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SUMMARY

SAD detected 240 square kilometers of deforestation in Legal Amazon in August 2011 (first month of the new deforestation year). It represented a 15% increase regarding August 2010 when the deforestation totaled 209 square kilometers. From this total, 49% occurred in Pará, followed by Rondônia (19%), Mato Grosso (15%), Amazonas (9%), Acre (4%), Roraima (3%), and Tocantins (1%).

The degraded forests in Legal Amazon totaled 131 square kilometers in August 2011. Regarding August 2010 there was an expressive reduction (92%) when the forest degradation totaled 1.555 square kilometers. In August 2011, the degradation occurred especially in Mato Grosso (58%) and in Pará (21%).

In August 2011, the deforestation detected by SAD compromised 3.7 million tons of equivalent CO^2 which represents a 9% increase regarding August 2010.

In August 2011, the cloud coverage was significantly reduced and it was possible to monitor 91% of Legal Amazon.

Deforestation Statistics

According to the Imazon's Deforestation Alert System (SAD), the deforestation, (i.e., the total suppression of the forest with soil exposition) in August 2011 (first month of the official deforestation calendar 2011-2012)[1] at Legal Amazon has reached 240 square kilometers. (Figure1 and Figure 2).

This represented an increase of 15% of deforestation in August 2011 regarding the deforestation detected in August 2010 when the deforestation reached 209 square kilometers. August is the first month of the official deforestation calendar.

[1] The official deforestation measuring calendar begins in August and ends in July.

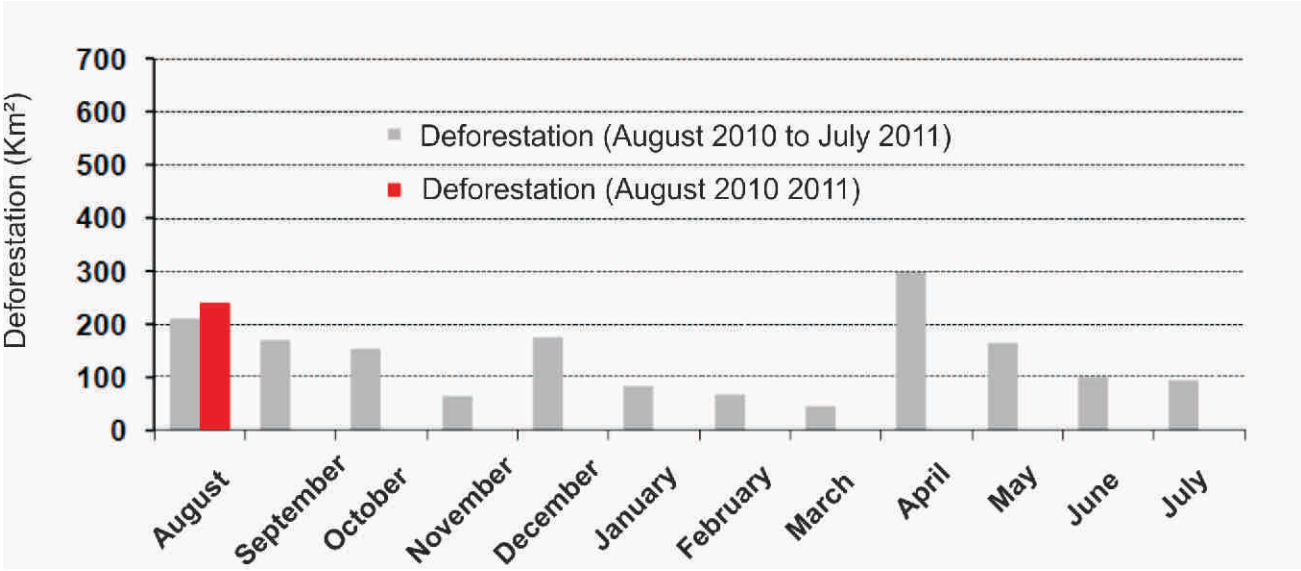

Figure 1. Deforesting from August 2010 to August 2011 in Legal Amazon (Source: Imazon/SAD).

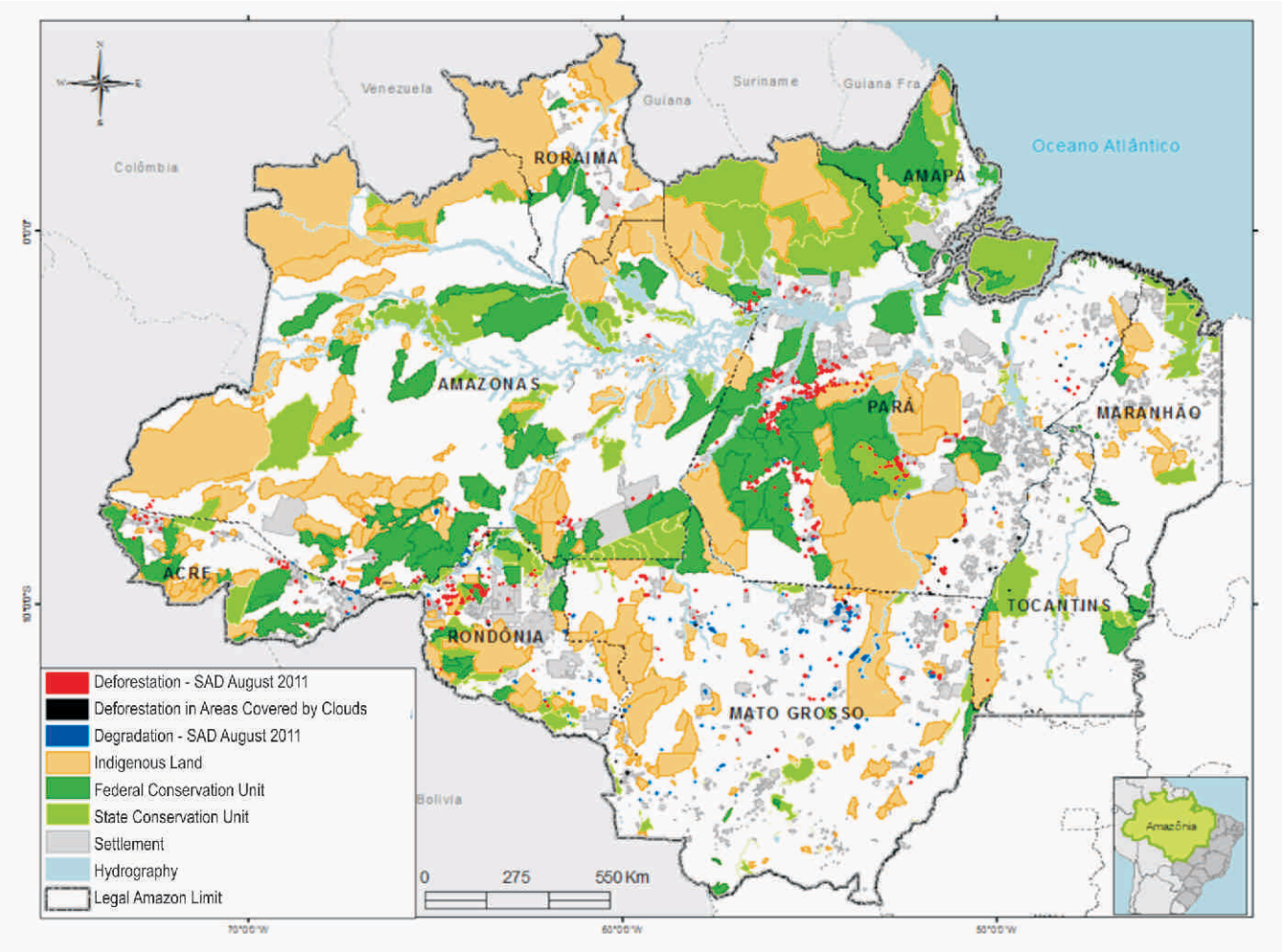

Figure2. Deforesting and Forest Degradation in August 2011 at Legal Amazon (Source: Imazon/ SAD).

*The recent deforestation might have occurred in June or previous months, however, it was only possible to detect it now, when there were no clouds over the region.

In August 2011, Pará led with (19%), Mato Grosso (15%), Amazonas (9%), 49% of deforestation followed by Rondônia Acre (4%) and Roraima (3%) (Figure 3).

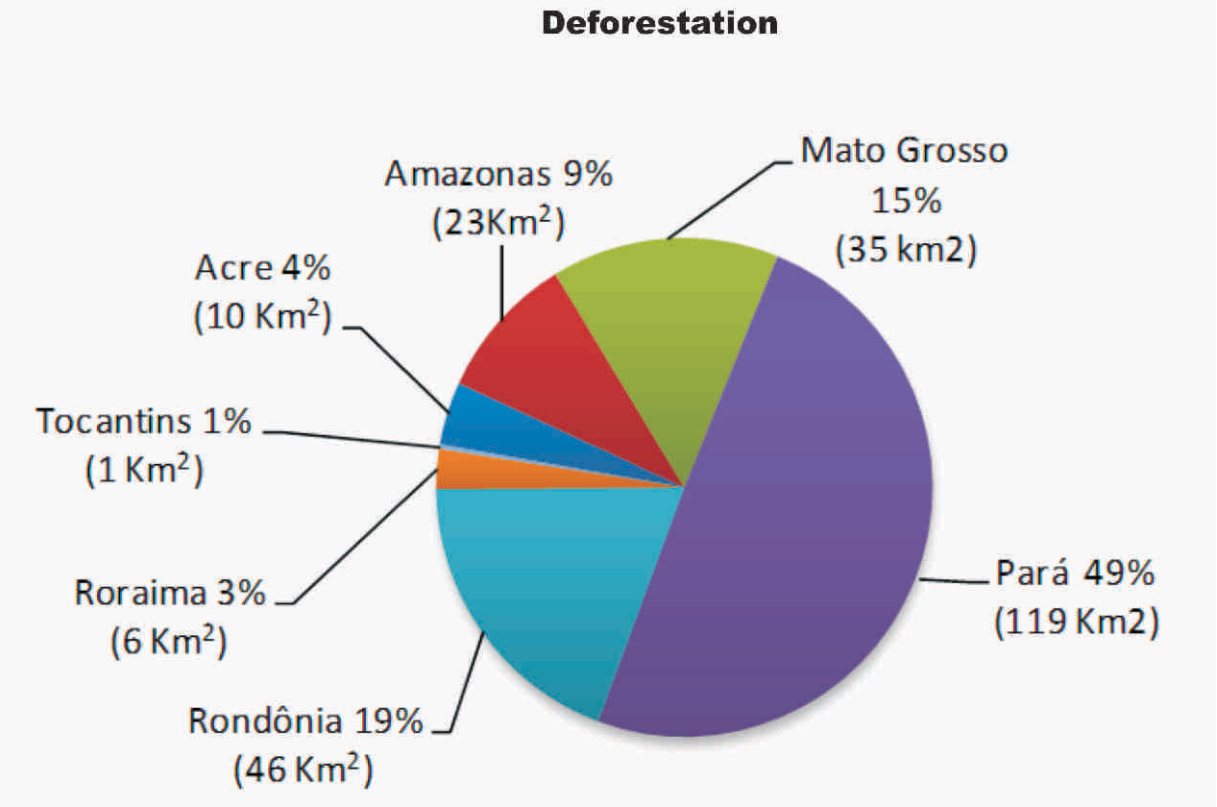

Figure 3. Deforestation (%) in the states of Legal Amazon in August 2011 (Source: Imazon/SAD).

In August 2011, the increase in deforestation was more expressive in Rondônia (+35%), Mato Grosso (+12%), Roraima (+6%). On the other hand, there was a reduction in deforestation in Pará (-23%) and Acre (-2%) (Table1).

Table 1. Evolution of the deforestation between the States of Legal Amazon of August 2010 and August 2011 (Source: Imazon/SAD).

State	August 2010	August 2011	Variation (%)
Acre	12	10	- 2
Amazonas	20	23	+ 2
Mato Grosso	24	35	+ 12
Pará	142	119	- 23
Rondônia	11	46	+ 35
Roraima	-	6	+ 6
Tocantins	-	1	+ 1
Amapá	-	-	-
Total	**209**	**240**	**+ 15**

* Data from Maranhão were not analyzed.

Forest Degradation

In August 2011, SAD registered 131 square kilometers of degraded forests (intensively explored forests by lumbering and/ or burning activities) (Figures 2 and 4). Regarding August 2010 when the Forest degradation was of 1.555 square kilometers, there was a 92% reduction of the forest degradation of August 2011. From the total, the majority (58%) of this degradation occurred in Mato Grosso, followed by Pará (21%), Amazonas (7%), Rondônia (7%), Roraima (5%) and Acre (2%) (Figure 5).

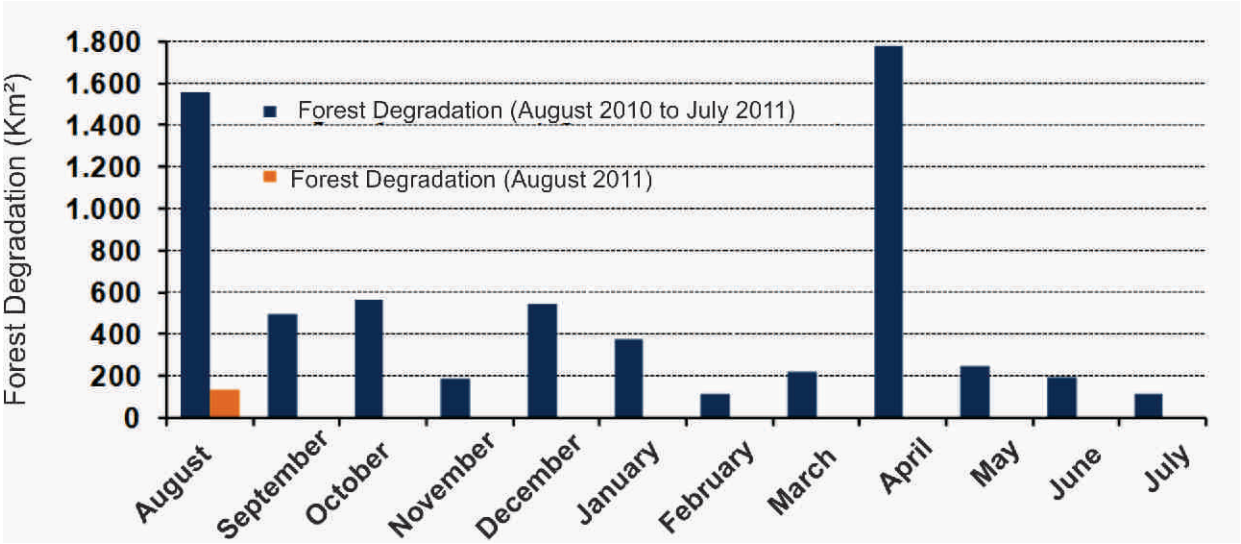

Figure 4. Forest Degradation from August 2010 to August 2011 at Legal Amazon (Source: Imazon/SAD).

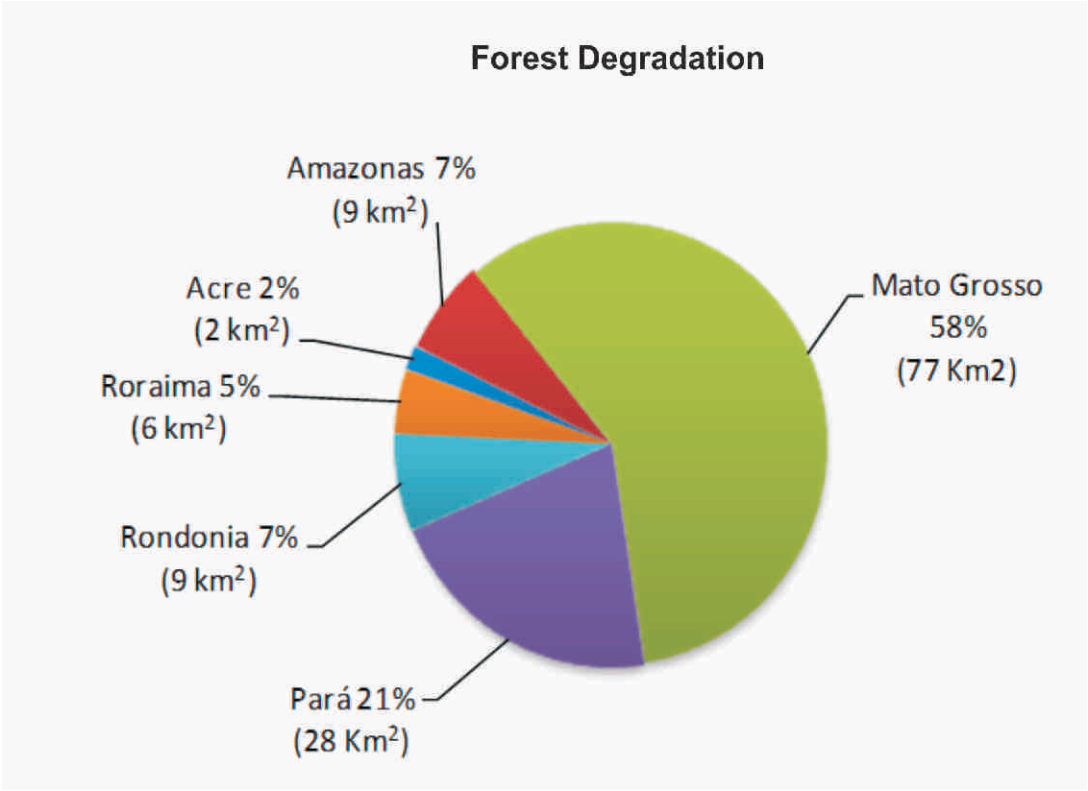

Figure 5. Forest Degradation (%) in the States of Legal Amazon in August 2011 (Source: Imazon/SAD).

The 92% reduction of the forest degradation in August 2011 was extremely expressive in Pará (-95%), Rondônia (-95%), Mato Grosso (-89%), Amazonas (-81%), and Acre (-78%) (Table 2).

Table 2. Evolution of the forest degradation between the States of Legal Amazon from August 2010 and August 2011 (Source: Imazon/SAD).

State	August 2010	August 2011	Variation (%)
Acre	11	2	- 78
Amazonas	47	9	- 81
Mato Grosso	711	77	- 89
Pará	591	28	- 95
Rondônia	189	9	- 95
Roraima	-	6	-
Tocantins	6	-	-
Amapá	-	-	-
Total	**1.555**	**131**	**- 92**

* Data from Maranhão were not analyzed.

Carbon Affected by the Deforestation

In August 2011, the 240 square kilometers of deforestation detected by SAD in the Legal Amazon compromised 3.7 million tons (with error radius of 385 thousand tons) of carbon. This amount of affected carbon results in 13.6 million tons of equivalent CO^2 (Figure 6). This represents an increase of 9.6% regarding August 2010 when the affected forest carbon was 3.4 million tons.

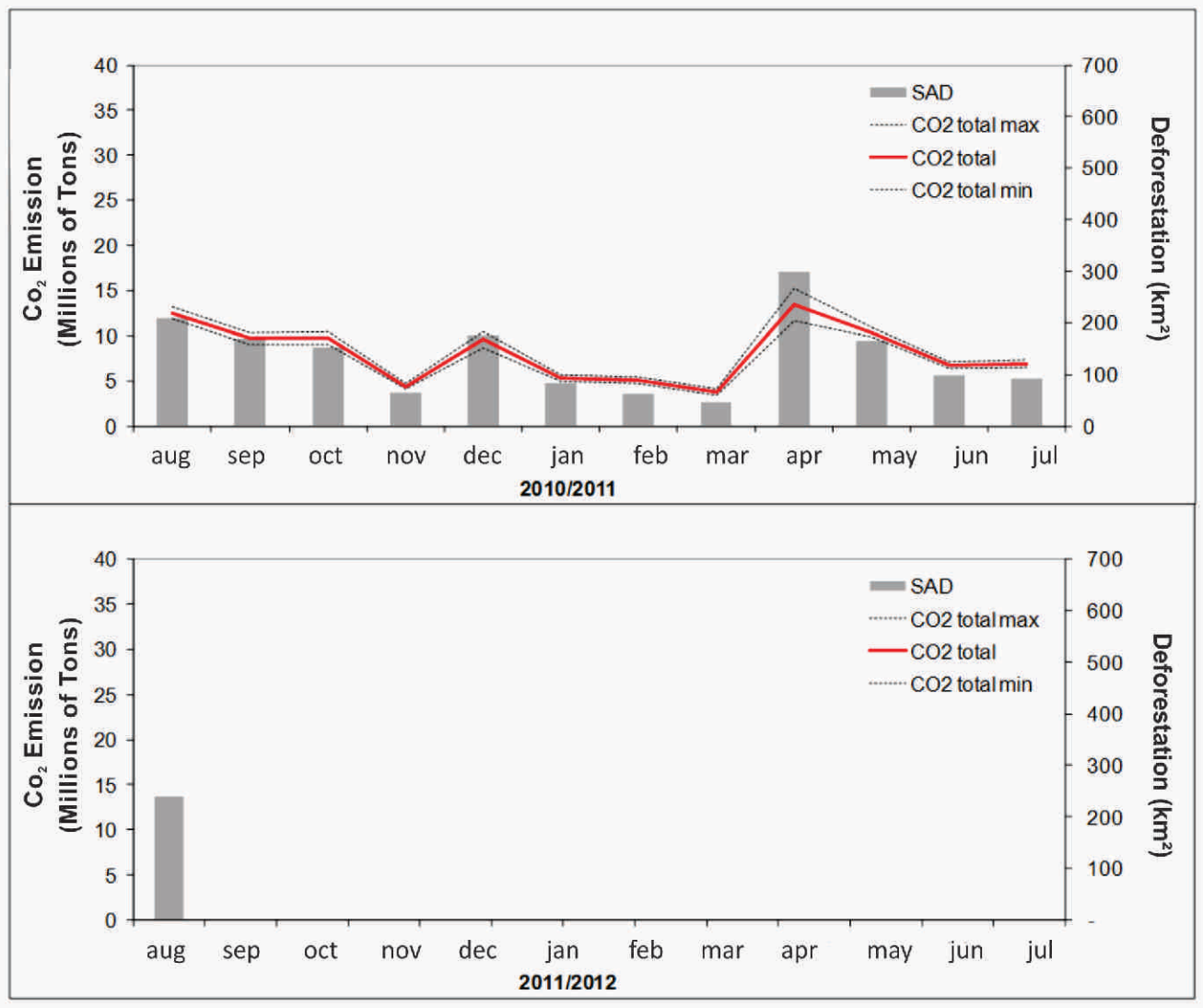

Figure 6. Deforestation and emission of Carbon Dioxide (CO^2) total equivalent from August 2010 to August 2011 in Legal Amazon (Source: Imazon).

Deforestation Geography

Regarding the land situation, in August de 2011, the great majority (59%) of deforestation occurred in private areas or under many stages of ownership. The rest of the deforestation was registered in Agrarian Reform Settlements (20,5%), Conservation Units (18,5%) and Indigenous Lands (2%) (Table 3).

Table 3. Deforestation by land category in August 2011 in Legal Amazon (Source: Imazon/ SAD).

Category	August 2011	
	Km²	%
Agrarian Reform Settlement	49	20.5
Conservation Units	44	18.5
Indigenous Lands	5	2
Private, Owned and Abeyance	142	59
Total (km²)	240	100

Agrarian Reform Settlements

SAD registered only 44 square kilometers in the Agrarian Reform Settlements during August 2011. The most affected settlements by the deforestation were Terra Nossa (Altamira; Pará), Anauá (Caracaí; Roraima), and Santa Júlia (Novo Progresso; Pará) (Figure 7).

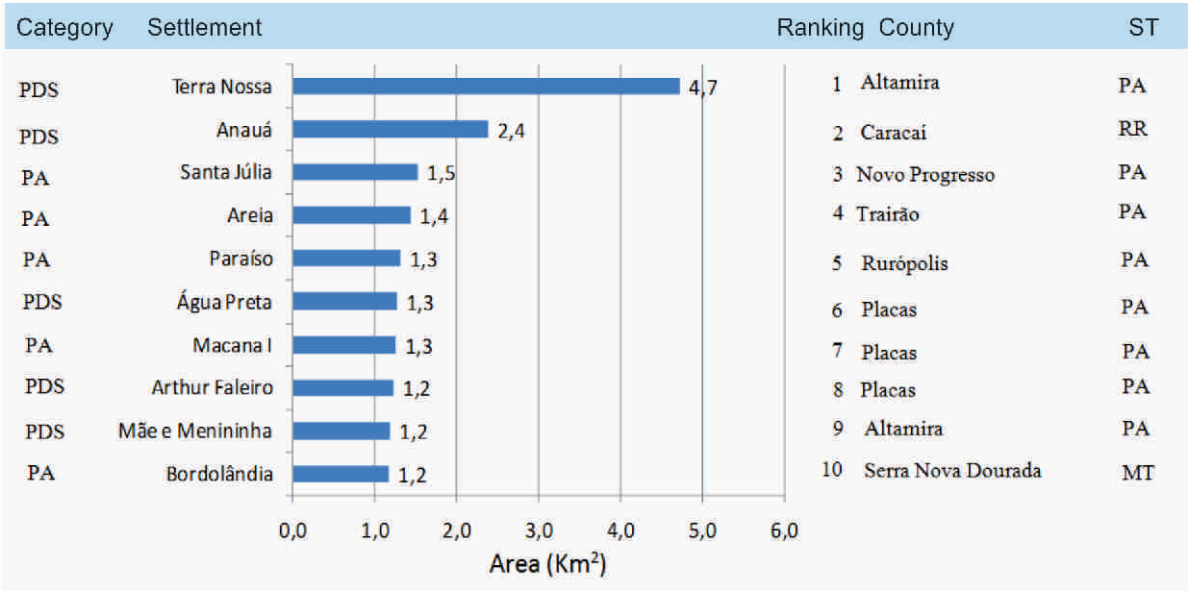

Figure 7. Most deforested Agrarian Reform Settlements in August 2011 at Legal Amazon (Source: Imazon/SAD). PA (Registry Project) and PDS (Sustainable Development Project)

[3] Includes private areas (owned or not) and non protected public forests

Protected Areas

SAD detected 27 square kilometers of deforestation in the Conservation Units (Figure 8). The Conservation Units that suffered deforestation were APA Triunfo do Xingu (Pará), APA Rio Pardo (Rondônia), and Esec de Cuniã (Amazonas). In the case of the Native Lands, in August 2011 were detected only 5 square kilometers. The most deforested Indigenous Lands were Cachoeira Seca do Iriri (Pará), Maraiwatsede (Mato Grosso), and Urubu Branco (Mato Grosso) (Figure 9).

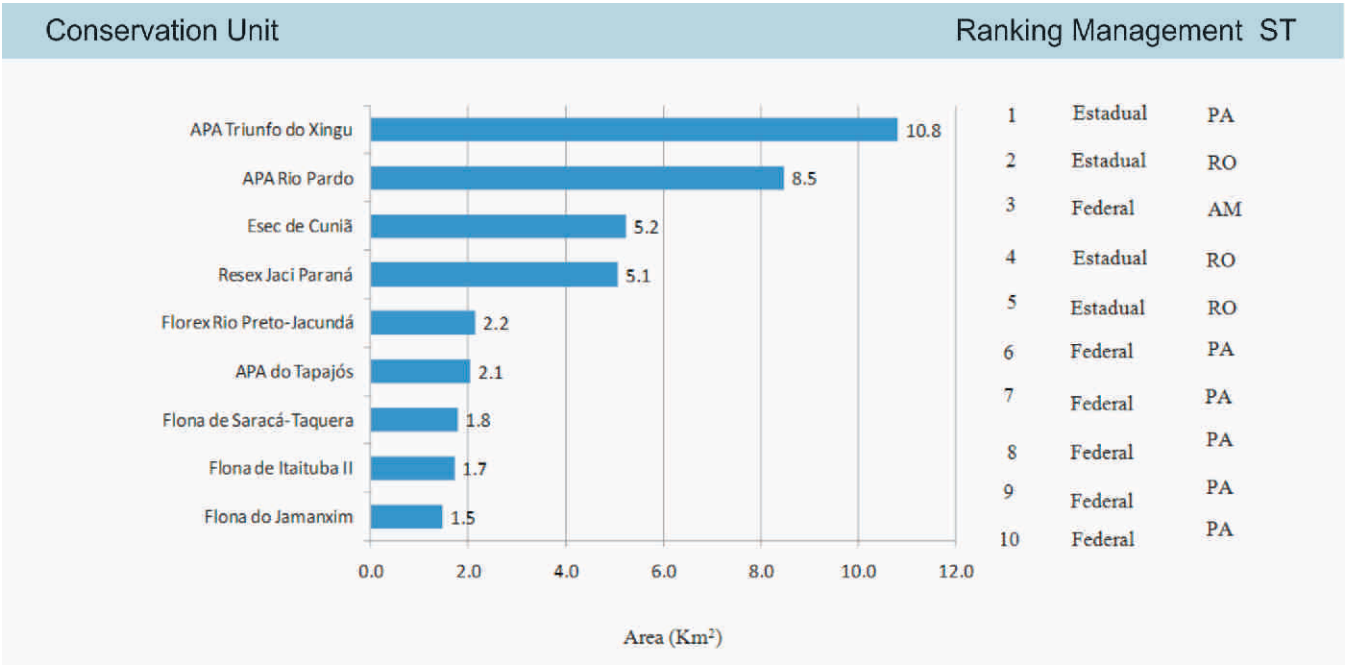

Figure 8. Most deforested Conservation Units at Legal Amazon in August 2011 (Source: Imazon /SAD).

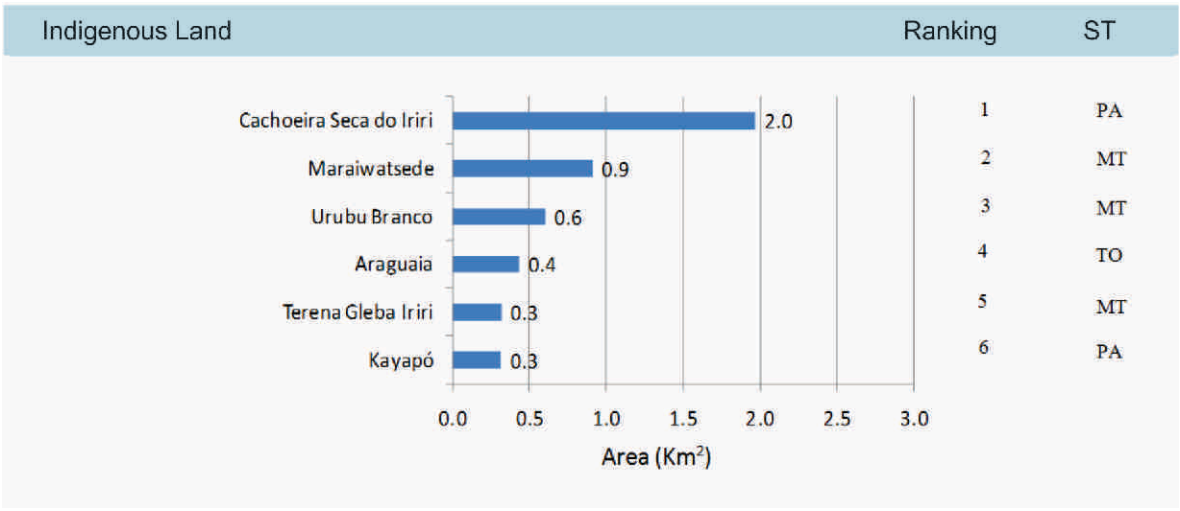

Figure 9. Most deforested Native Lands at Legal Amazon in August 2011 (Source: Imazon /SAD).

Critical Counties

In August 2011, the most deforested counties were: Porto Velho (Rondônia), São Félix do Xingu (Pará) and Altamira (Pará) (Figures 10 and 11).

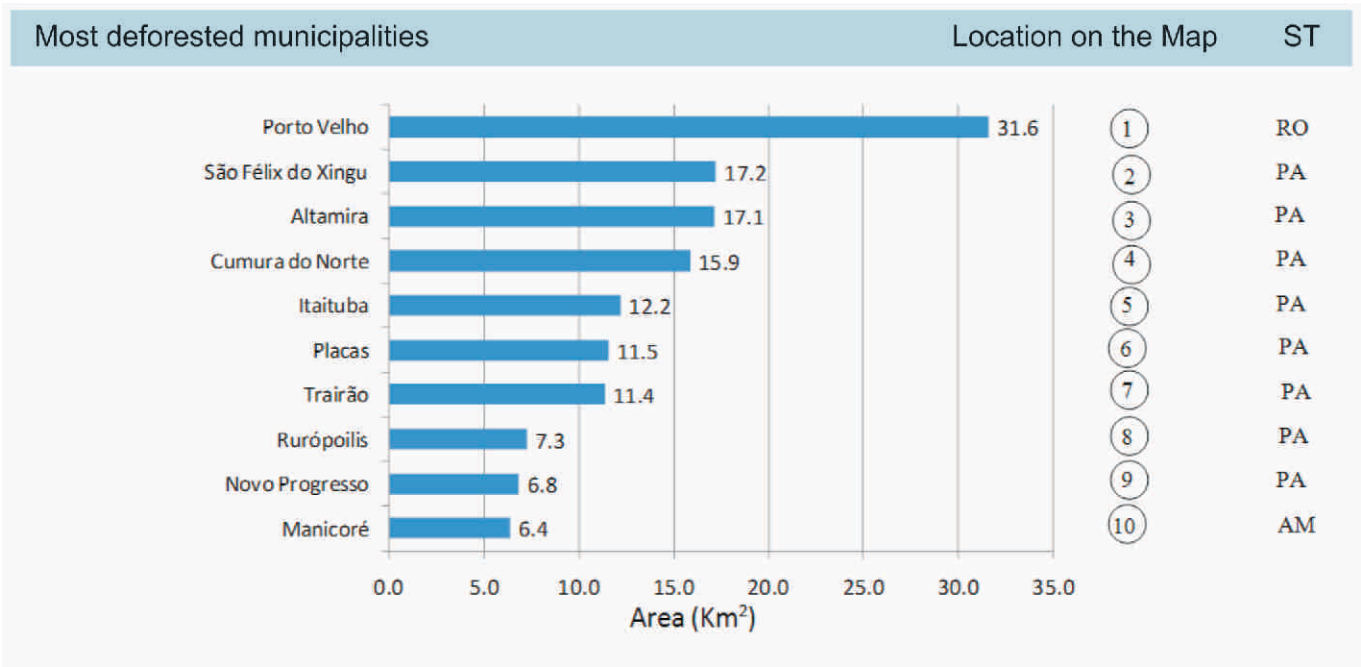

Figure 10. Most deforested municipalities at Legal Amazon in August 2011 (Source: Imazon /SAD).

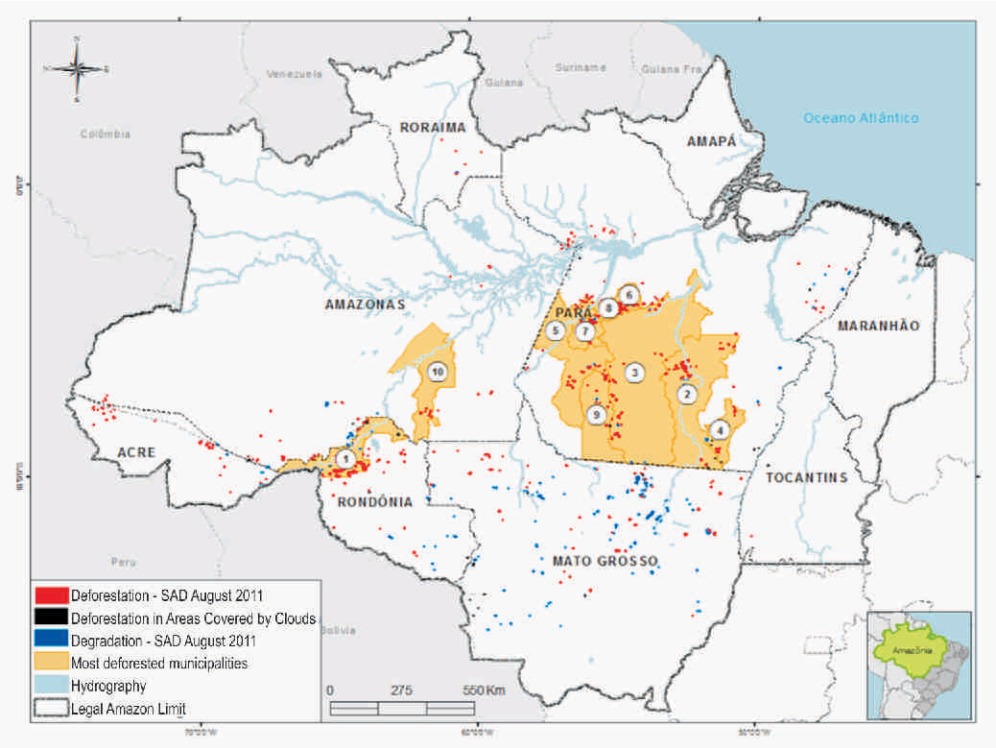

Figure 11. Most deforested counties in August 2011 (Source: Imazon/SAD).

*The recent deforestation might have occurred in June or previous months, however, it was only possible to detect it now, when there were no clouds over the region.

Coverage by clouds and Shade

In August 2011, it was possible to monitor with SAD only 91% of the forest area in Legal Amazon. The other 9% of the territory was covered by clouds which complicated the monitoring (Figure 12).

* The part of Maranhão that integrates Legal Amazon was not analyzed

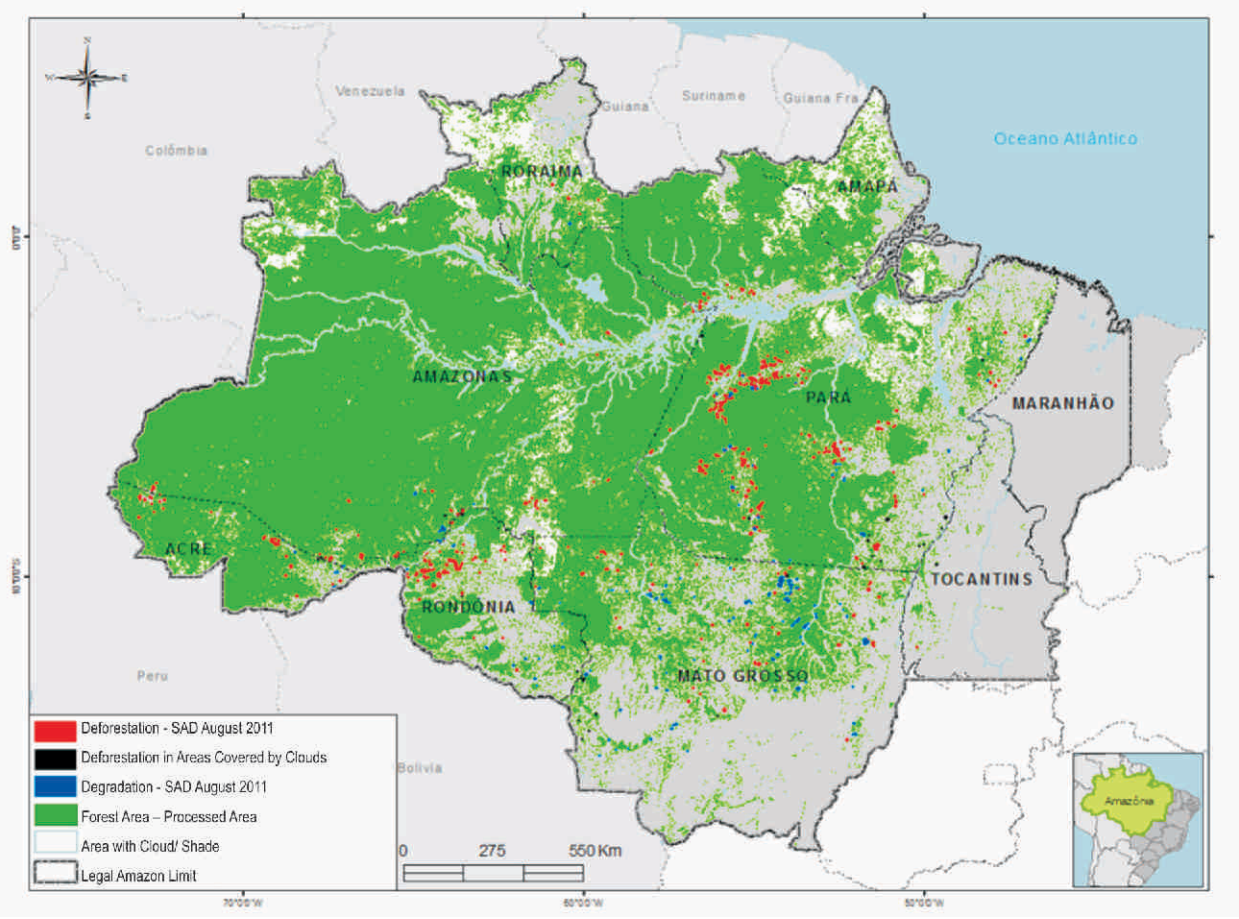

Figure 12. Area with cloud and shade in August 2011 in Legal Amazon

*The recent deforestation might have occurred in June or previous months, however, it was only possible to detect it now, when there were no clouds over the region.

Validation of the SAD data using Landsat and Cbers images

The data from SAD are validated with CBERS and Landsat images (thinner spatial resolution) available by the Instituto Nacional de Pesquisas Espaciais (Inpe) – National Institute for Space Research. The images used are the ones available right after the analyzed month by SAD. All the deforestation polygons detected by SAD are verified using the detailed images. Deforestations smaller than 6.25 hectares, i.e., below SAD's detection capacity, are not included in the statistics, in case they occur in more detailed images. However, if SAD detects false signals of deforestation, they will be removed from the monthly statistics.

In August 2011, 82% of the deforestation detected by SAD were confirmed with the Landsat images (Figure 13). The other 18% were not confirmed due to the great occurrence of clouds in the Landsat and CBERS images available in the period.

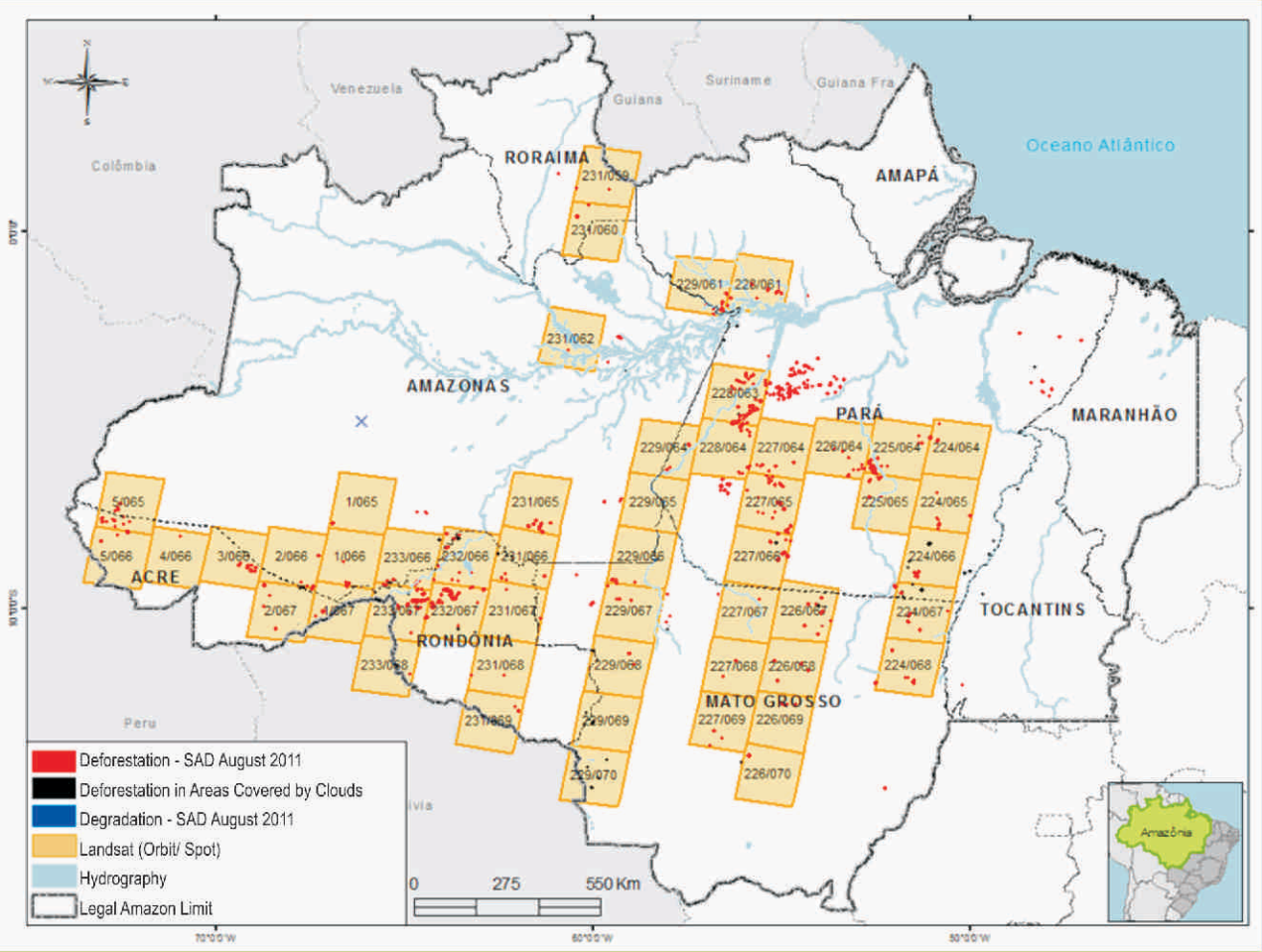

Figure 13. Landsat images used in the validation of the deforestation polygons detected by SAD in August 2011.

*The recent deforestation might have occurred in June or previous months, however, it was only possible to detect it now, when there were no clouds over the region.

Frame I: SAD 3.0

Since August 2009, SAD presented some new features. First we created an graphic interface to integrate all the image processing programs used with SAD. Second, we started to compute the deforestation in areas that were covered by clouds in the previous months in a new class. Last, the deforestation and the degradation are detected with pairs of NDFI images in a change detection algorithm. The main methodology remains the same as SAD 2 as described below.

SAD generates the temporal mosaic of daily MODIS images of the products MOD09GQ and MOD09GA for the filtering of the clouds. Next, we use a fusion technique of different spectral resolution bands, i.e., with pixels of different sizes. In this case we changed the scale of 5 bands with 500 meter pixels of the MODIS for 250 meters. This allowed the improvement of the spectral model of pixel mixing, providing the capacity of estimating the abundance of vegetation, soil and Vegetation photosintetically non active (NPV - Non-Photosynthetic components (Vegetation, Soil and Shade) to calculate the NDFI, with the equation below:

$$NDFI = (VGs - (NPV + Solo)\ (VGs + NPV + Solo)$$

Where VGs is the vegetation component normalized for shade given by: VGs =

Vegetation/(1- Shade)

The NDFI varies from -1 (pixel with 100% of exposed soil) to 1 (pixel with > 90% of forest vegetation). This way, we start having a continuous image that shows the transition of deforested areas, going through degraded forests, until we reach the forests without signs of disturbance.

The deforestation and degradation detection spent this month with the difference of NDFI images of the consecutive months. This way, there is a reduction of the NDFI values between -200 and -50 indicating the areas possibly deforested and between -49 and -20 with signs of degradation.

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

SAD is already operational in the State of Mato Grosso since August 2006 and at Legal Amazon sonce April 2008. In this Bulletin, we presented the monthly data generated by SAD from August 2006 to August 2010.

Frame II: Carbon Affected by the Deforestation

Since January 2010 we report the estimates of the compromised carbon (i.e., forest carbon subject to the emission due to the burning and the decomposition of residues in the forest biomass) resulting from the detected deforestation by SAD in the Legal Amazon.

The carbon estimates are generated based on the combination of SAD's deforestation maps with simulation of the spatial distribution of biomass to the Amazon. We developed an estimate model of carbon emissions, as base in a stochastic simulation (Morton et al, in prep.), denominated Carbon Emission Simulator (CES). We generate 1000 simulations of spatial distribution of biomass in the Amazon using a geostatistic model (Sales et al., 2007), and transform these simulation of biomass in stocks of C using conversion factors of biomass for C from the literature, according to the formula below:

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

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

$$BPF = ff * AGLB$$

$$BAS_0 = bf * AGLB$$

where:

t: time (month)

Ct: Carbon emitted in the month t.

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

SD: Deforest area.

BVAS: Biomass above the soil of the deforested region SD.

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

fc: charcoal fraction (3 to 6%).

BAS_0: Biomass below the soil before the deforestation.

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

$pd \; x \; e^{(-pdxe)}$: monthly decomposition rate of the biomass below the soil after the deforestation.

For the application of the CES model using SAD's data, we considered only the carbon compromised by the deforestation, i.e., the fraction of forest biomass composed by carbon (50%) subject to instantaneous emissions due to forest burnings by the deforestation and/ or future decomposition of the remaining forest biomass. In addition, we adapted the CES model to estimate the forest carbon compromised by the deforestation in monthly scale. Lastly, the simulation allowed to estimate the uncertainty of the compromised carbon, represented by the standard deviation (+/- 2 times) from the simulation of carbon affected in each month.

For the conversion of carbon values to equivalent CO2 we applied the value of 3.68.

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.

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Data Source:
The deforestation statistics are generated from SAD's data (Imazon);
INPE data- Deforestation (PRODES)
http://www.obt.inpe.br/prodes/

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