Ministério do
Meio Ambiente

The Satellite Monitoring and the use of ScanSAR data as a complementary data to fast detection

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Brazilian Institute for Environment and Renewable Resources - IBAMA
Ministry of Environment

Tokyo – january 2008

Inter-institutional Integration

National Institute of Space Research

Orbital Sensors and Systems

FEDERAL POLICE

Field and investigation

IBAMA CEMAM

IBAMA LAW ENFORCEMENT

Airborne Sensors and Systems

Protection System of the Amazon

IBAMA & INPE Cooperation

DETER System

Near Real Time Deforestation Detection System (15 days interval) – Short Time

+

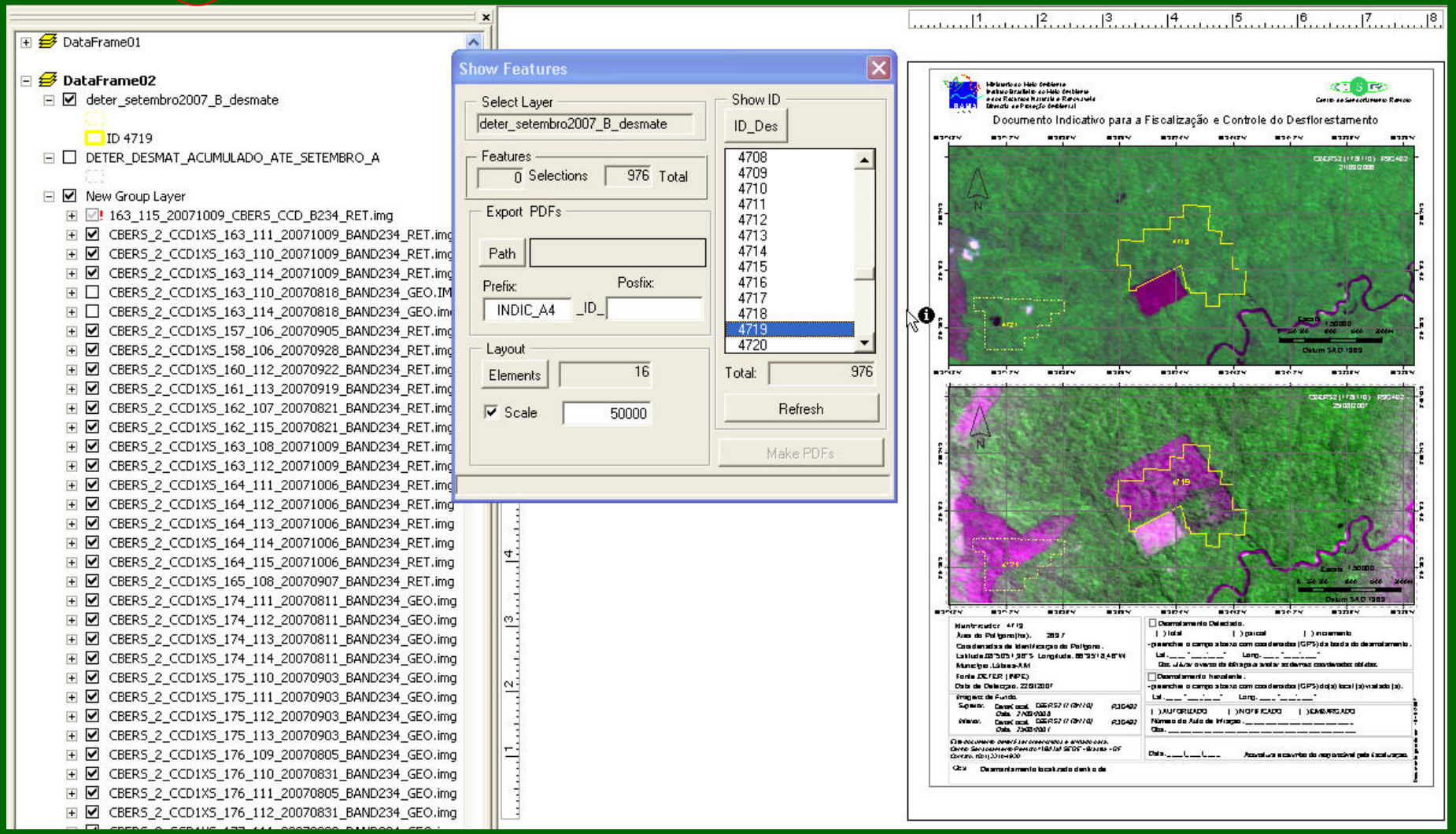
PRODES System

Deforestation Measuring System (year interval) – Long Term

DETEX System

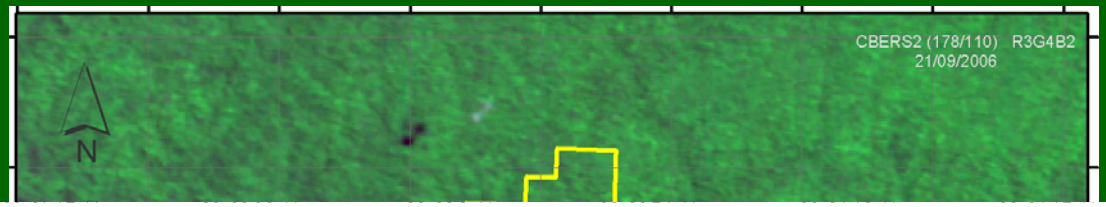
Selective Logging Detection System (Regional Definition – initial phase)

Individualized Documents



Individualized Documents

DB connected



Identificador: 4416
Área do Polígono(ha): 57.3
Coordenadas de Identificação do Polígono:
Latitude:06°20'54,25"S Longitude:53°11'02,24"W
Município: São Félix do Xingu-PA
Fonte:DETER (INPE)
Data de Detecção:28/9/2007

Imagens de Fundo:
Superior: *Cena/Local: CBERS2 (165/107)* *R3G4B2*
Data: 17/01/2006
Inferior: *Cena/Local: CBERS2 (165/107)* *R3G4B2*
Data: 12/08/2007

Este documento deverá ser preenchidos e enviado para:
Centro Sensoriamento Remoto / IBAMA SEDE - Brasilia - DF
Contato: (061)3316-1830

Obs: Desmantamento localizado dentro de
UC EST. APA Triunfo do Xingu (US)

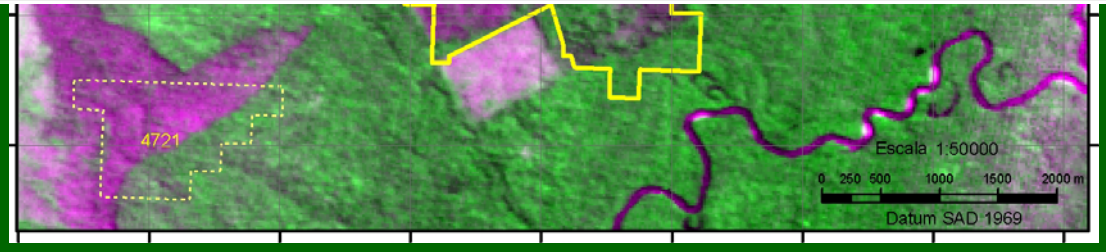
☐ Desmatamento Detectado:
( ) total ( ) parcial ( ) incremento
- preencher o campo abaixo com coordenadas (GPS) da borda do desmatamento.
Lat: ____ °____'____" Long: ____ °____'____"
Obs: utilizar o verso da folha para anotar as demais coordenadas obtidas.

☐ Desmatamento Inexistente:
- preencher o campo abaixo com coordenadas (GPS) do(s) local (s) visitado (s).
Lat: ____ °____'____" Long: ____ °____'____"

( ) AUTORIZADO ( ) NOTIFICADO ( ) EMBARGADO
Número do Auto de Infração: _____
Obs: _____

Data: ____/____/____ *Assinatura e carimbo do responsável pela fiscalização.*

Documento gerado em: 10/10/2007



2007

7000 docs

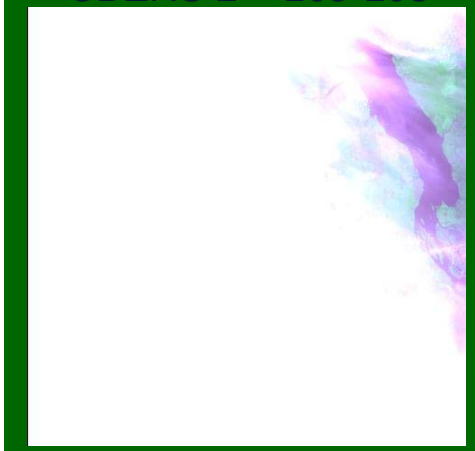
ALOS K&C Proposal

Main goals:

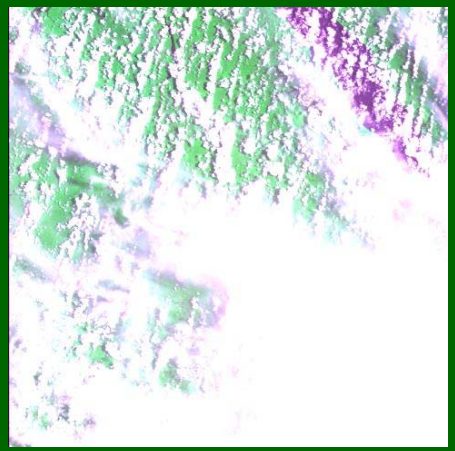
- Increase the fast detection system provide by DETER (best rapid response)
- Expands the monitoring area per time.
- Improve the qualification of the data provided to the enforcement law agents.
- Intensify IBAMA´s capability to realize the time series analyses (old deforestation doubts).

Antecipating actions with RADAR data

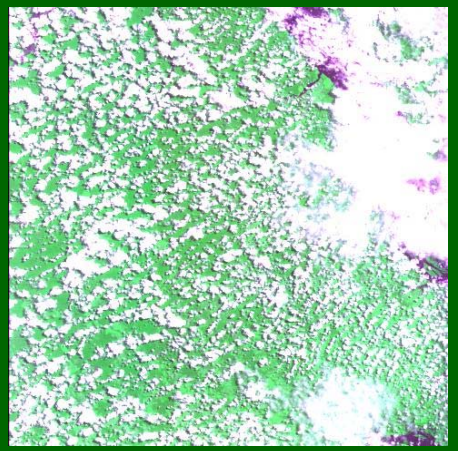
CBERS 2 – 165-103



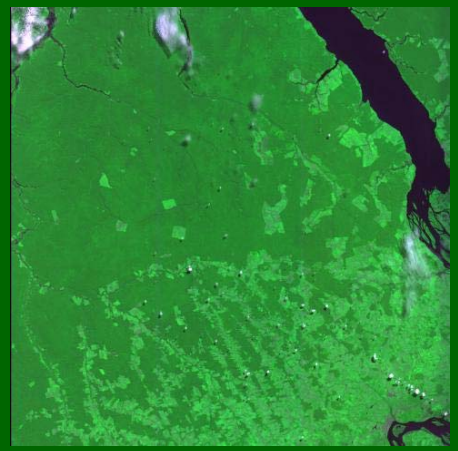
17/01/2006



10/03/2006

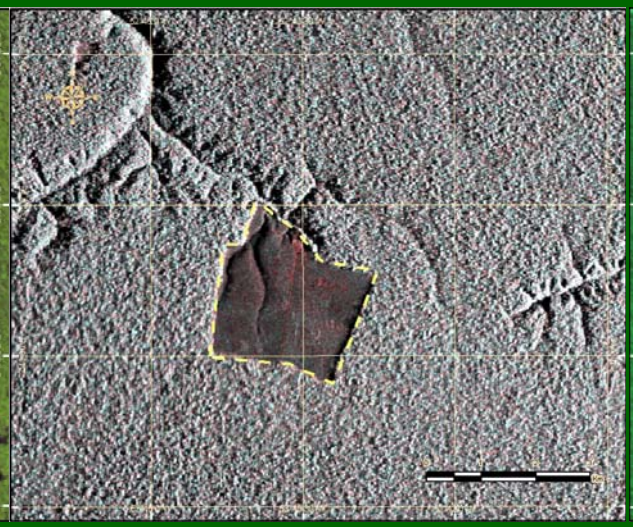


05/04/2006

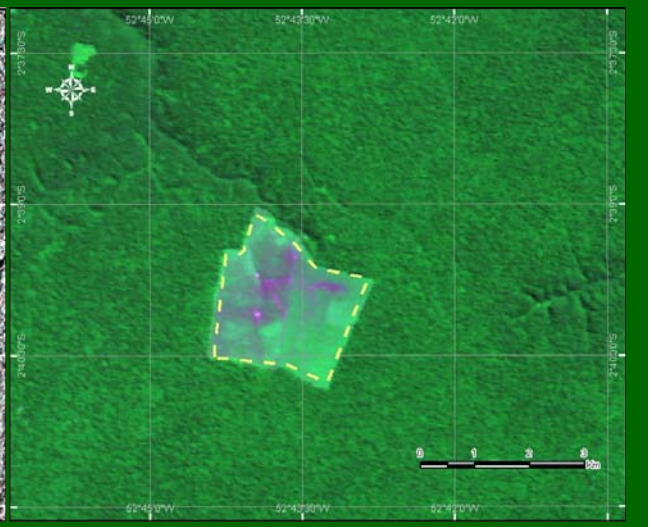


22/06/2006

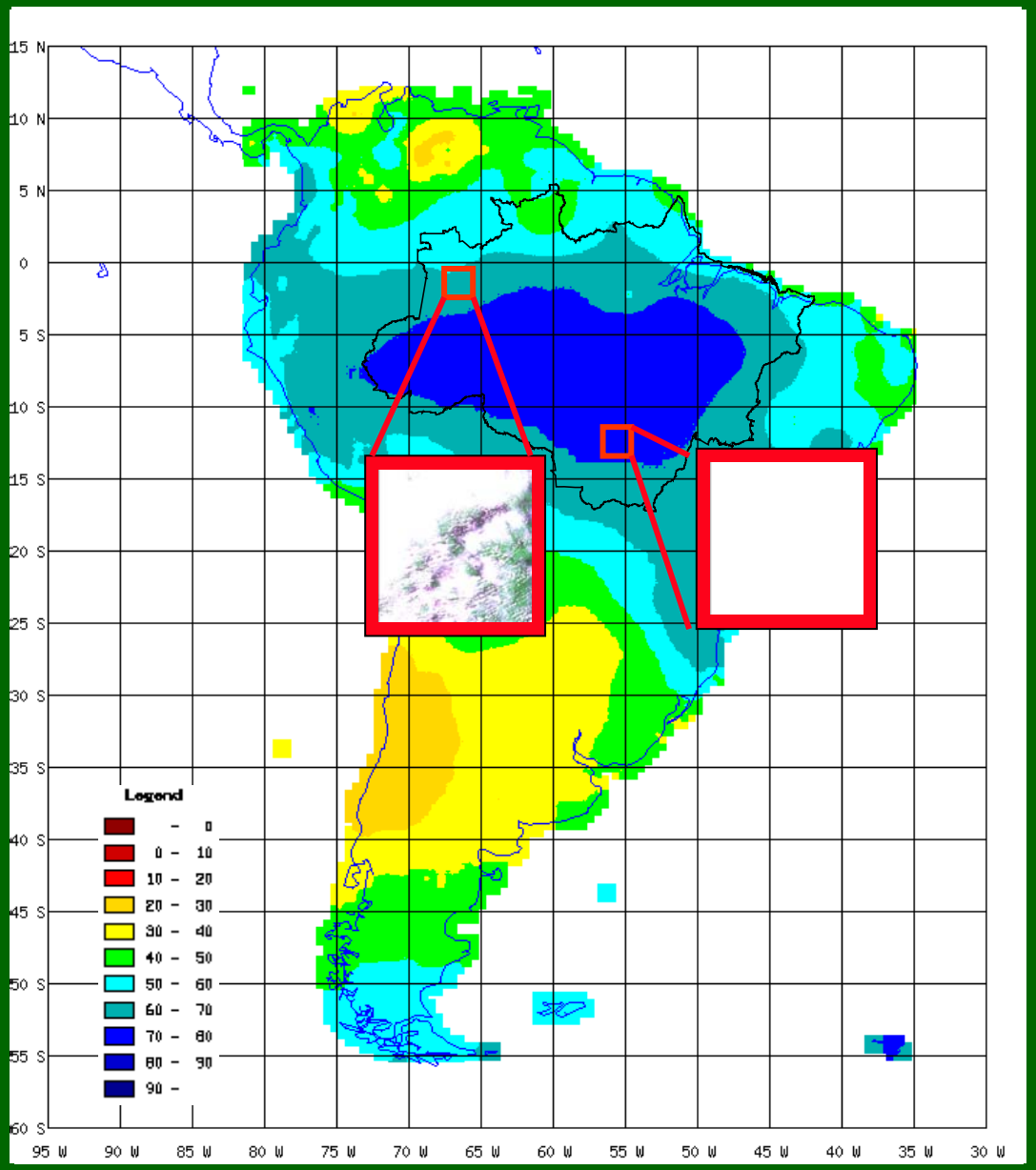
LANDSAT 19/08/2005

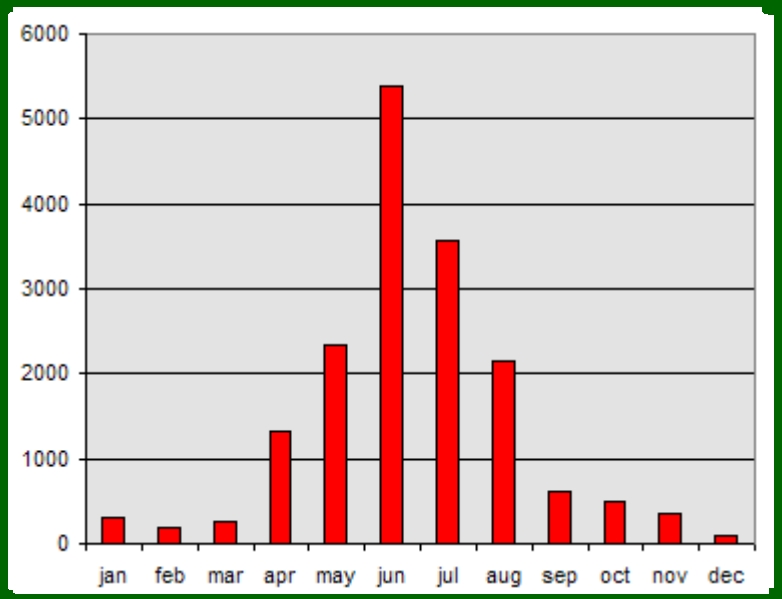


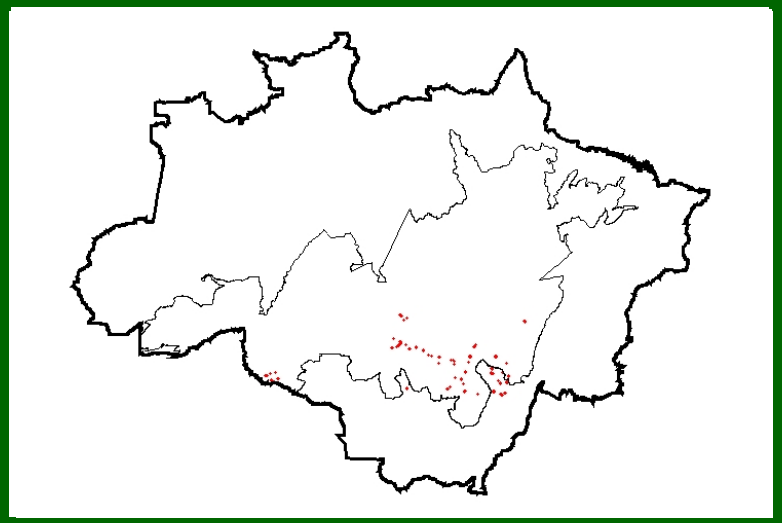
RADAR R99B 07/04/2006



CBERS 2 22/06/2006







Monthly Cloud Coverage average between 1961 – 1990 (Climatic Research Unit, University of East Anglia)

ALOS K&C Proposal

What are expected for IBAMA:

- High demanding of data per time (sort time)
- Fast pre-processing and image processing (sort time)
- Large database to store and share data (long time)
- Good knowledge of image interpretation (long time)

Preliminary results

- Web availability time interval
- Knowledege of image metadata
- Coverage vs. prototypes areas
- Georeference
- Geometrical problems (distortions)
- Image Processing

Acquisition and Web Availability Time Delay

From 23/08 to 07/12:

ALL

- Average delay = 8 days
- Maximum = 20
- Minimum = 2

First Half

From 23/08 to 19/10:

- Average delay = 10 days
- Maximum = 20
- Minimum = 6

Second Half

From 22/10 to 07/12:

- Average delay = 6 days
- Maximum = 12
- Minimum = 2

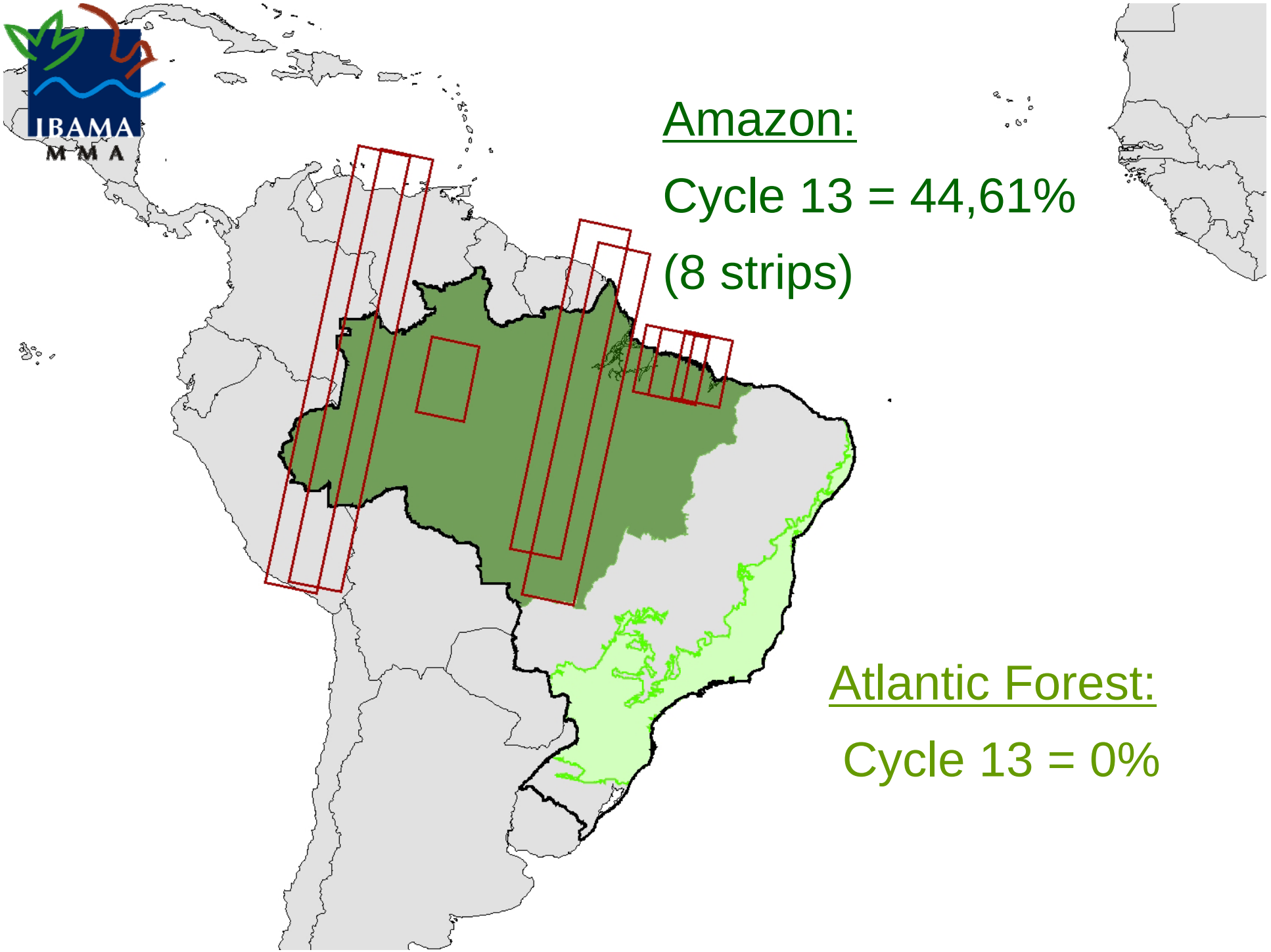
Monitoring Area Coverage

Amazon Region:

- Cicle 13 = 44,61% (8 strips)
- Cicle 14 = 26,56% (11 strips)
- Cicle 15 = 100% (21 strips)

Atlantic Forest Region:

- Cicle 13 = 0 % (8 strips)
- Cicle 14 = 62,21 % (11 strips)
- Cicle 15 = 48,30% (21 strips)



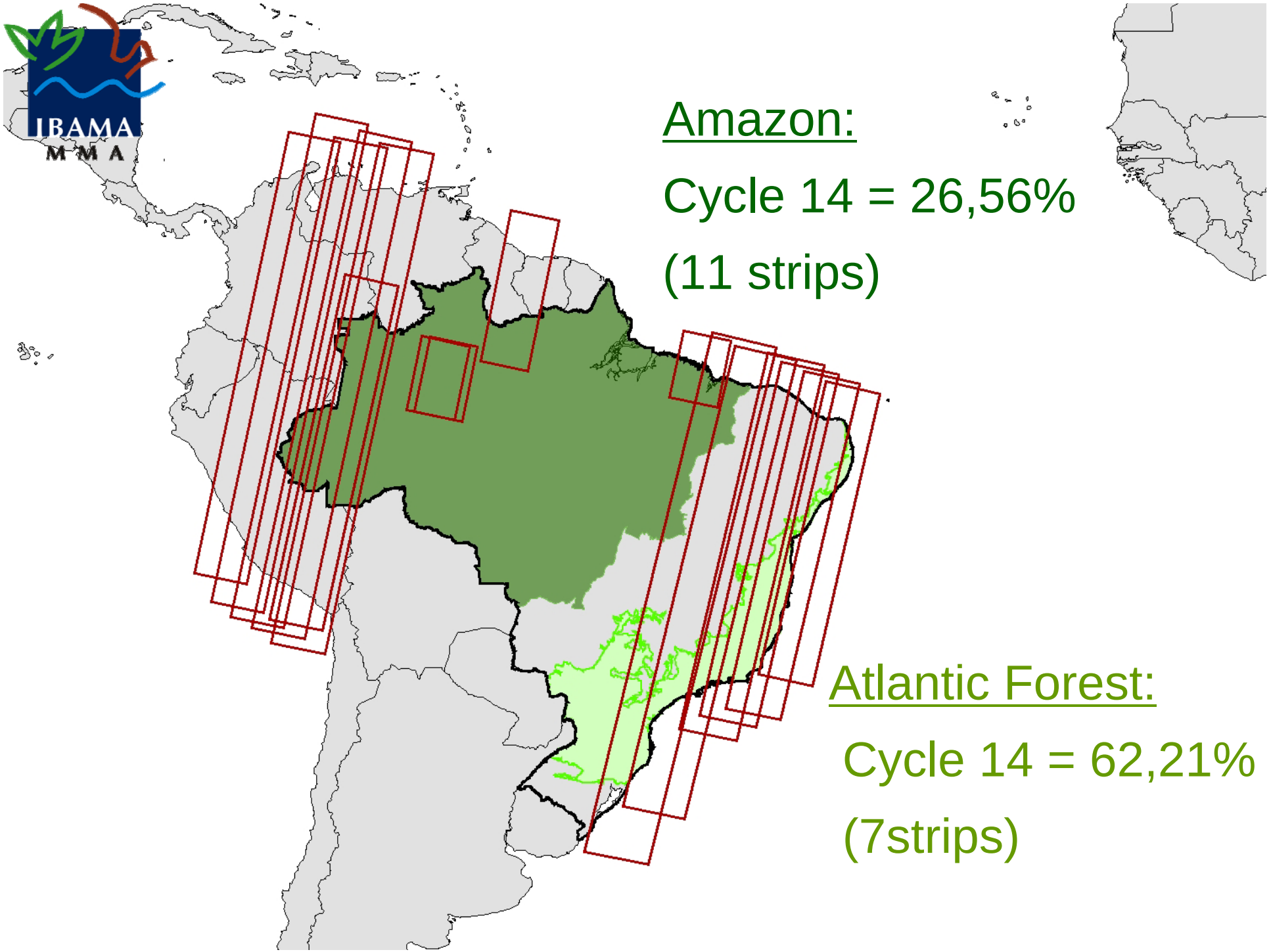
Amazon:

Cycle 13 = 44,61%

(8 strips)

Atlantic Forest:

Cycle 13 = 0%


IBAMA
MMA
Amazon:
Cycle 14 = 26,56%
(11 strips)
Atlantic Forest:
Cycle 14 = 62,21%
(7strips)

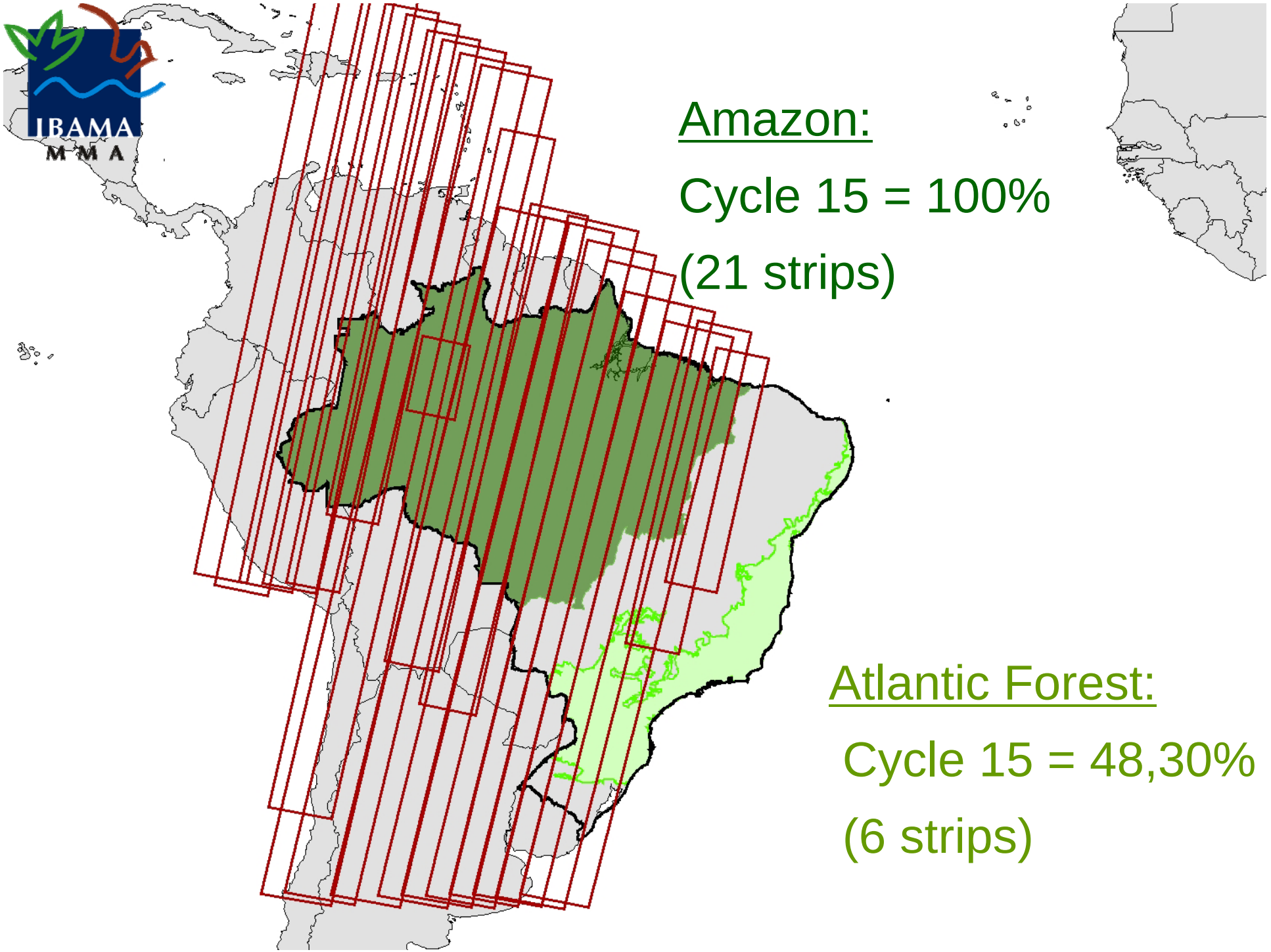

IBAMA
MMA
Amazon:
Cycle 15 = 100%
(21 strips)
Atlantic Forest:
Cycle 15 = 48,30%
(6 strips)

Image metadata

- facter_m.dat = ASCII
- geo factors = binary
- gparameter.dat = ASCII
- LED-ASPSR = binary & ASCII
- RSP403_GER20070823WB1271HH5_W0577449001-02_001_HDR = ASCII
- sar_Q16_g_ref_HH = Raw data binary 16bit
- dataf_m.dat = ASCII

Image Processing

16 bits

Rows

Columms

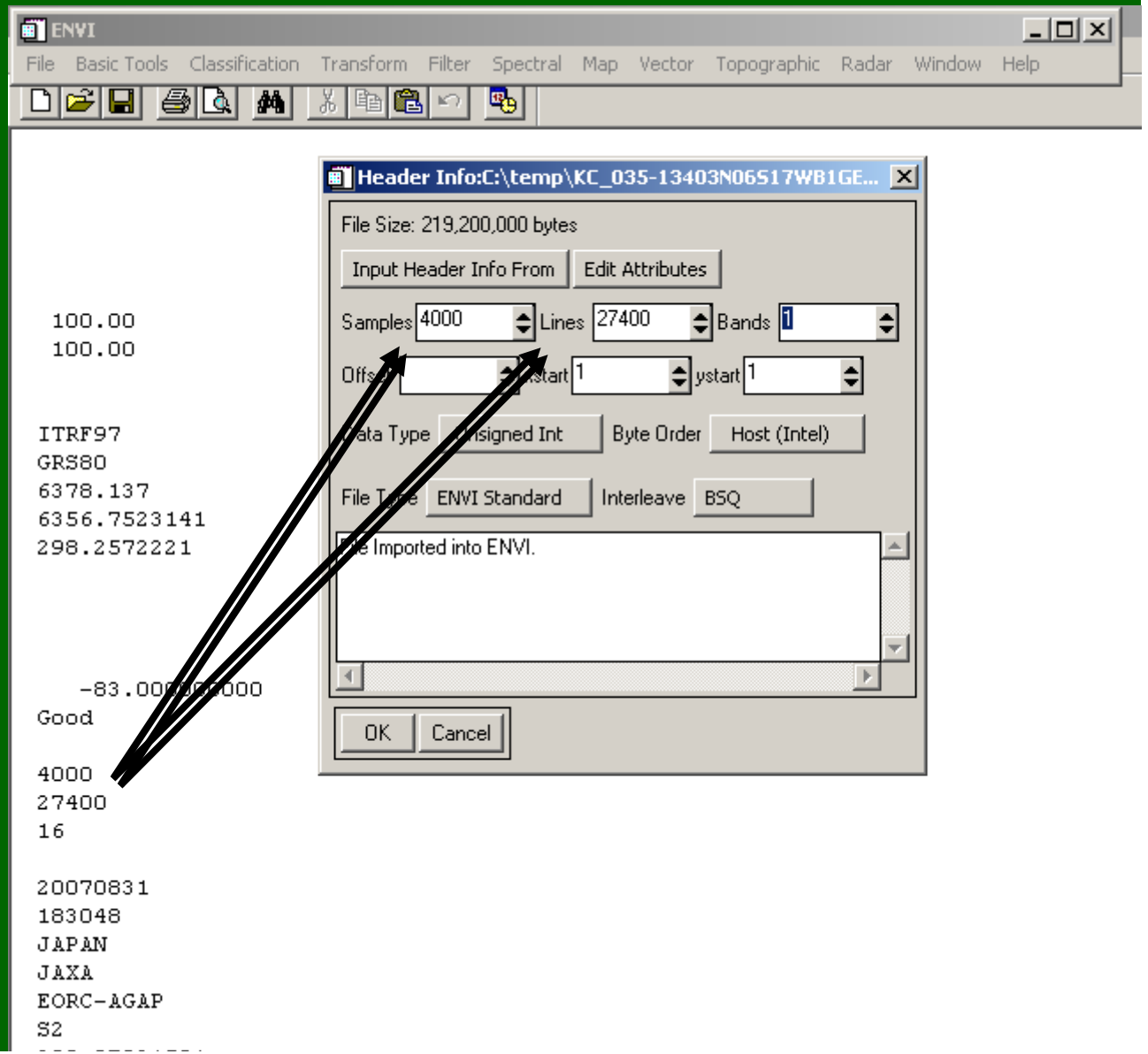


Image Processing

Convert the four corners of Header File to Mercartor Projection (plane, WGS84) with 100x100 meters and register the image file

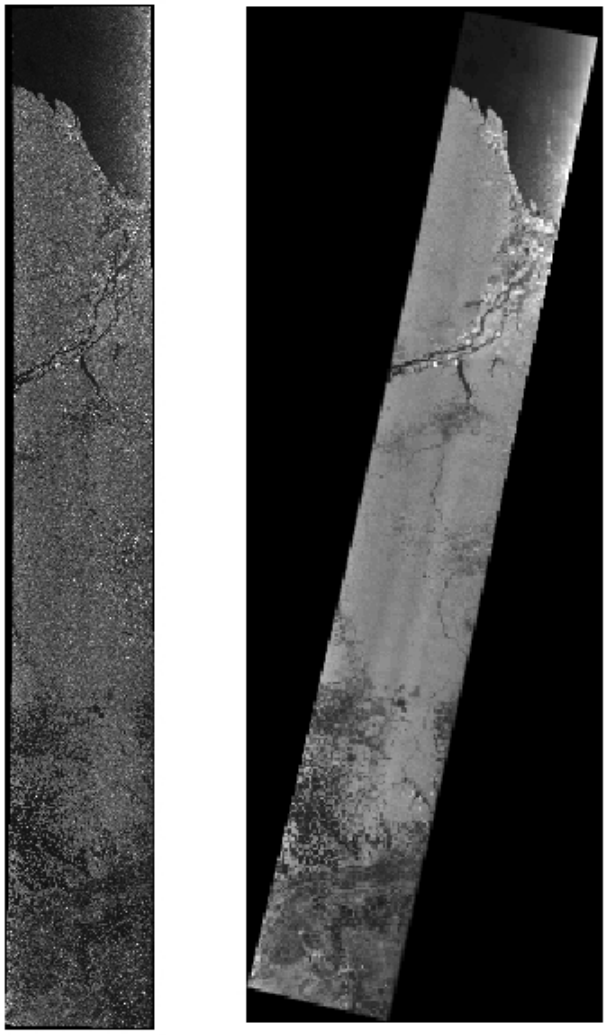
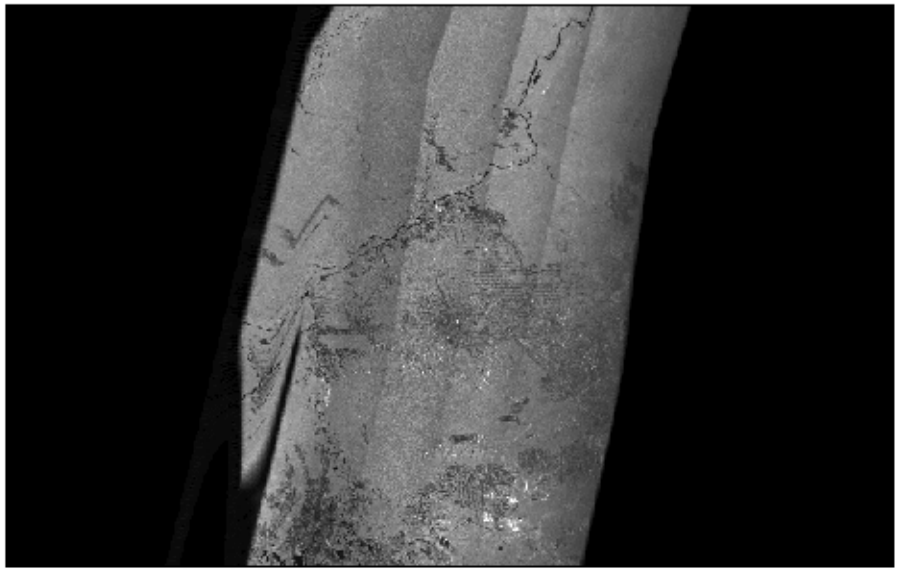


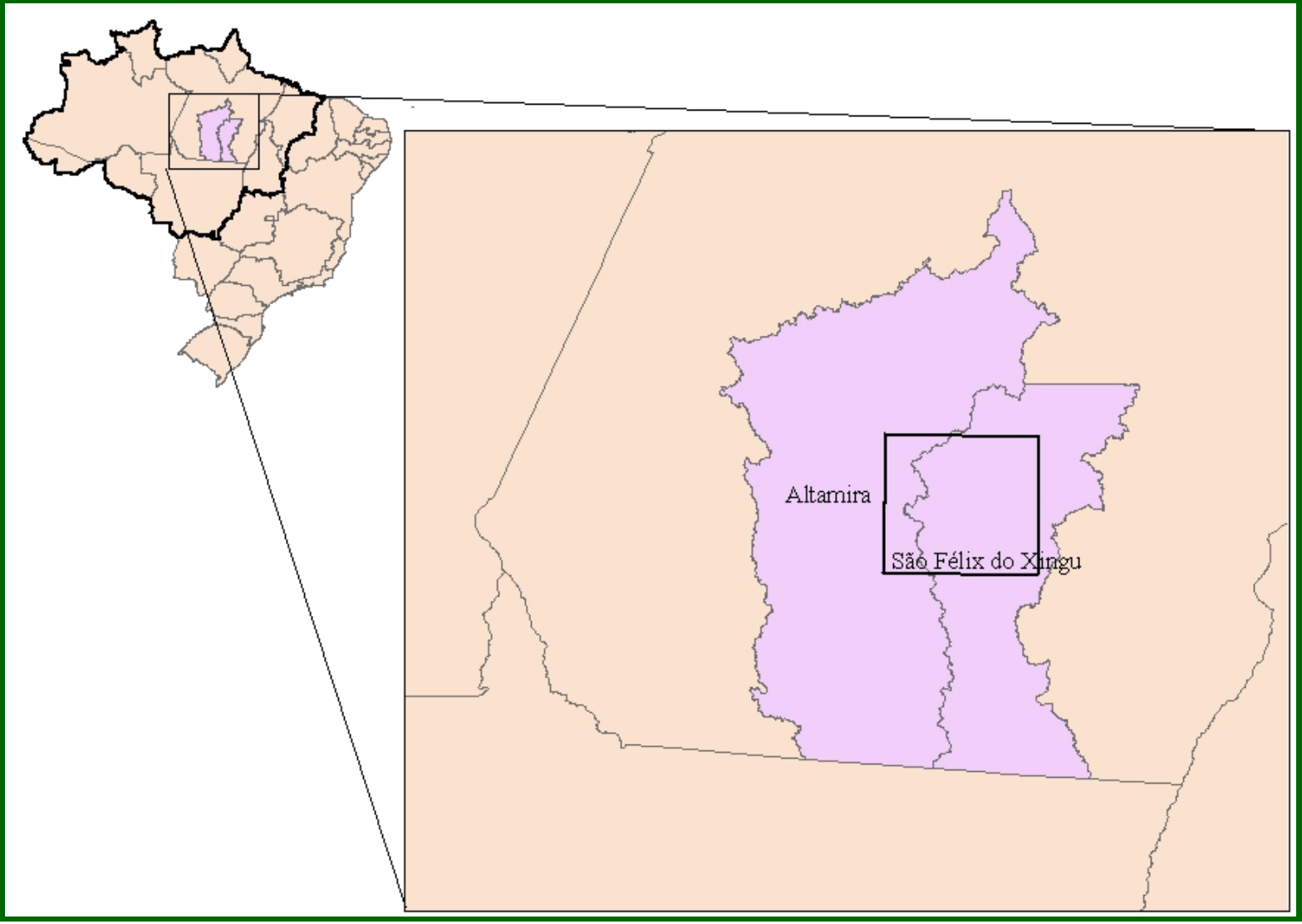
Image Processing



Study Area

- Rectangle (180km by 200km) centrally located in the state of Para, Brazil (52º 47’ 44” W and 6º 34’ 03” S)
- Area of forest that has been facing a growing pressure of deforestation
- High mount of recent deforested areas detected by DETER.
- The area was selected to be used as pilot area to test new methodologies on real-time deforestation monitoring.

Study Area



Objectives

- To test new methodologies for detecting deforestation in real-time monitoring (on course or on going) with SAR as a complement for the DETER system.

- Test the capability of ScanSAR data to discriminate recent deforestated areas.

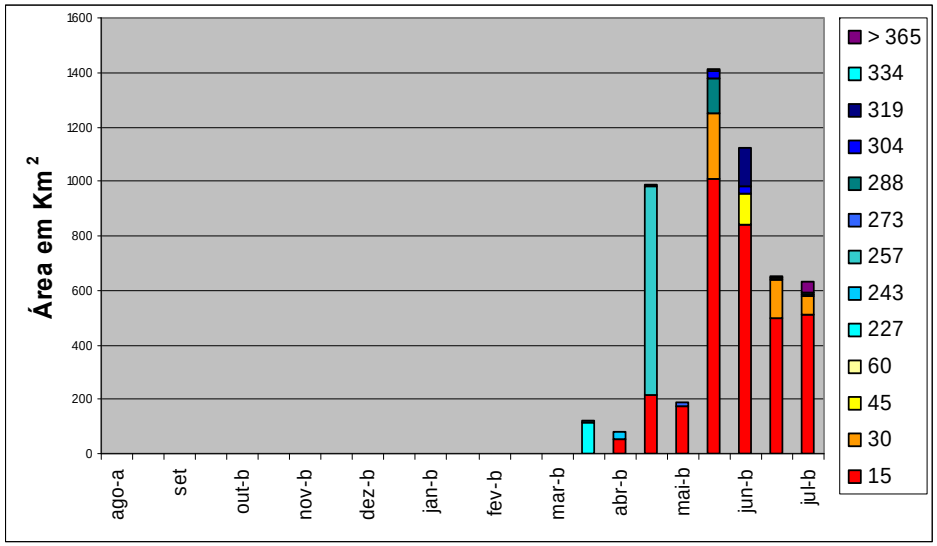
Problems

- Orbital optical sensors detection of deforestation in the tropical rainforest is usually delayed due to presence of clouds.
- The age of the observation detection (Δt = starts when original forest was last observed and ends when deforestation was first observed)
- Recent deforestion are priority for the law enforcement agent (indicate ongoing deforestation processes).

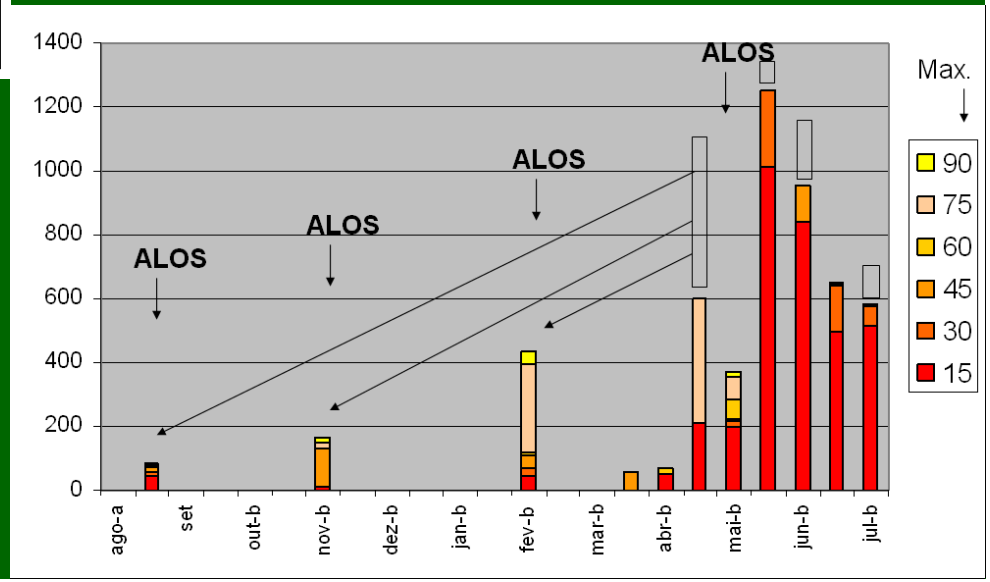
Problems

- DETER's deforestation polygons age from 15 days up to more than a year long.
- In the beginning of the dry season most polygons are old (more than 90 days), due to a long period without clear images.
- ALOS-ScanSAR can be used to reduce the age of the polygons.
- Test the operational capability of ScanSAR images as complementary resource to the optical sensors.

Problems



Reduce the observation detection age



Methods

- ScanSAR strip mode image was geo-rectified and subset (2sd order).
- DN values were converted to the normalized radar cross section (so), in dB, with a calibration factor of -83 dB.
- Areas previously detected by PRODES were masked to eliminate very old deforestation areas (>year).
- Sigma value extraction for all sets of DETER deforestation detections along the year 2007 and also for the rain forest.

Intermediary Results

(DETER by date)

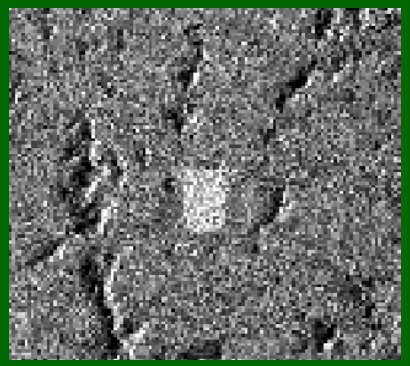
Date	COUNT	MIN	MAX	RANGE	MEAN	STD
14/5/2007	7069	-33,995	1,712	35,707	-7,794	2,449
13/6/2007	2418	-18,269	-0,590	17,679	-8,058	2,648
17/6/2007	411	-21,445	0,862	22,307	-10,016	2,689
24/6/2007	6760	-22,718	8,384	31,102	-7,408	2,687
4/7/2007	279	-15,505	1,118	16,623	-7,832	2,561
24/7/2007	2568	-17,213	-0,291	16,922	-7,388	2,413
2/8/2007	2913	-17,856	1,071	18,927	-7,490	2,343
12/8/2007	140	-15,788	-3,583	12,205	-8,397	2,304
12/9/2007	8396	-21,748	8,605	30,353	-7,735	2,500
28/9/2007	11498	-20,836	5,883	26,719	-7,745	2,555

Intermediary Results

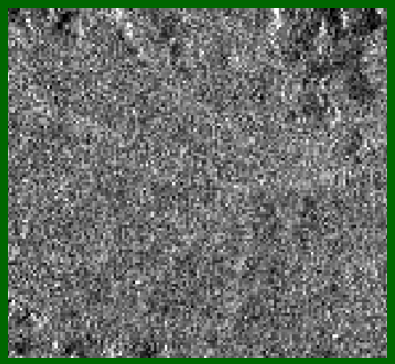
By vegetation type

Class	Area	Min	Max	Range	Mean	Std
DETER Recent Confirm (1)	2279	-12,330	4,204	16,534	-4,992	1,893
Forest.PRODES (2)	132020769	-15,520	0,178	15,699	-7,254	1,818
Deforest.PRODES (3)	162780000	-20,374	0,899	21,273	-11,020	2,505

(1)



(2)

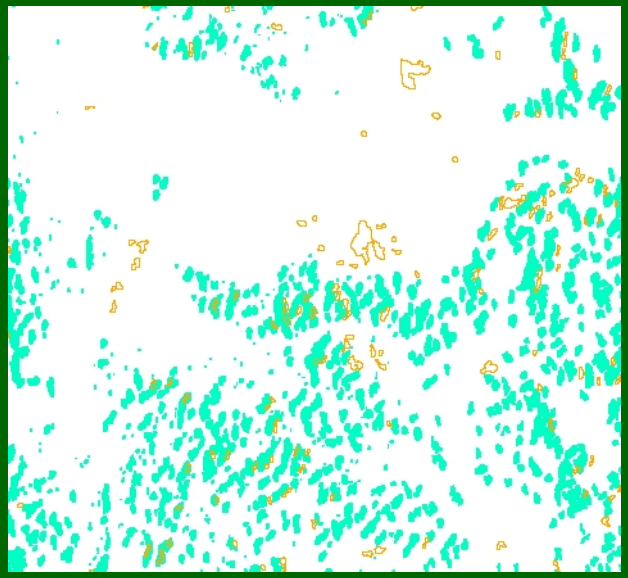


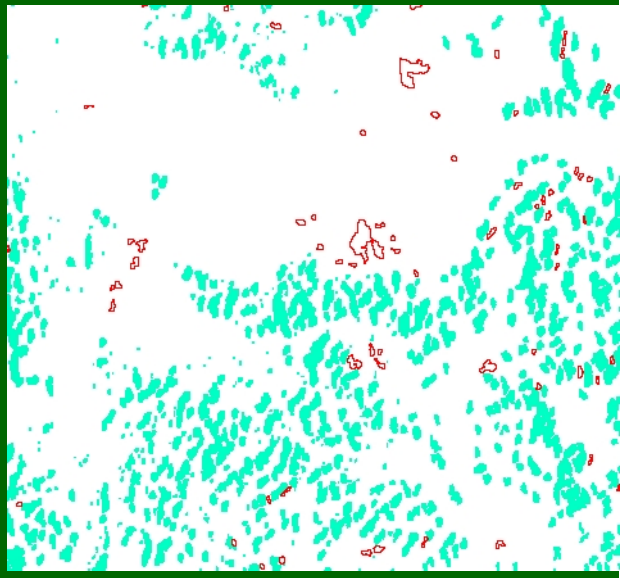
(3)

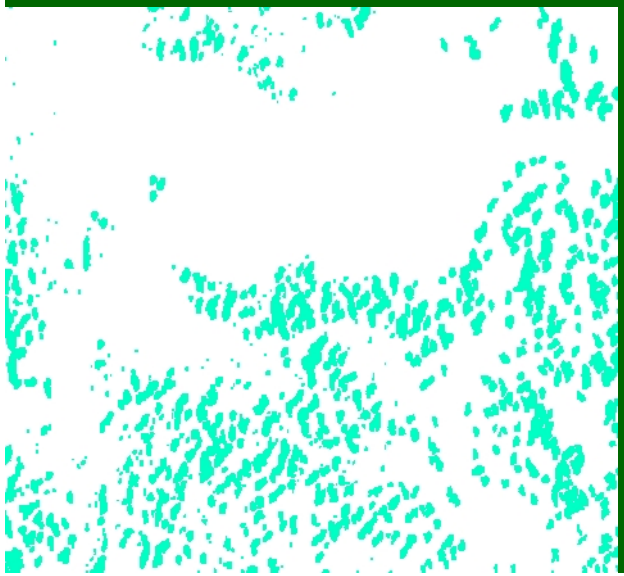
Methods

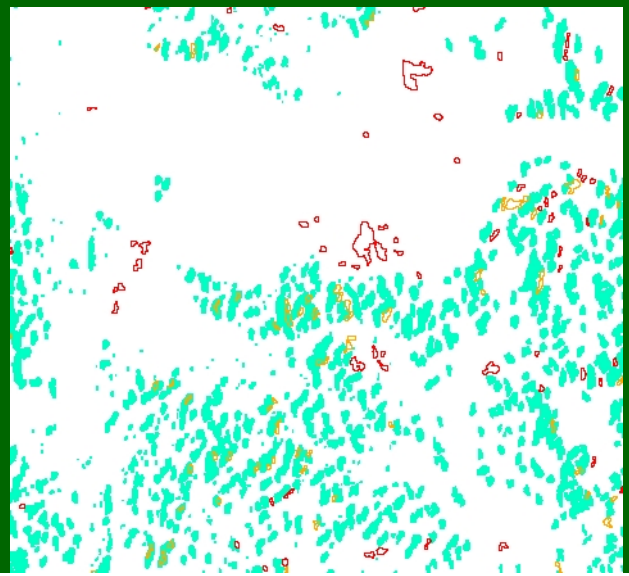
- A Lee-sigma speckle reduction filter was applied to the ScanSAR image.
- This image was than classified using the mean sigma value of the recent deforested areas as threshold to identify recent deforested areas not detected by DETER.
- An illuminated topographic image based on the position of the SAR sensor was generated from the SRTM data to exclude areas were the relief caused a high sigma value.

Methods





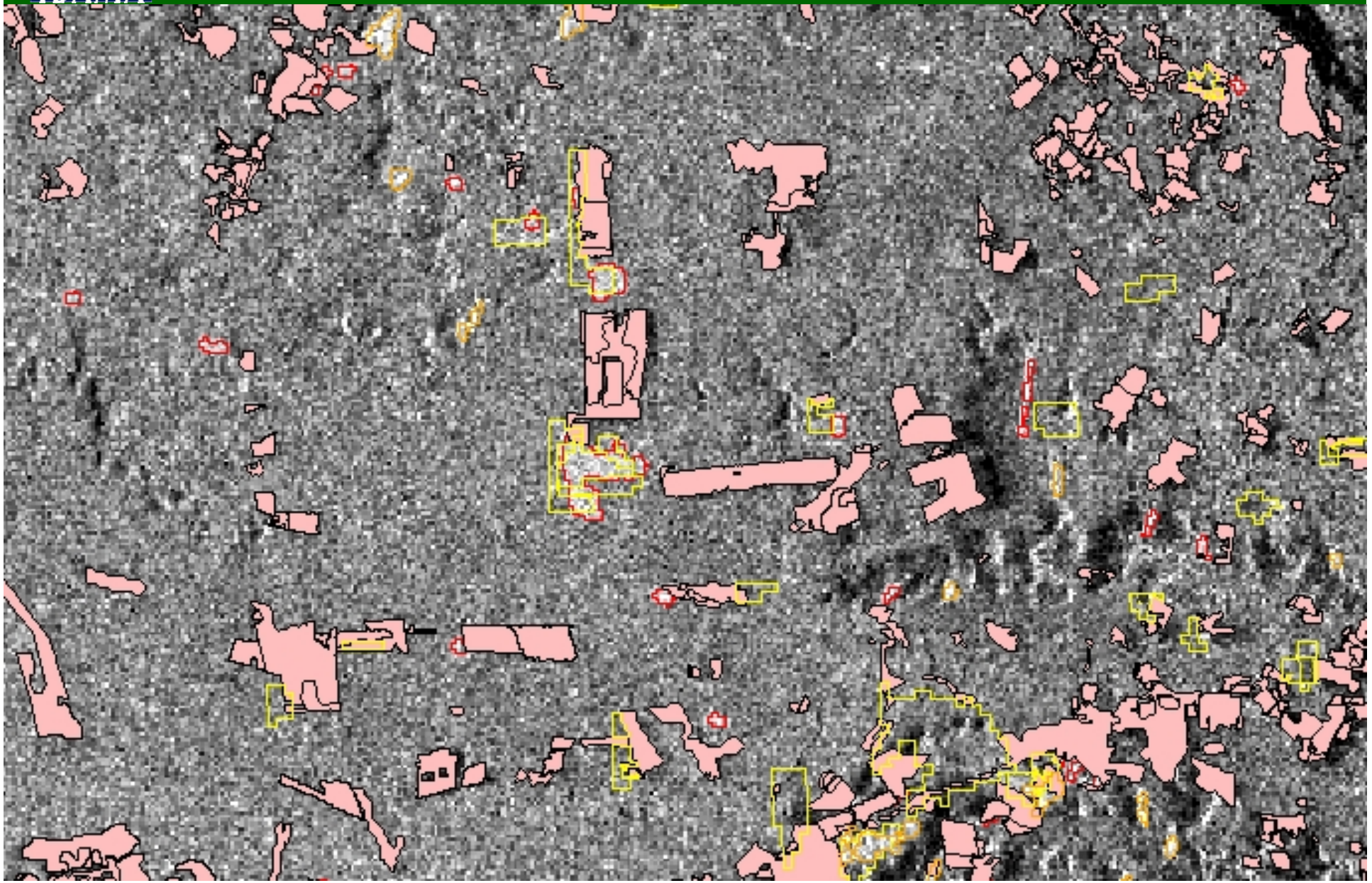




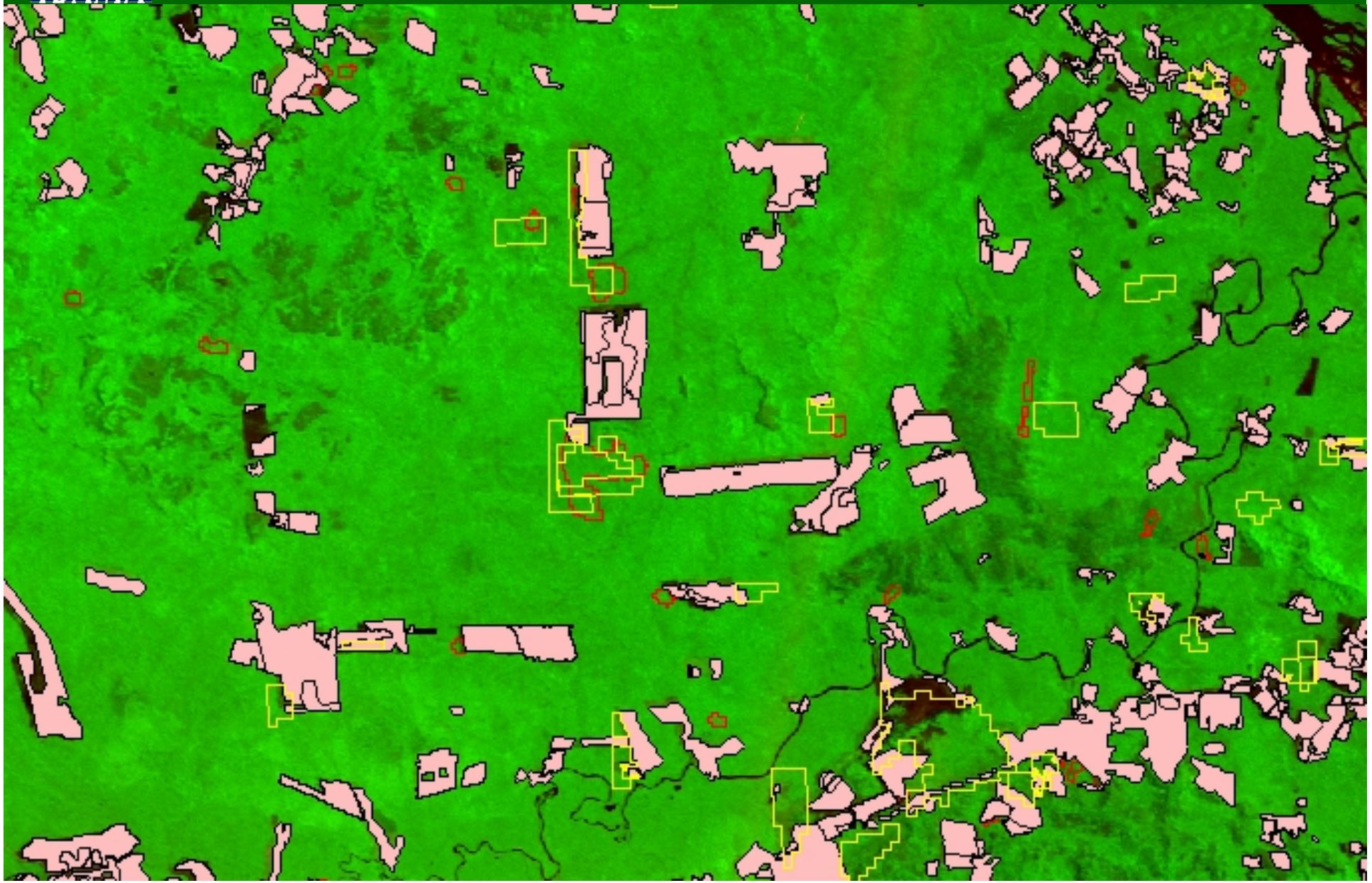
Results

- The results showed that areas corresponding to old deforestation are related to low dB values, while recently deforested areas are related to high dB values. The mean s value for recent deforested area was -5.315dB and the mean so value for preserved native forest was - 7.569dB.

Results



Results



Results

Results

Preliminary Results (CEMAM)

Conclusions

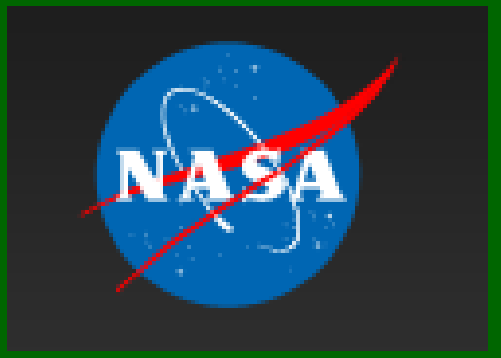
- The dB threshold to classify new deforested areas, has a good potential to be the base of a semiautomatic detection system for operational purposes.
- This system has potential to produce data that could complement the information already available from optical sensor satellites (CBERS-CCD, Landsat-TM and Terra-MODIS images).
- The resulted monitoring system would decrease the average age of the deforested areas.

Preliminary Results (CEMAM)

Considerations

- Some areas may be not detected because of the backscattering ambiguity between the medium age deforestation areas and the native preserved forest.
- The ambiguity of high values of the recent deforested areas and double reflection caused where the relief is faced to the sensor can hide some deforestation.

Acknowledgements



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humberto.mesquita-junior@ibama.gov.br

Arigatô, Obrigado, Thank You, ευχαριστού, Merci