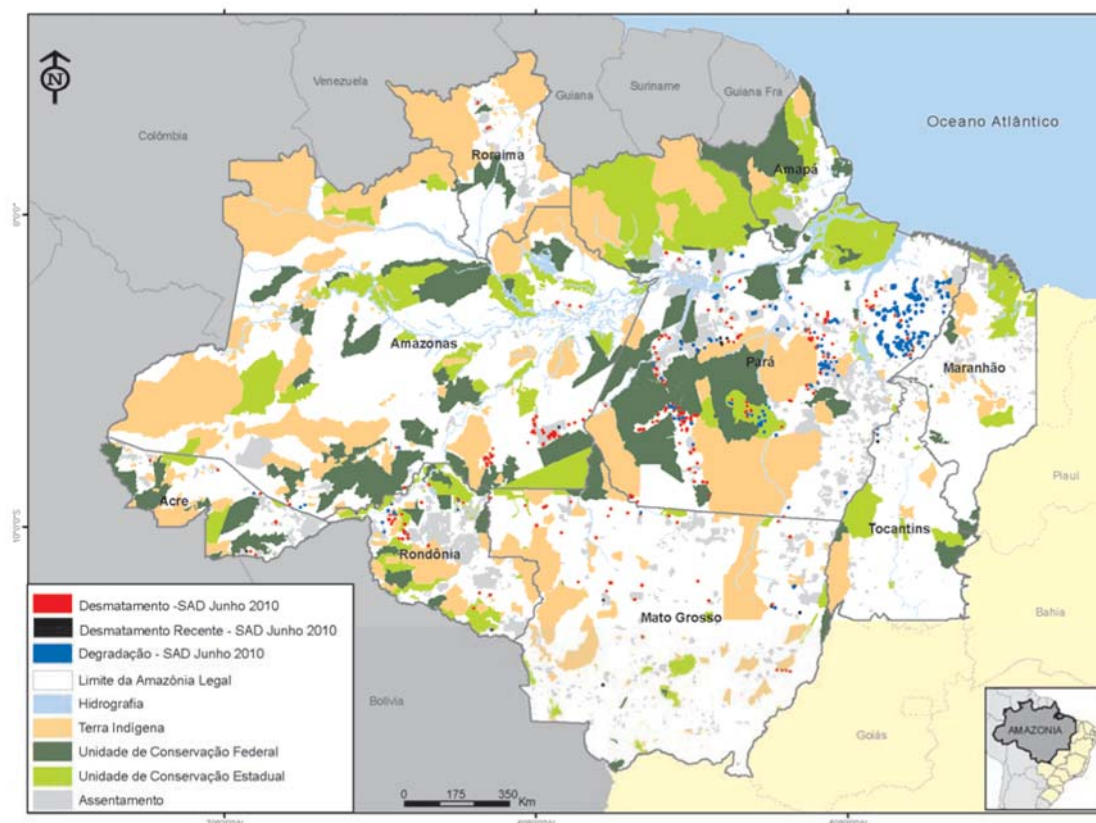


Figure 2. Deforestation and Forest Degradation in June, 2010 in the Legal Amazon (Source: Imazon/SAD).

In relation to forest degradation (that is, that have undergone intense logging and/or that have suffered from forest fire), SAD in June, 2010 recorded a considerably higher area: 402 square kilometers (Figures 1 and 2). Of

that total, almost all (97%) forest degradation occurred in Pará. The remainder was equally distributed between Mato Grosso (1%), Rondônia (1%), Tocantins (0.5%) and Amazonas (0.5%).

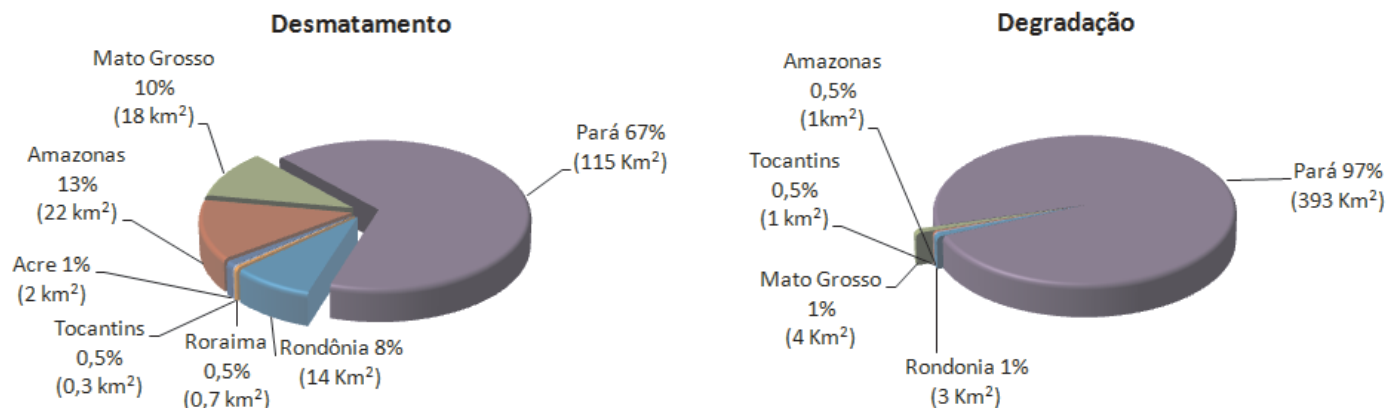


Figure 3. Participation (%) of the Legal Amazon States in deforestation and degradation in June, 2010 (Source: Imazon/SAD).

Considering the first eleven months of the current deforestation calendar (August, 2009 to June, 2010), Pará continues to lead the ranking with 47% of the total deforestation recorded for the period. Next appears Mato Grosso with 23%, Rondônia with 11% and Amazonas with 11%. Those four states were responsible for 92% of the deforestation occurring in the Legal Amazon in that period. One should note the participation of Amazonas in the total composition of deforestation for the Legal Amazon tying the State of Rondônia. The remaining 8% of deforestation occurred in Acre, Roraima, Amapá, and Tocantins.

August, 2009 to June, 2010 with the same period for the previous year (August, 2008 to June, 2009), there was an 8% increase in deforestation in the Legal Amazon (Table 1). In relative terms, that increase was most significant in Amazonas (87%), followed by Acre (+66%), Rondônia (+65%), and by Pará (+7%). On the other hand, there was a 92% reduction in Tocantins, 33% in Roraima, and 17% in Mato Grosso.

In absolute terms, Pará leads the ranking of accumulated deforestation with 622 square kilometers, followed by Mato Grosso (307 square kilometers), Rondônia (149 square kilometers) and Amazonas (149 square kilometers).

Comparing deforestation occurring from

Table 1. Evolution of deforestation among the States of the Legal Amazon from August, 2008 to June, 2009 and from August, 2009 to June, 2010 (Source: Imazon/SAD).

Estado	August 2008 to June, 2009	August 2009 to June, 2010	Variation (%)
Acre	24	40	+ 66
Amazonas	80	149	+ 87
Mato Grosso	368	307	- 17
Pará	581	622	+ 7
Rondônia	90	149	+ 65
Roraima	77	51	- 33
Tocantins	13	1	- 92
Amapá	-	15	-
Total	1,234	1,333	+ 8

*The data from Maranhão were not analyzed.

Carbon Affected by Deforestation

Since January, we have been reporting estimates for committed carbon (meaning forest carbon subject to emissions due to burning and decomposition of forest biomass residues) coming from deforestation detected by SAD in the Legal Amazon. Information on the method for estimated forest carbon committed through deforestation is summarized in Box II.

In June, 2010, the 172 square kilometers of deforestation detected by SAD in the Legal Amazon committed 3 million tons (with a margin of error of 739 mil tons) of carbon. That quantity of carbon affected resulted 11 million tons of CO² equivalent (Figure 4). That represents a drop of 28% in relation

to June, 2009 when the forest carbon affected was 4 million tons even with 15% increase in deforestation for the same period. That is because in June, 2010 deforestation occurred in forests with a lower carbon density if compared to the forests deforested in June, 2009.

The forest carbon committed by deforestation for the period of August, 2009 to June, 2010 (eleven first months of the current deforestation calendar) was 23 million tons (with a margin of error of 421 mil tons), which represented around 85 million tons of CO² equivalent (Figure 4). In relation to the same period the previous year (August, 2008 to June, 2009) there was an increase of 3% in the quantity of carbon committed by deforestation. The relative increase in forest carbon affected by deforestation, in relation to last year, was less than the 8% increase in deforestation for the same period.

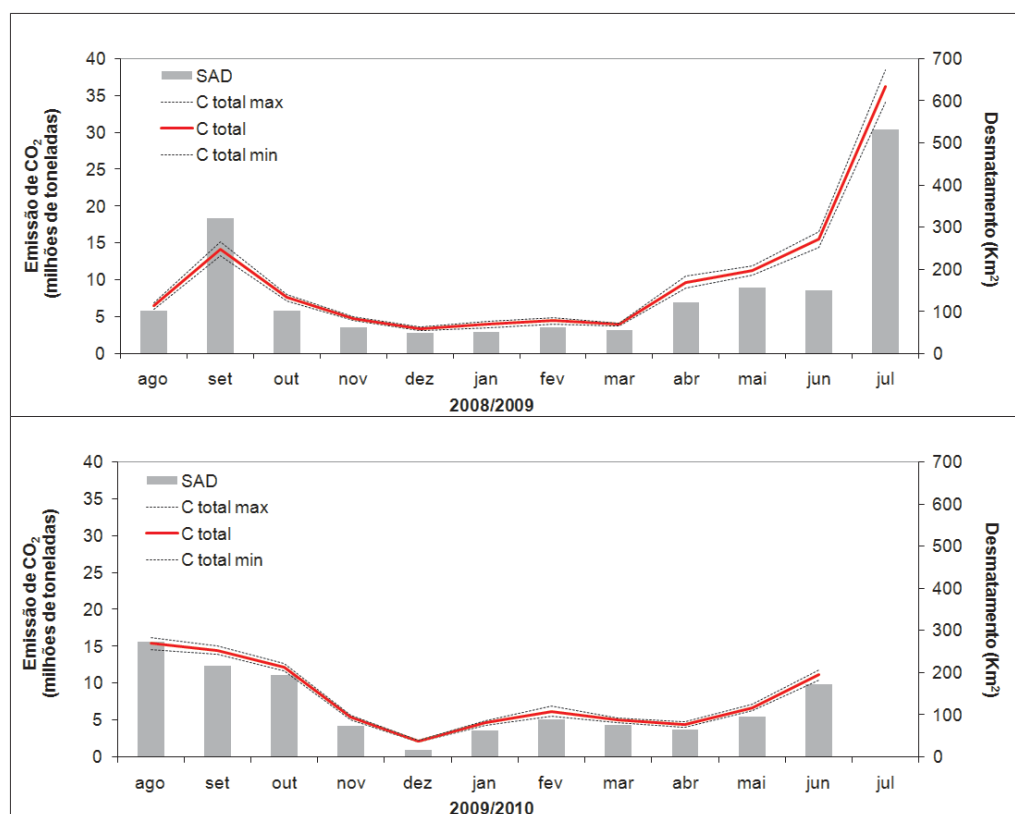


Figura 4. Desmatamento e emissões de Dióxido de Carbono (CO₂) equivalente total de agosto de 2008 a junho de 2010 na Amazônia Legal (Fonte: Imazon).

Geography of Deforestation

In June, 2010, deforestation occurred mainly along the BR-163 (Santarém-Cuiabá Highway) in the stretches between the municipalities of Itaituba, Novo Progresso and district of Castelo de Sonhos (municipality of Altamira in Pará). Another critical area was the TransAmazon Highway (BR-230)

principally between the municipalities of Apuí and Humaitá in Amazonas.

In relation to land title situation, in June, 2010, the great majority (70%) of deforestation occurred in private areas or lands at various stages of possession. The remaining deforestation was recorded in Land Reform Settlements (16%), followed by Conservation Units (11%) and Indigenous Lands (3%) (Table 2).

Table 2. Deforestation by land title category in June, 2010 in the Legal Amazon (Source: Imazon/ SAD).

Category	March 2010	
	km ²	%
Land Reform Settlement	28	16
Conservation Units	18	11
Indigenous Lands	6	3
Private, Possession & Vacant ²	120	70
Total (km²)	172	100

Land Reform Settlements

SAD recorded 28 square kilometers in the Land Reform Settlements during June, 2010. The Settlements most affected by deforestation were Rio

Juma (Apuí; Amazonas), Campos de Pilar (Aveiro; Pará), and Terra Nossa (Altamira; Pará) (Figure 5).

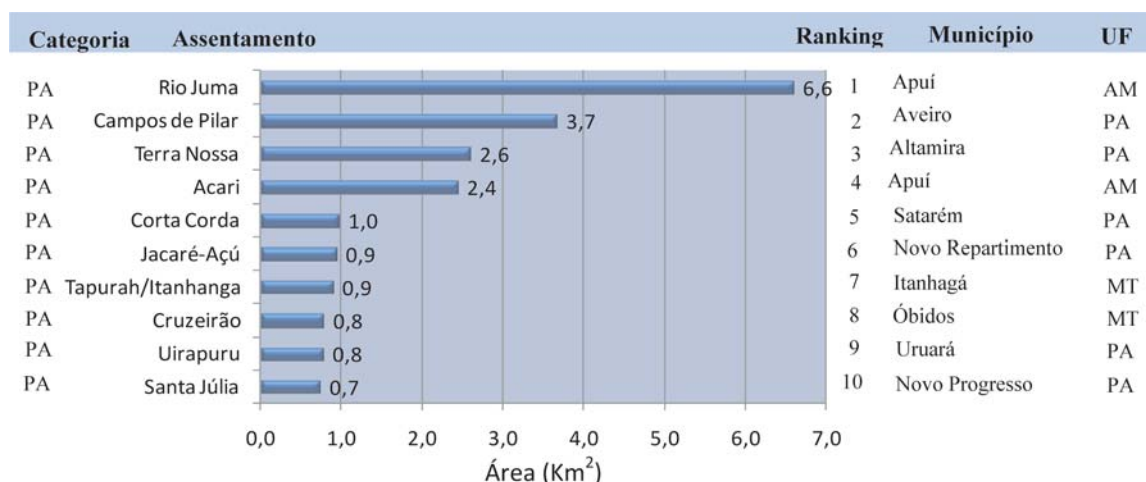


Figure 5. Most deforested Land Reform Settlements in June, 2010 in the Legal Amazon (Source: Imazon/SAD).

² Includes private areas (titled or not) and non-protected public forests.

Protected Areas

SAD detected only 18 square kilometers of deforestation in Conservation Units (Figure 6). The Conservation Units suffering the most deforestation were APA Triunfo do Xingu (Pará), Flona de

Altamira (Pará) and Resex do Rio Jaci-Paraná (Rondônia).

In the case of Indigenous Lands in June, 2010 six square kilometers were detected. The most affected were Kayabi (Pará), Trincheira/Bacajá (Pará) and Cachoeira Seca do Iriri (Pará) (Figure 7).

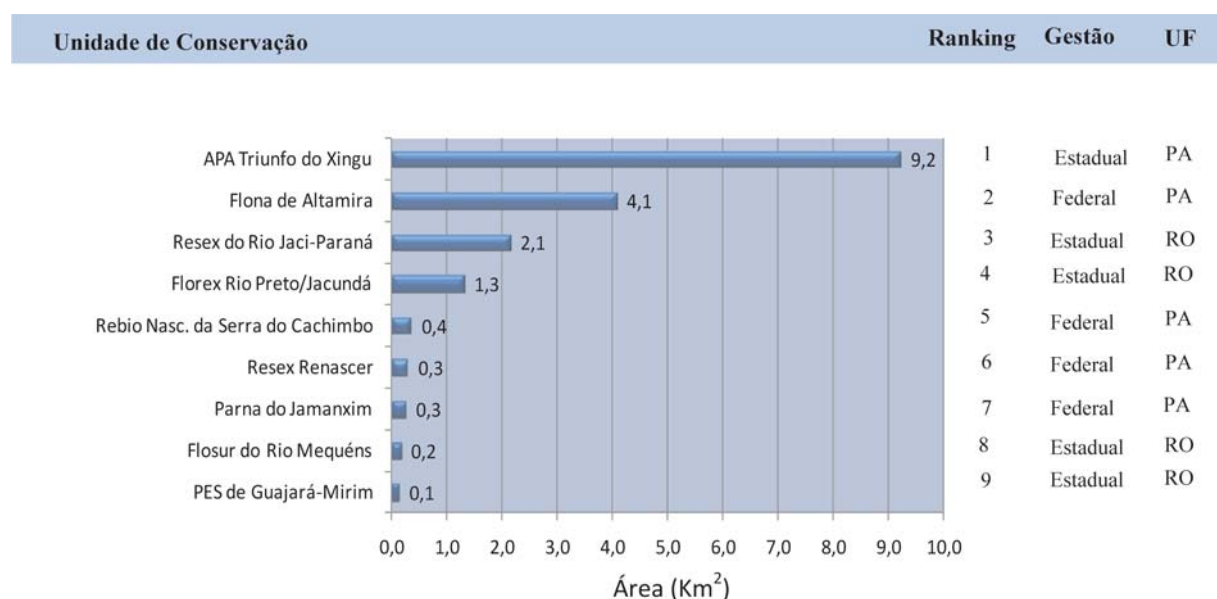


Figure 6. Most deforested Conservation Units in the Legal Amazon in June, 2010 (Source: Imazon /SAD).

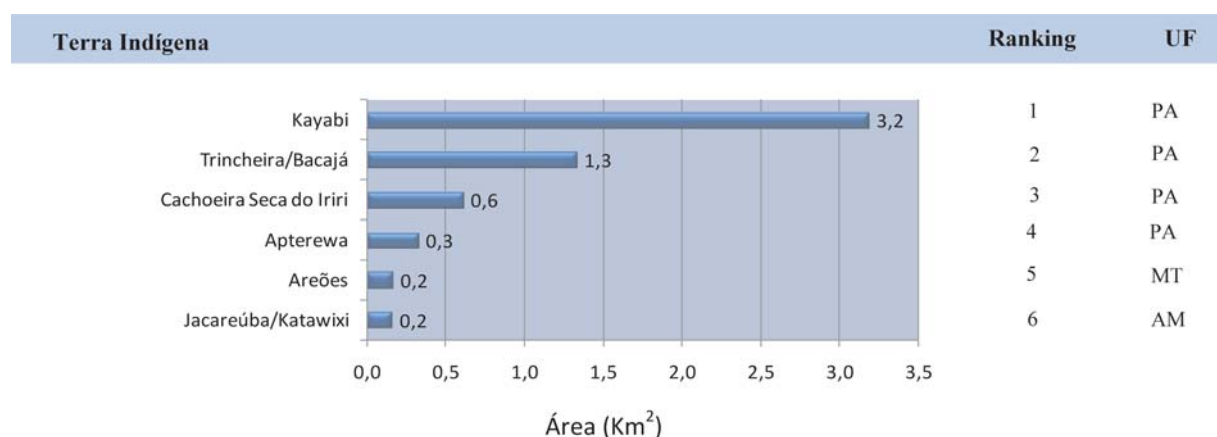


Figure 7. Most deforested Indigenous Lands in the Legal Amazon in June, 2010 (Source: Imazon /SAD).

Critical Municipalities

In June, 2010, seven of the ten most deforested municipalities were located in Pará, notably Itaituba and Altamira (especially in the

Castelo de Sonhos district), Portel (along the TransAmazon) and São Félix do Xingu. In Amazonas deforestation was concentrated in Apuí and Manicoré (principally along the TransAmazon) and in Porto Velho (Rondônia) (Figure 8 and Figure 9).

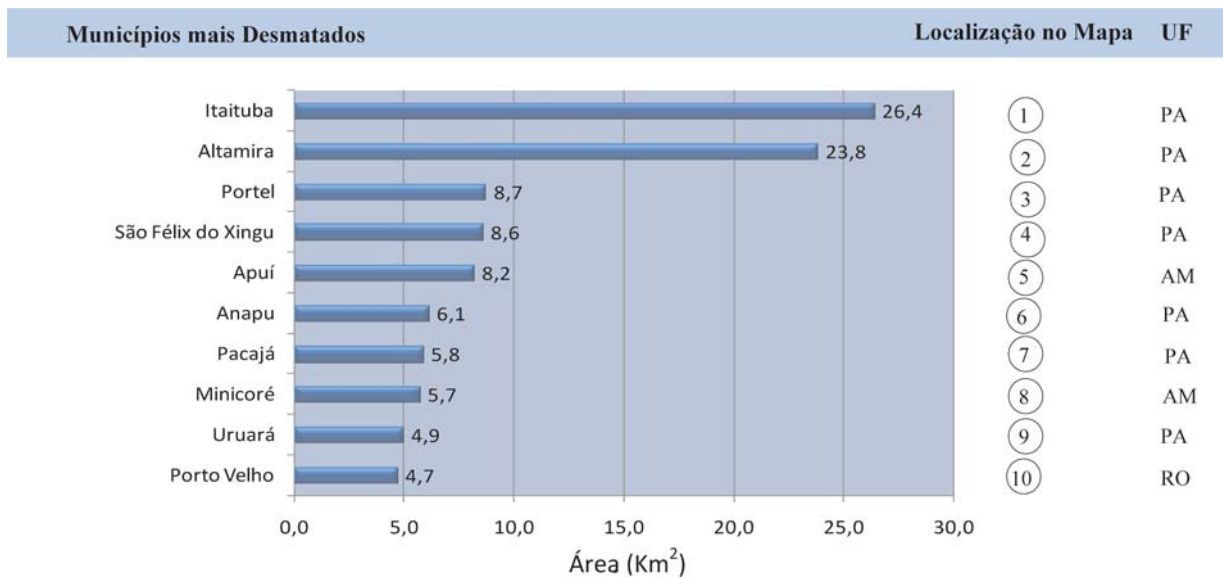


Figure 8. Most deforested Indigenous Lands in the Legal Amazon in June, 2010 (Source: Imazon /SAD).

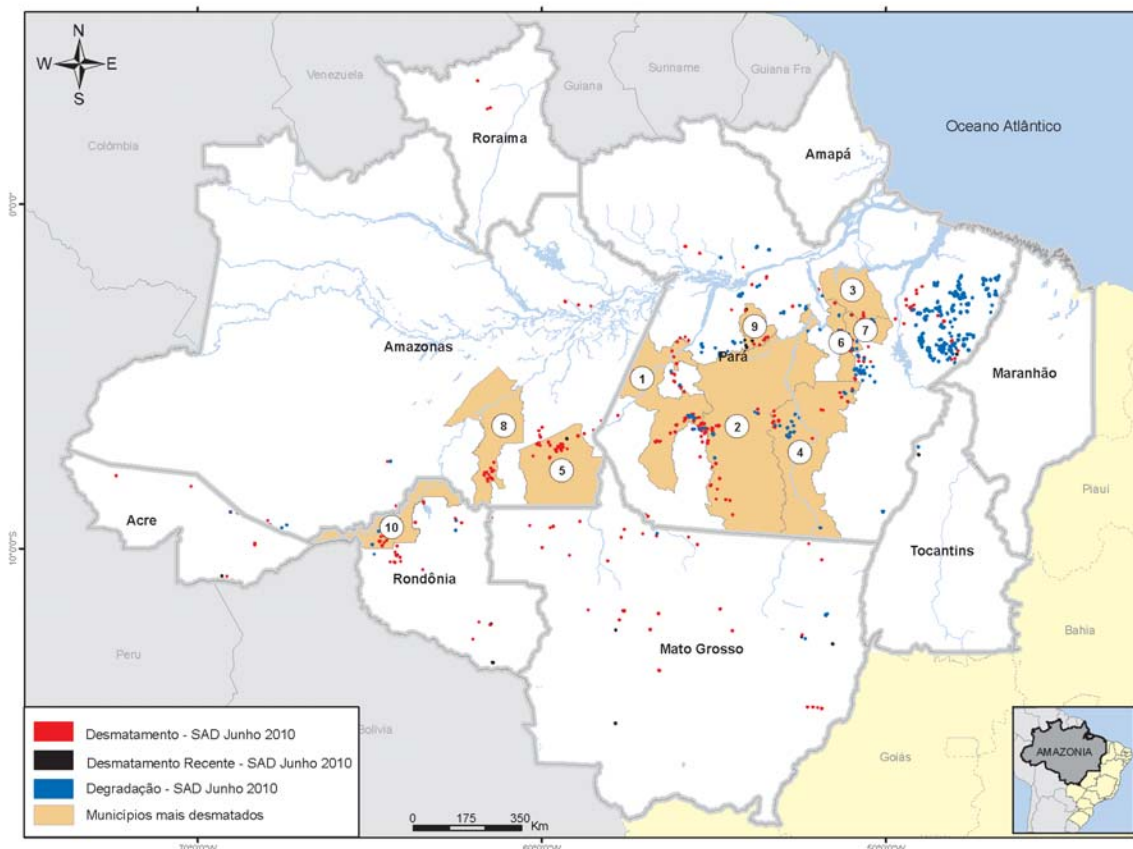


Figure 9. Most deforested municipalities in June, 2010 (Source: Imazon/SAD).

Cloud and Shadow Cover

In June, 2010, it was possible to monitor 75% of the area with forest cover in the Legal Amazon, since only 25% of the territory was covered by clouds

(Figure 10). The non-mapped region corresponds to the forest area in Roraima and Amapá.

* The part of Maranhão belonging to the Legal Amazon was not analyzed.

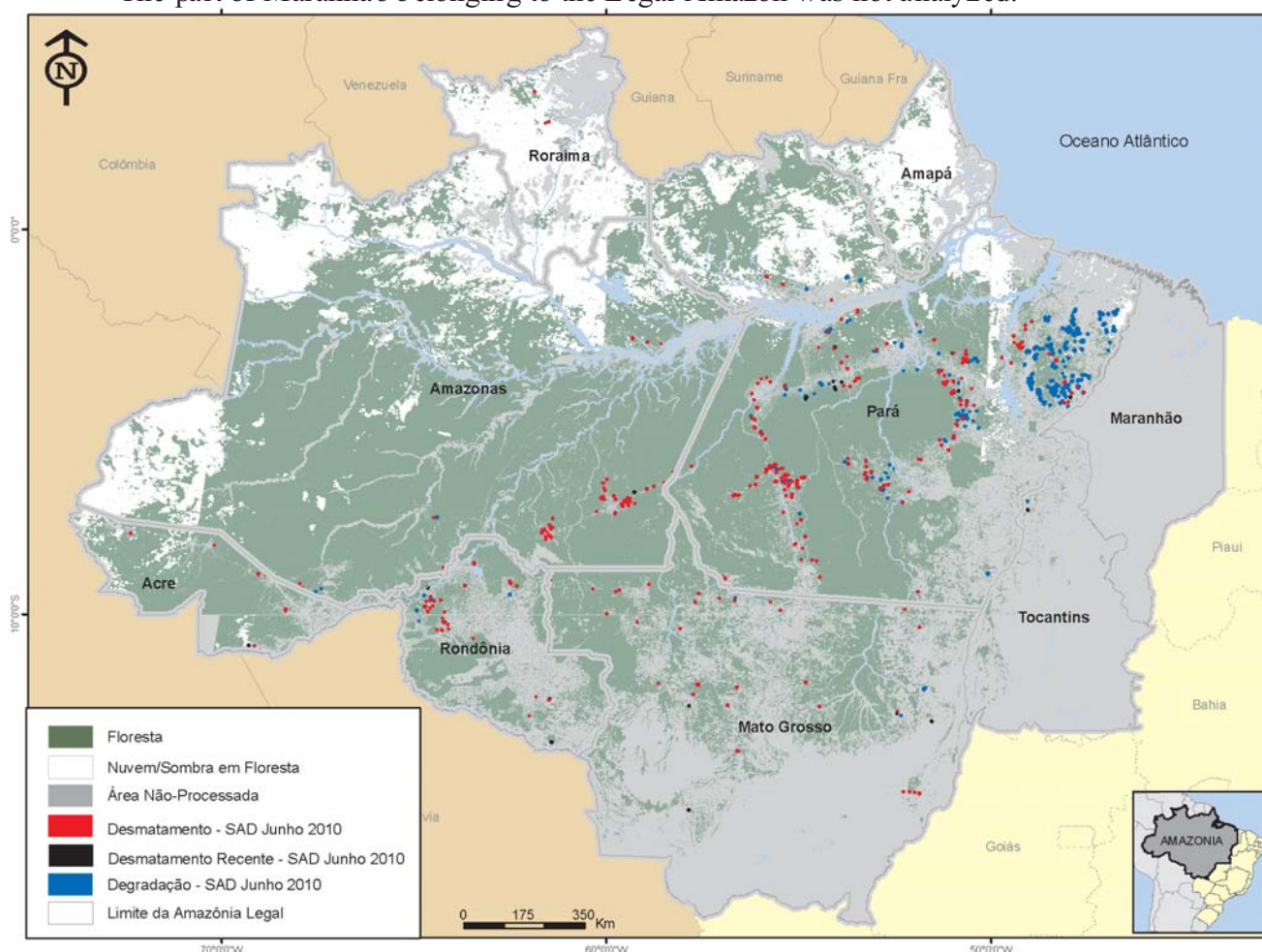


Figure 10. Area with cloud and shadow in June, 2010 in the Legal Amazon.

Validation of SAD data utilizing Landsat and Cbers Images

In 2008, Imazon improved validation of data from SAD, utilizing CBERS and Landsat images, with a finer spatial resolution (20 and 30 meters, respectively). We used the images available shortly after the month analyzed by SAD. All of the deforestation polygons detected by SAD are verified using the detailed images. Deforestation events smaller than 6.25 hectares, in other words, below the SAD capacity for detection, are not included in the statistics, should they occur in the images with more detailed resolution. However, if false signals of deforestation detected by SAD are confirmed, those are removed from the monthly statistics. What is new in the SAD validation process is that we have applied that methodology in almost real time, thanks to the availability of CBERS and Landsat images from the National Institute for Space Research (Inpe).

In June, 2010, 87% of the deforestation detected by SAD was confirmed with the Landsat images (Figure 11). The other 13% were not confirmed due to major cloud occurrence in the Landsat and CBERS images available for the period.

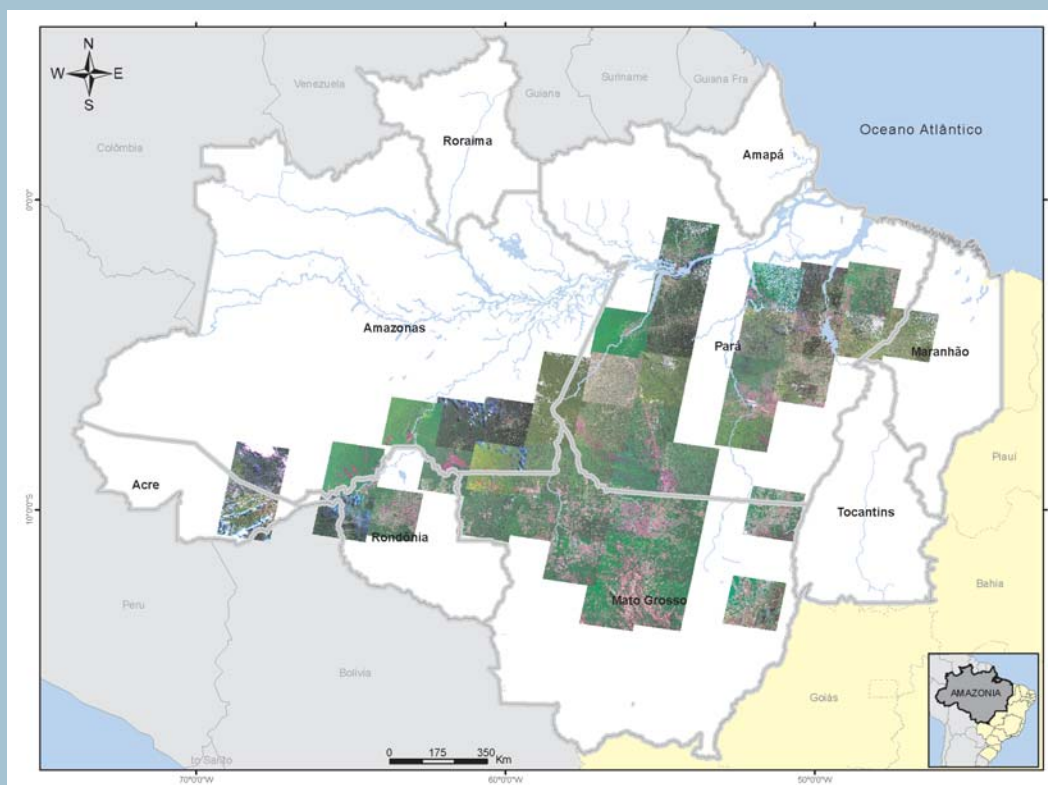


Figure 11. Landsat Scenes used for validating the deforestation polygons detected by SAD in June, 2010.

Box I: SAD 3.0 Beta.

Beginning in August, 2009, SAD has presented some new features. First, we created a graphic interface to integrate all of the image processing programs used in SAD. Next, we began computing deforestation as a new class for areas that were covered by clouds in previous months. Finally, deforestation and degradation are detected with pairs of NDFI images in an algorithm for detecting changes. The principal methodology continues to be the same The SAD 2, The described below.

SAD generates a temporal mosaic of daily MODIS images from the MOD09GQ and MOD09GA products to filter clouds. Next, we utilize a technique for fusing different spectral resolution bands, meaning with pixels of different sizes. In that case, we made the change in scale from the bands with 500 meter pixels in MODIS to 250 meters. That allowed us to improve the spectral model for the pixel mix, by providing the capacity for estimating the abundance of Vegetation, Soils and Non-Photosynthetically Active Vegetation (NPV – Non-Photosynthetic components - Vegetation, Soil and Shadow) to calculate the NDFI, with the equation below:

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

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

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

The NDFI varies from -1 (pixel with 100% of exposed soil) to 1 (pixel with > 90% having forest vegetation). This way, we obtain a continuous image that shows the transition from deforested areas, going to degraded forests, until reaching forests with no signs of disturbance.

Detection of deforestation and degradation this month included the difference in NDFI images from consecutive months. Thus, a reduction in NDFI values of between -200 and -50 indicates possibly deforested areas and between -49 and -20 shows signs of degradation.

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

SAD has been operational in the State of Mato Grosso since August, 2006 and in the Legal Amazon since April 2008. In this bulletin, we present the monthly data generated by SAD from August, 2006 to June, 2010.

Box II: Carbon affected by deforestation

The carbon estimates are generated based on the combination of SAD deforestation maps with simulations of the spatial distribution of biomass for the Amazon. We have developed a model for estimating carbon emissions, based on a stochastic simulation (Morton *et al*, in prep.) known The *Carbon Emission Simulator* (CES). We generated 1,000 simulations of the spatial distribution of biomass in the Amazon using a geostatistical model (Sales *et al.*, 2007) and transformed those biomass simulations into C stocks using factors in the literature for converting biomass into C, 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 committed in month t.

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

S_D: Area deforested.

BVAS: Biomass above the soil in deforested region S_D.

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

fc: fraction of charcoal (3 to 6%).

BAS₀: Biomass below the soil before deforestation.

pd: parameter for monthly decomposition of biomass below the soil after deforestation (0.0075).

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

In applying the CES model using data from SAD we considered only the carbon committed by deforestation, meaning the fraction of forest biomass composed of carbon (50%) subject to instantaneous emissions due to forest burnt during deforestation, and/or the future decomposition of remaining forest biomass. Additionally, we adapted the CES model to estimate the forest carbon committed by deforestation on a monthly scale. Finally, the simulations allow us to estimate the uncertainty of the carbon committed, represented by the standard deviation (+/- 2 times) of the simulations of carbon affected in each month.

For conversion of the values of carbon into equivalent CO₂, a value of 3.68 is applied.

Bibliographical References

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Data Source:

Statistics for deforestation are generated using data from SAD (Imazon);
Data from INPE- Deforestation (PRODES)
<http://www.obt.inpe.br/prodes/>

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