A case of illegal clearing in Amazonia antecipated by the detection of fires and forest degradation

Alberto W. Setzer, Silvia C. de Jesus, Fabiano Morelli, Luis E. Maurano
silviac@dsr.inpe.br

ABSTRACT

This paper shows how a 520 ha illegal deforestation in Amazonia detected in early 2012 was the result of burning and forest degradation processes started at least eight years before. The daily monitoring of fires in low spatial resolution satellite images (1 to 6 km), as well as the yearly mapping of degraded forested areas with medium resolution imagery (up to 30 meters), both operationally done by INPE, registered the recurrence of illegal anthropic activities in the area since 2004. The results show that deforestation and its environmental consequences, such as biodiversity stress and atmospheric emissions, occur gradually and should not be considered as representative just of the year in which the complete forest clearing takes place. The area studied, in the southwest of the Feliz Natal County, Mato Groso State, Brazil, was more intensely affected by fire in the anomalous dry seasons of 2004, 2007 and 2010; particularly, in the pronounced drought of 2007, the fire impact was severe in an area of ~160,000 ha, what enabled its classification as a degraded area. The paper concludes that the combined monitoring of vegetation fires and forest degradation using satellites allows the identification and the forecast of illegal deforestation tendencies many years in advance.

Keywords: fire, forest, monitoring, deforestation, satellites.

Introduction

Following an alert of DETER, INPE´s system for deforestation detection in near-real time, in a recent case during May/2012 enforcement agents of Ibama (the Environmental Institute of Brazil,) arrived at a site in the southwest of the Feliz Natal County, Mato Grosso State with an illegal deforestation of 512 ha in progress.

Ibama impede o que poderia ser o maior desmatamento deste ano em Mato Grosso

Sinop (18/05/2012) - Atendendo a uma Detecção em Tempo Real (Deter) de desmatamento emitida por satélite, equipes de agentes ambientais federais do Ibama deslocaram-se para Feliz Natal, município que compõe o eixo da Gerência Executiva do Ibama em Sinop, região norte de Mato Grosso. O serviço de inteligência havia levantado informações de que no local seriam devastados mil hectares de floresta. Diante da informação, foi montada uma operação que mobilizou agentes por terra e ar.

Ao chegarem ao local, os fiscais deram o flagrante e conseguiram estancar o que poderia ser o maior desmatamento registrado este ano em Mato Grosso. Foram encontrados 520 hectares de floresta derrubados. Dois tratores de esteira, com alto poder de destruição, foram apreendidos e recolhidos ao pátio do Ibama em Sinop. Os autos de infração lavrados poderão gerar multas que chegam a R$ 2, 2 milhões.

Imagens georreferenciadas mostram a evolução do desmatamento da área. Nesta área, de acordo com histórico de imagens, o proprietário extraiu toda a madeira entre 2009 e 2010, na sequência, a floresta sofreu com incêndio e neste ano foi efetuado o desmatamento com o uso do correntão. "Reconhecemos que 520 hectares é muita coisa, contudo, poderia ser o dobro disso se não tivéssemos chegado a tempo", avalia o gerente executivo do Ibama em Sinop, Evandro Selva.

Segundo a Divisão Técnica, naquela área havia plano de manejo florestal aprovado pelo Ibama na década de 90, e a área tinha reserva legal averbada na matrícula do imóvel, portanto, não poderia ocorrer o desmatamento. Além da multa imposta e da apreensão do maquinário, o proprietário da área terá restringido o crédito rural e embargado todo o perímetro desmatado. Após a conclusão do processo administrativo, todo procedimento será encaminhado à Promotoria de Justiça de Feliz Natal.

Badaró Ferrari
Ascom - Ibama
Fotos: Carlos Eguiberto Rodrigues Jr e Émerson Gonçalo

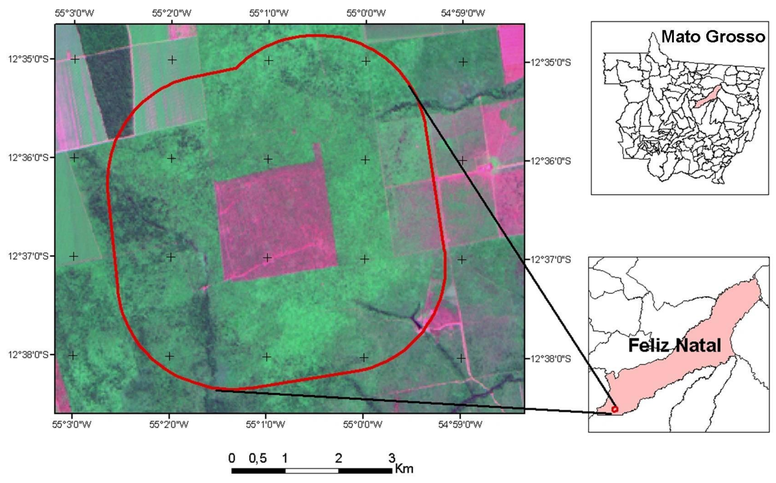

Figure 1. The area of illegal deforestation in the county of Feliz Natal, Mato Grosso State, is indicated by the magenta square with ~2 km x ~2 km in the center of the figure extracted from the 07/May/2012 image of the Indian ResourceSat image, LISS3 sensor, received by INPE; the surrounding polygon includes an additional buffer of 2 km width, where the fire pixels analyzed were located.

Data Source

Vegetation fires were obtained from INPE´s national system and database of fire pixels detected in up to 200 daily images from different polar orbiting and geostationary satellites operationally processed in near-real time (www.inpe.br/queimadas). Table 1 shows the monthly amounts of fire pixels detected in the polygon that includes the deforestation site with an additional surrounding buffer of 2 km along its border to account for possible fires mis-registered. No fires were detected before 2004 and in 2012, and in the months not shown in the table.

Table 1. Number of fire pixels detected in the polygon surrounding deforestation site

Month\Year	2004	2005	2006	2007	2008	2009	2010	2011
May	9	1	-	-	2	1	-	-
June	6	-	2	3	-	1	-	3
July	26	-	-	6	-	-	-	-
August	3	5	-	4	-	-	194	-
September	1	16	-	106	-	2	6	-
October	-	8	-	-	3	-	1	-
November	-	-	-	-	3	-	1	-
December	-	-	-	-	-	-	-	-
Total	45	30	2	119	8	4	202	3

DETER was also used in the analysis (http://www.obt.inpe.br/deter/). It provides monthly maps with contours of recent deforestation with at least 25 ha in the Brazilian Amazonia, identified through visual analyses of digital MODIS 250 m resolution images; its purpose is to alert control agencies of possible ongoing unlawful forest cuts, and this was the tool that directed the IBAMA enforcement agents to the case herein presented.

Results and Discussions

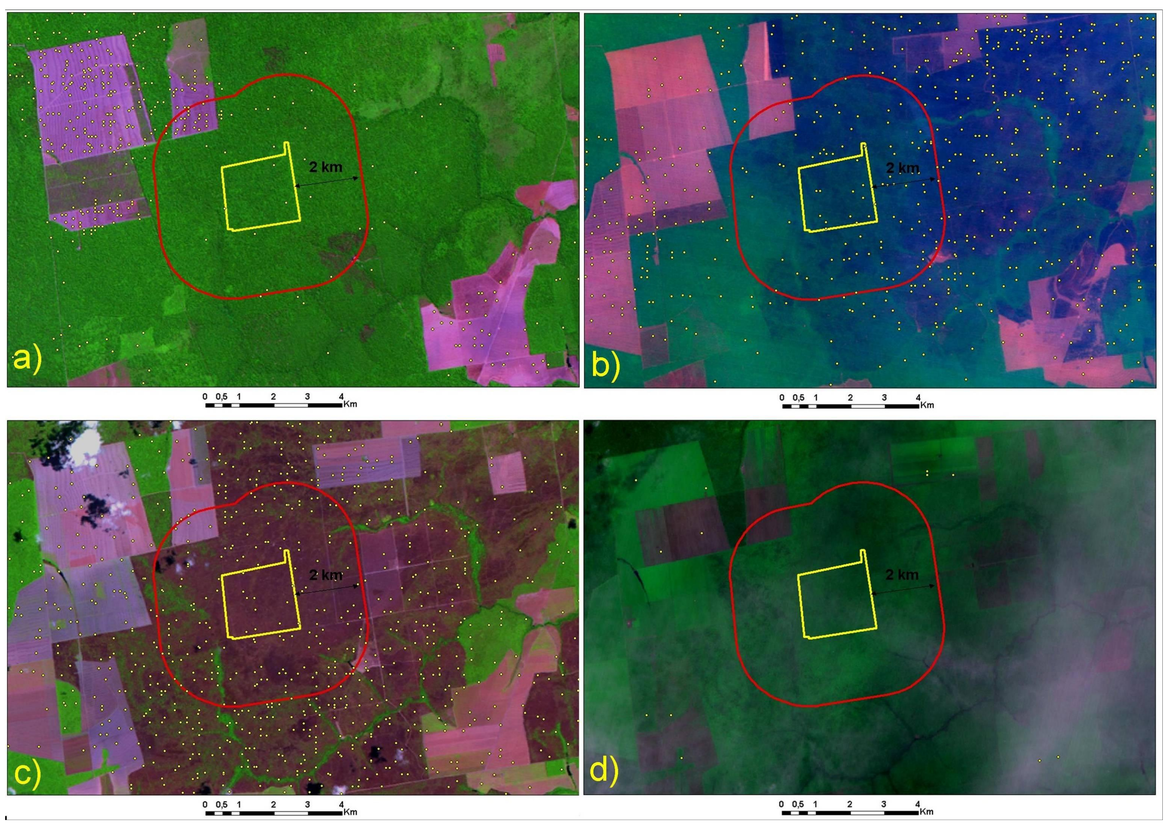

Figure 2. The deforestation site (outlined in yellow) in four years and the associated fire detections (small yellow dots): 2a) 23/Jul/2004, with the first fires detected; 2b) 18/Sept/2007, in a dry year with more fires; 2c) 13/Apr/2010, where the wide-scale effect of the 2007 fire is still present and fires peaked, and; 2d), 13/Apr/2012, prior to the final deforestation shown in Figure 1. The first three images are Landsat-TM, with R5-G4-B3 color & band combination, and the fourth is a RSI-LISS3 with R3-G4-B2.

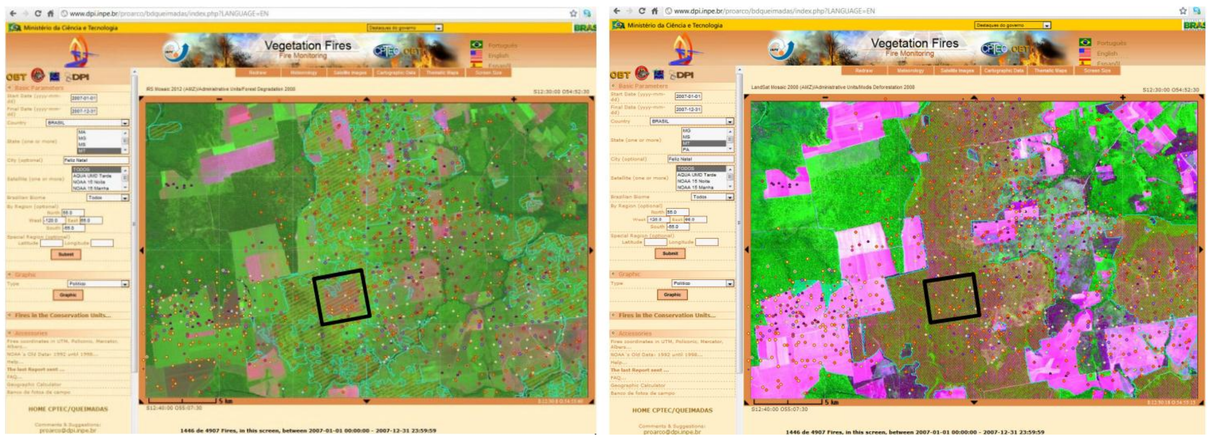

Figure 3. a) INPE´s fire system BDQ showing the fire pixels of 2007 (colored dots) and the contours of the 2007 degraded areas from DEGRAD, with the RSI image of 13/April/2012 as background; the illegal deforestation plot is in the black square. b) INPE´s fire system BDQ showing the fire pixels of 2007 (colored dots) and the contours of the 2008 potential deforestation, with a Landsat-TM image of 2008 as background; the illegal deforestation plot is in the black square.

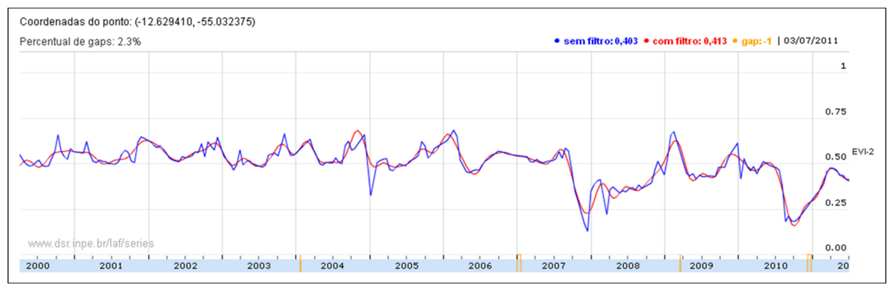

Figure 4. EVI vegetation index since 2010 from the 16-day temporal series of MODIS 250 m data for the site deforested in May/2012 (INPE-LAF, 2012); the low values at the end of 2004, 2007 and 2010, probably result from the fire effect in degrading the natural forest.

These tools (BDQ and DETER) can support the monitoring of areas subject to this gradual degradation. Recently, Ibama's agents located and fined irregular deforestation and fires through data available at BDQ that guided a flight also in Mato Grosso State (see http://www.obt.inpe.br/fototeca/fototeca.html).

Conclusions

Illegal forest clearings in the Brazilian Amazon forest during the last decades account for at least some 80% of the total of ~750,000 km² of deforestation mapped until the end of 2011 by INPE-PRODES (2012). This value increases substantially when areas of natural forests degraded by selective logging and/or fires are included – an evaluation that remains to be done. In a dynamic process, the extraction of valuable timber and the use of fire, particularly in anomalous dry years, signal the initial steps of a procedure lasting many years, until a final clearing is achieved. Monitoring of fires in satellite images provide a first indication for most of the areas that will be subject to this gradual degradation. As shown in this paper, the identification of critical deforestation areas and their spatial and temporal dynamics, legal or not, becomes feasible when combining existing satellite monitoring tools and products. Enforcement agencies and environmental protection groups can greatly benefit from a more effective use of these freely available data sources.

Acknowledgments

The scholarships/processes CNPq-PCI-INPE-CCST #551006/2011-0 and CNPq-AP #309765/2011-0 are highly acknowledged by the authors.