

## Summary

In March 2015, more than half (53%) of the forest area of the Brazilian Amazon was covered by clouds, a cover lower than that in March 2014 (58%). The States with the largest cloud cover were Roraima (86%), Pará (67%) and Amapá (65%). For the period analyzed and under those cloud conditions, 58 square kilometers of deforestation were detected by SAD in the Brazilian Amazon. That represents an increase of 195% in relation to March 2014 when deforestation totaled 20 square kilometers.

In March 2015, deforestation was to a large degree concentrated in Mato Grosso (76%) and Amazonas (13%), with a lower occurrence in Rondônia (8%), Tocantins (2%) and Pará (1%).

The accumulated deforestation for the period of August 2014 to March 2015, corresponding to the first eight months of the official calendar for measuring deforestation, reached 1,761 square kilometers. There was a 214% increase in deforestation in relation to the previous period (August 2013 to March 2014) when it reached 560 square kilometers.

Degraded forests in the Brazilian Amazon totaled 15 square kilometers in March 2015. In relation to March 2014, when forest degradation totaled 5 square kilometers, there was a 200% increase.

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## Deforestation statistics

According to SAD, deforestation (total suppression of forest for other alternative land uses) reached 58 square kilometers in March 2015 (Figure 1 and Figure 2).

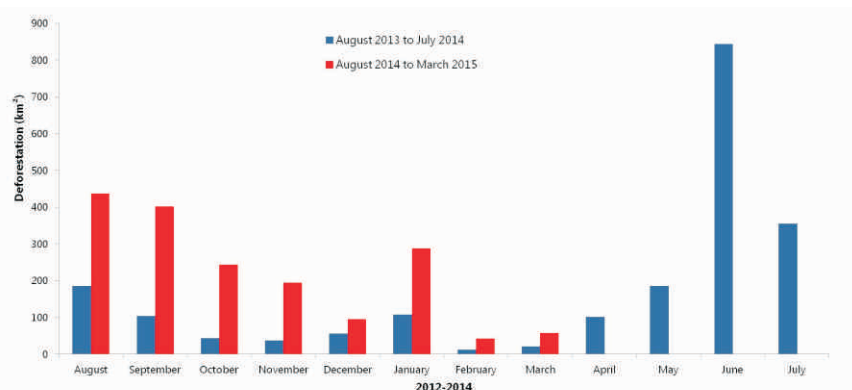


Figure 1. Deforestation from August 2013 to March 2015 in the Brazilian Amazon (Source: Imazon/SAD).

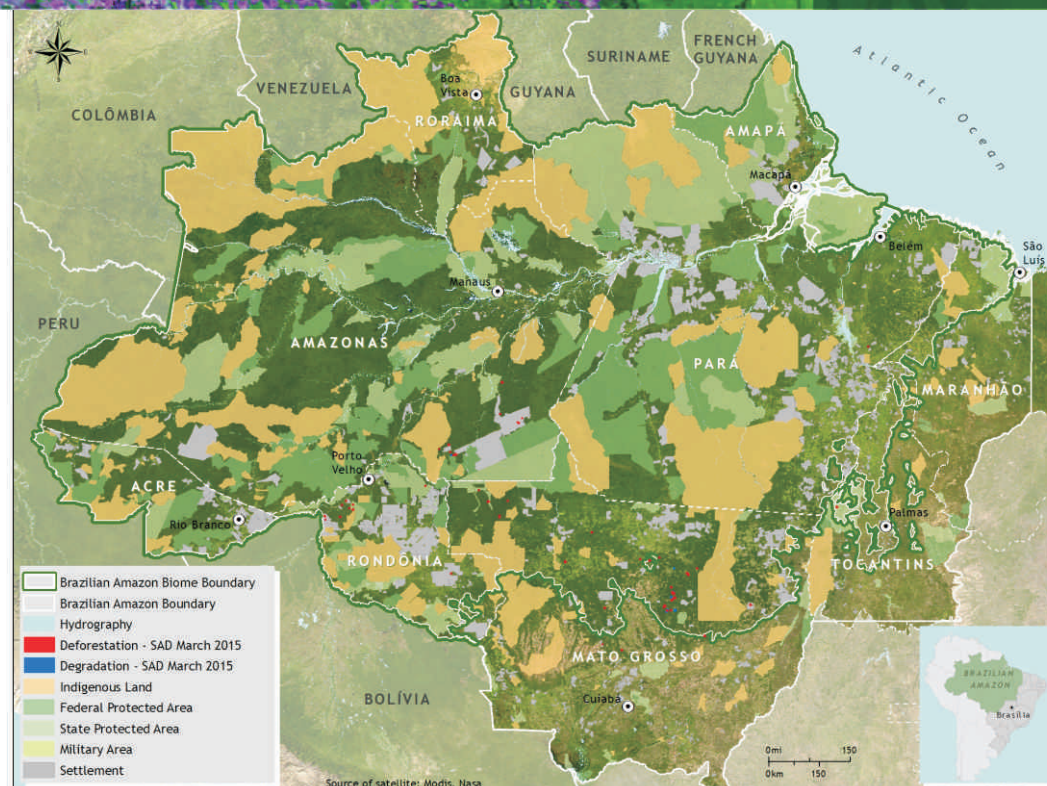


Figure 2. Deforestation and forest degradation in March 2015 in the Brazilian Amazon (Source: Imazon/ SAD).



In March 2015, deforestation was to a large degree concentrated in Mato Grosso (76%) and Amazonas (13%), with a lower occurrence in Rondônia (8%), Tocantins (2%) and Pará (1%). (Figure 3).

Accumulated deforestation during the period of August 2014 to March 2015, corresponding to the first eight months of the official calendar for measuring deforestation, reached 1.761 square kilometers. There was a 214% increase in deforestation in relation to the previous period (August 2013 to March 2014) when it reached 560 square kilometers.

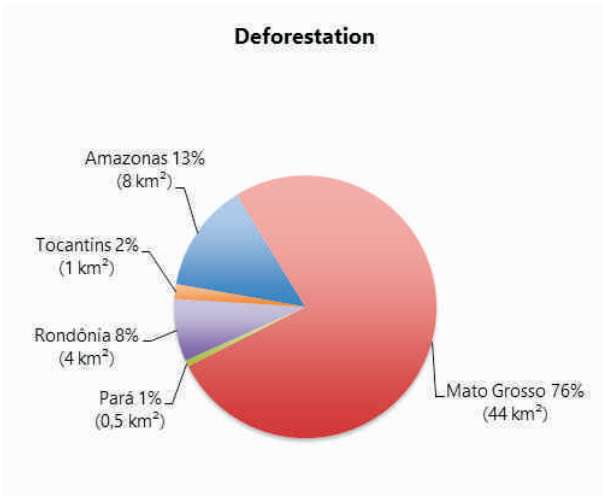


Figure 3. Percentage of deforestation in States of the Brazilian Amazon in March 2015 (Source: Imazon/SAD).

Considering the first eight months of the current deforestation calendar (August 2014 to March 2015), Mato Grosso leads the ranking with 36% do total deforested during the period. Next are Pará (25%) and Rondônia (20%). In relative terms, there was a significant increase of 640% in Mato Grosso and 227% in Pará.

In absolute terms, Mato Grosso leads the ranking of accumulated deforestation with 639 square kilometers, followed by Pará (434 square kilometers) and Rondônia, with 347 square kilometers (Table 1).

Table 1. Evolution of deforestation among States in the Brazilian Amazon from August 2013 to March 2014 and August 2014 to March 2015 (Source: Imazon/SAD).

State	August2013 to March 2014	August 2014to March 2015	Variation (%)
Pará	133	434	+227
Mato Grosso	86	639	+640
Rondônia	112	347	+209
Amazonas	120	189	+57
Roraima	55	79	+44
Acre	42	66	+56
Tocantins	12	3	-75
Amapá	-	4	-
Total	560	1.761	+214

\* Data from Maranhão were not analyzed.

## Forest degradation

In March 2015, SAD recorded 15 square kilometers of degraded forests (forests intensely exploited by logging activity and/or burned) (Figures 2 and 4). Of that total, the great majority (97%) occurred in Mato Grosso, followed by Amazonas (3%).

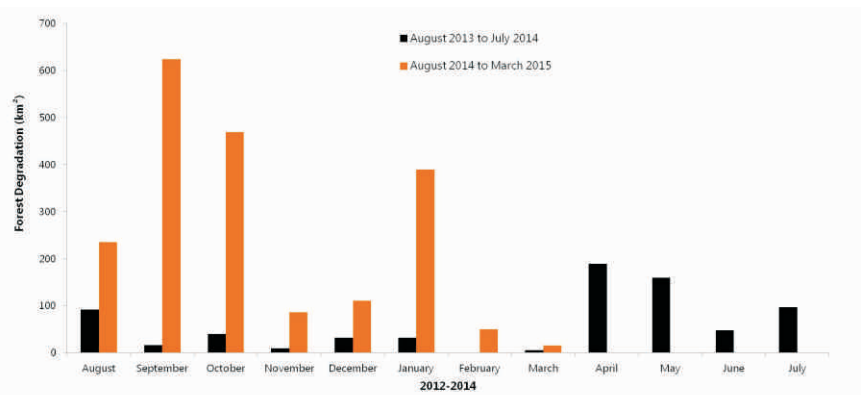


Figure 4. Forest Degradation from August 2013 to March 2015 in the Brazilian Amazon (Source: Imazon/SAD).

Table 2. Evolution of forest degradation among States in the Brazilian Amazon from August 2013 to March 2014 and August 2014 to March 2015 (Source: Imazon/SAD).

State	August 2013 to March 2014	August 2014 to March 2015	Variation (%)
Mato Grosso	160	1,662	+942
Pará	48	116	+140
Rondônia	7	37	+450
Amazonas	3	8	+154
Roraima	-	4	-
Acre	-	-	-
Tocantins	-	-	-
Amapá	-	2	-
Total	218	1,829	+740

\* Data from Maranhão were not analyzed.

## Geography of deforestation

In March 2015, the majority (86%) of deforestation occurred in private areas or lands under various stages of possession. The remaining deforestation was recorded in Land Reform Settlements (9%) e Conservation Units (5%) (Table 3).

Table 3. Deforestation by land title category in March 2015 in the Brazilian Amazon (Source: Imazon/ SAD).

Category	March 2015	
	km <sup>2</sup>	%
Land Reform Settlement	5	9
Conservation Units	3	5
Indigenous Lands	-	-
Private, Possession & Untitled Public Lands	50	86
<b>Total (km<sup>2</sup>)</b>	<b>58</b>	<b>100</b>

## Land Reform Settlements

SAD recorded 5 square kilometers of deforestation in Land Reform Settlements in March 2015 (Figure5). The Settlements most affected by deforestation were PA Rio Juma (Apuí; Amazonas), PA Acari (Novo Aripuanã; Amazonas) and PA Pingos D'Água (Querência; Mato Grosso).

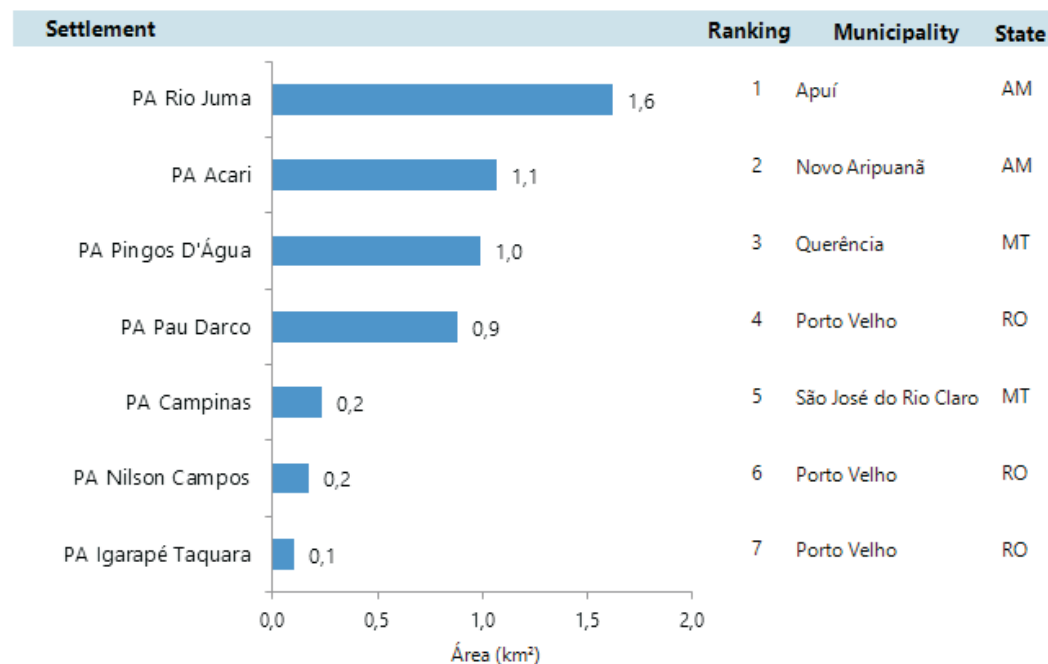


Figure 5. Land Reform Settlements deforested in March 2015 in the Brazilian Amazon (Source: Imazon/SAD).

## Protected Areas

In the month of March 2015, SAD detected 3 square kilometers de deforestation in Conservation Units (Figure 6). In the case of Indigenous Lands, in March 2015 no deforestation was detected.

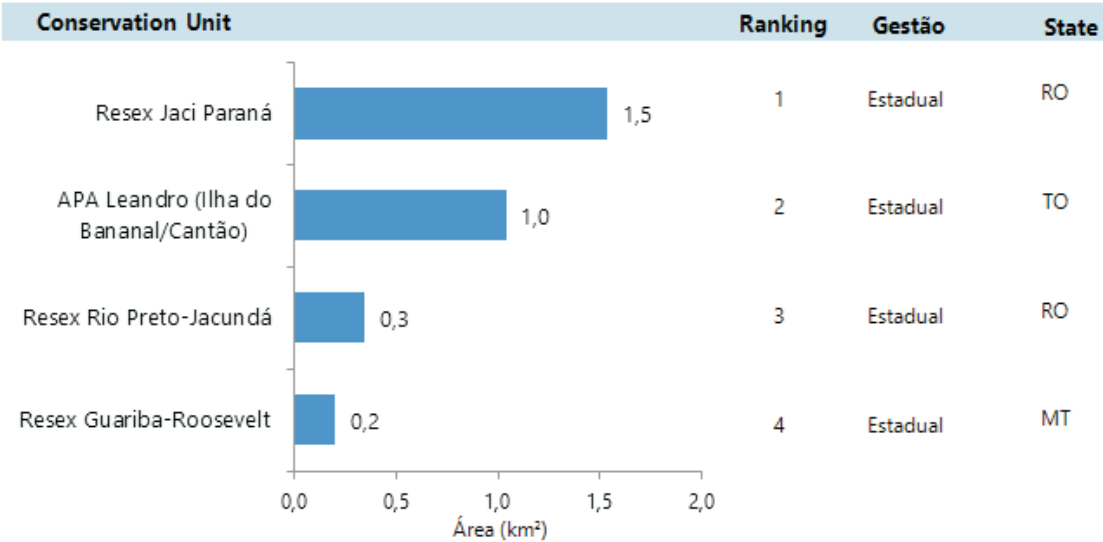


Figure 6. Most deforested Conservation Units in the Brazilian Amazon in March 2015 (Source: Imazon/SAD).



## Critical municipalities

In March 2015, the most deforested municipalities were: Feliz Natal (Mato Grosso) and Itaúba (Mato Grosso) (Figure 7 and 8).

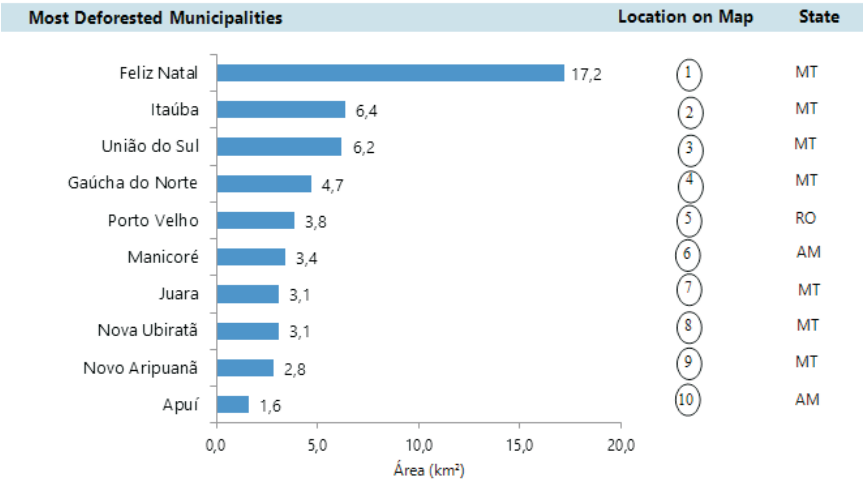


Figure 7. Most deforested municipalities in the Brazilian Amazon in March 2015 (Source: Imazon /SAD).

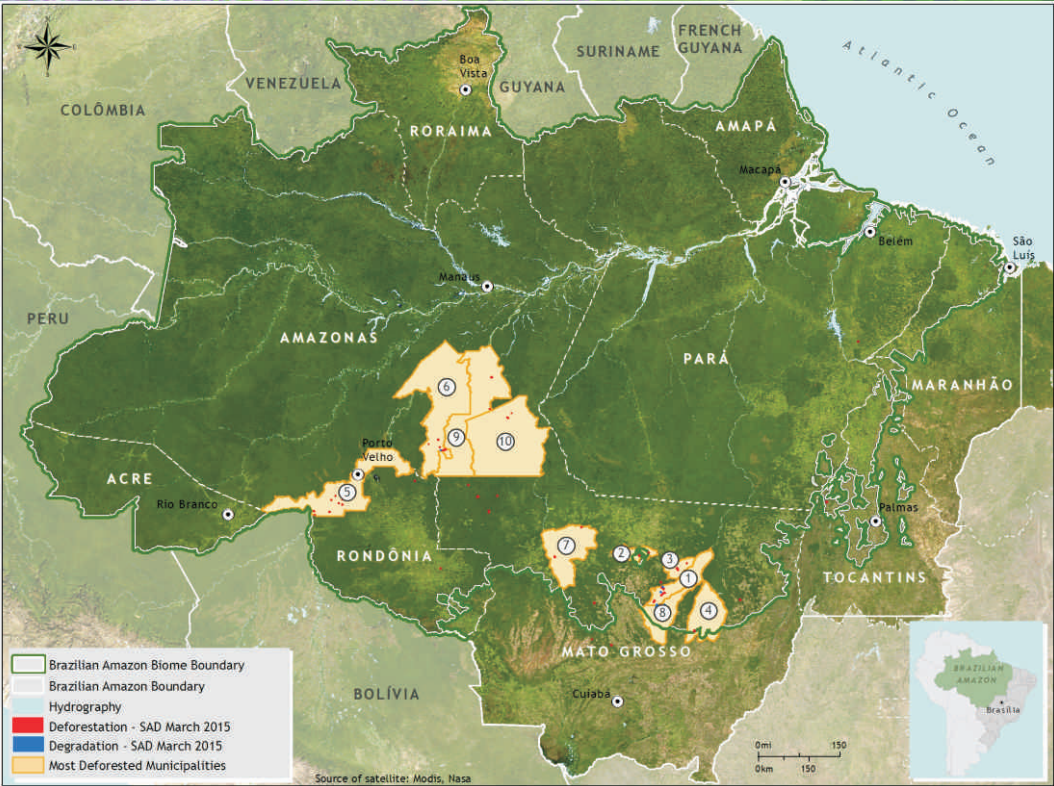


Figure 8. Municipalities with the largest areas deforested in March 2015 (Source: Imazon/SAD).



## Cloud and shadow cover

In March 2015, with SAD it was possible to monitor 47% of the forest area in the Brazilian Amazon. The other 53% of forest territory was covered by clouds, which made detection of deforestation and forest degradation difficult. The States with the largest cloud cover were Roraima (86%) and Pará (67%). Because of that, the data for deforestation and forest degradation in March 2015 may be underestimated (Figure 9).

## SAD-EE

Since July 2012 deforestation and forest degradation detection alerts have been performed using the Google Earth Engine platform (EE), with the new SAD EE version. That system was developed in collaboration with Google and uses the same process already employed by SAD 3.0 (Box I), with reflectance images from MODIS to generate the deforestation and forest degradation alerts.

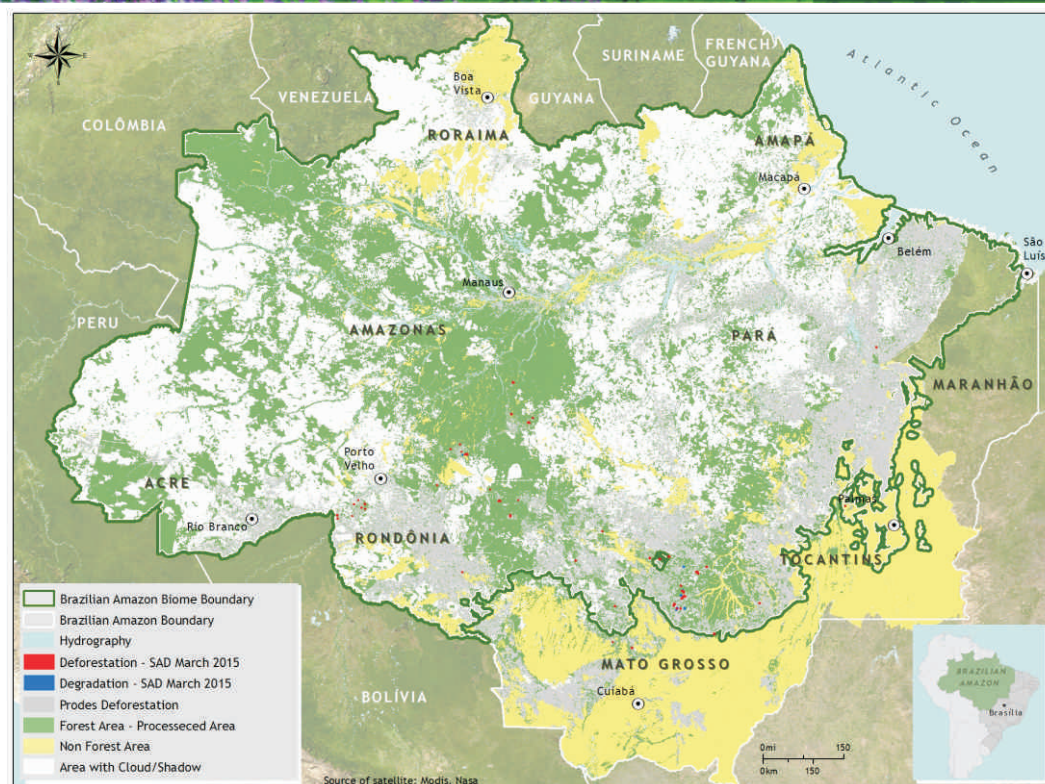


Figure 9. Area with cloud and shadow in March 2015 in the Brazilian Amazon.

\* The portion of Maranhão that is part of the Brazilian Amazon was not analyzed.



## BOX I: SAD 3.0

Since August 2009, SAD has had some new features. First, we created a graphic interface to integrate all of the image processing programs used in SAD. Next, we began to compute deforestation in areas that were covered by clouds in the previous months in a new class. Finally, deforestation and degradation are detected with pairs of NDFI images using a change detection algorithm. The principal method continues to be the same as with SAD 2.0 as described below.

SAD generates a temporal mosaic of daily MODIS images from the MOD09GQ and MOD09GA products for filtering clouds. Next, we use a technique for fusing different spectral resolution bands, i.e. with pixels of different sizes. In this case, we made a change in scale from 5 bands with 500 meter pixels in MODIS to 250 meters. That allowed us to improve the spectral mixture model and provided the capacity for estimating the abundance of Vegetation, Soils and Non-Photosynthetic Vegetation (NPV) components (Vegetation, Soil and Shadow) to calculate the NDFI, with the following equation:

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

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

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

The NDFI varies from -1 (pixel with 100% of exposed soil) to 1 (pixel with > 90% of forest vegetation). Thus, we have a continuous image that shows the transition from deforested areas, going through degraded forests, until reaching forest without signs of disturbances.

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

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

SAD has been in operation in the State of Mato Grosso since August 2006 and in the Legal Amazon since August 2008. In this bulletin, we present the monthly data generated by SAD from August 2013 to March 2015.

## Team reasponsible

General Coordination: Carlos Souza Jr. e Adalberto Veríssimo (Imazon).  
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Team: João Siqueira e Marcelo Justino (Image interpretation),  
Kátia Pereira and Victor Lins (ImazonGeo) e Bruno Oliveira (Communication).

## Data source

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

## Acknowledgements

Google Earth Engine Team  
<http://earthengine.google.org/>

## Partnerships

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Federal Public Prosecution Service in Pará  
State Public Prosecution Service of Pará  
State Public Prosecution Service of Roraima  
State Public Prosecution Service of Amapá  
State Public Prosecution Service of Mato Grosso  
Instituto Centro de Vida (ICV- Mato Grosso)

## Support

