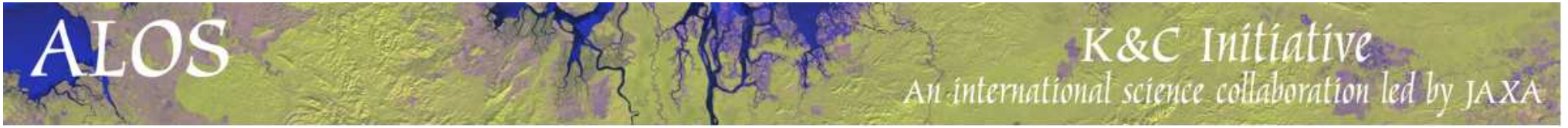
ALOS-PALSAR data assimilation into INPE's Brazilian Amazon Environmental Monitoring Program (PRODES, DETER and DEGRAD)



Silvana Amaral
Dalton de Morisson Valeriano

INPE - Brazilian National Institute for Space Research

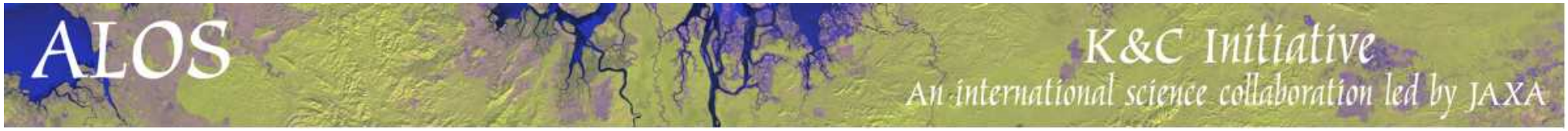
ALOS Kyoto & Carbon Initiative Science Team Meeting #12
Tokyo, June 2009

MINISTÉRIO DA CIÊNCIA E TECNOLOGIA
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

Assimilation of PALSAR data into INPEôs Amazon Monitoring Program

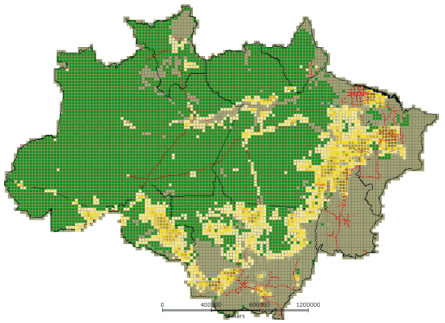
Project Uptade

- Deter x Palsar
- Palsar x Deter Multi-temporal analysis
- Palsar Mosaic for Amazonia
- Next steps

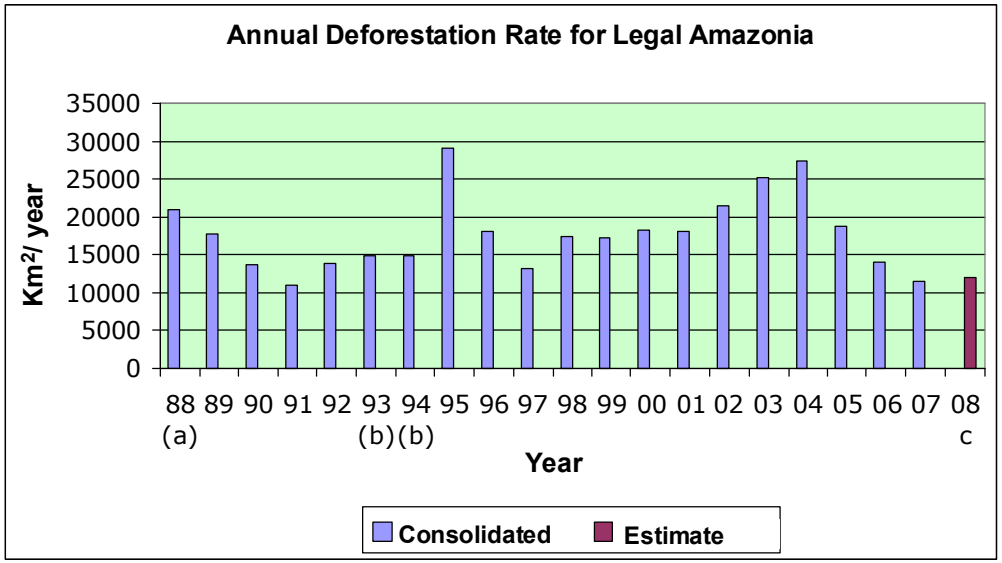


INPEÕs Brazilian Amazon Environmental Monitoring Program

PRODES Assessment of deforestation rate in Brazilian Amazon Region
DEGRAD Assessment of Forest Degradation
DETEX Assessment of Selective Logging Areas



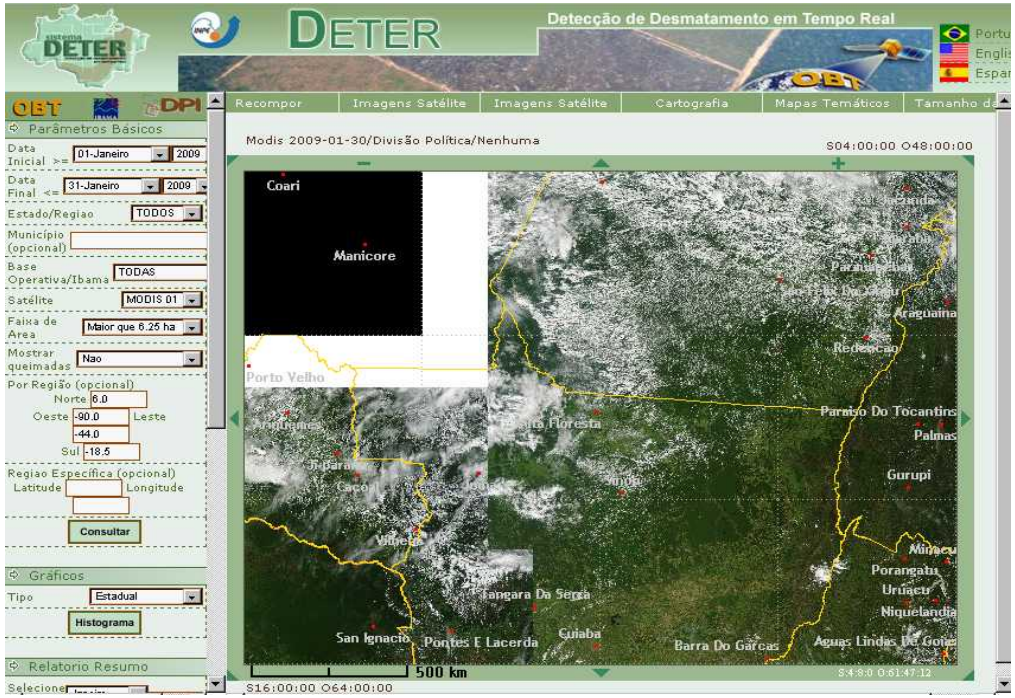
Areas >> 6.25 ha - TM/Landsat imagery (30m)



INPEôs Brazilian Amazon Environmental Monitoring Program

DETER Near-Real Time Detection of Deforestation and Degradation
(Rapid response system for environmental law enforcement

Progressive forest degradation >> 25 ha - MODIS imagery (250m)

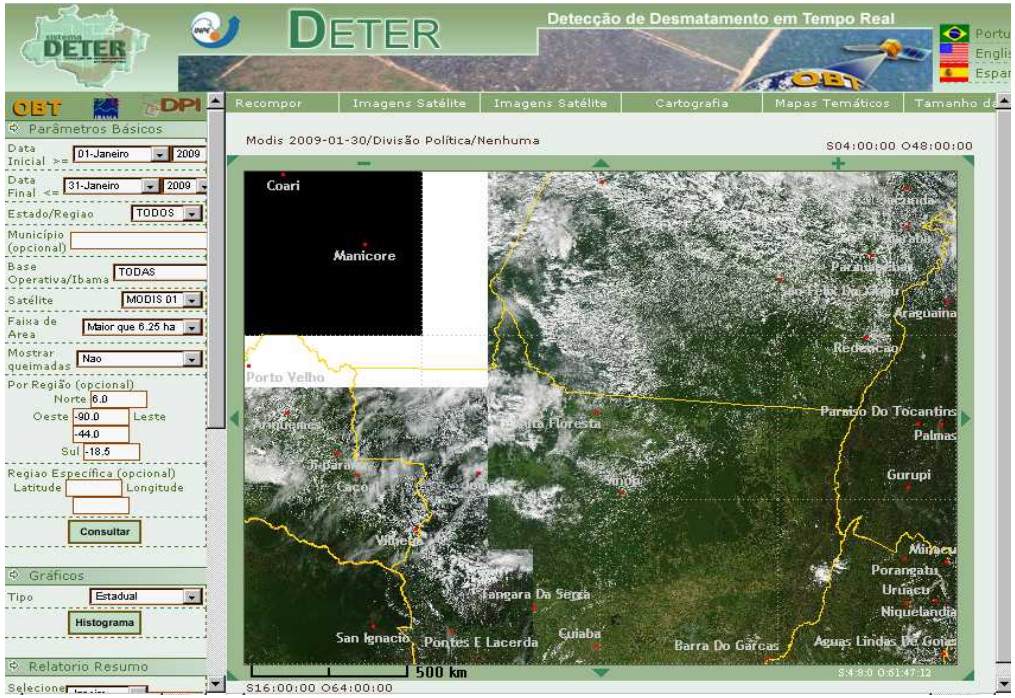


INPEôs Brazilian Amazon Environmental Monitoring Program

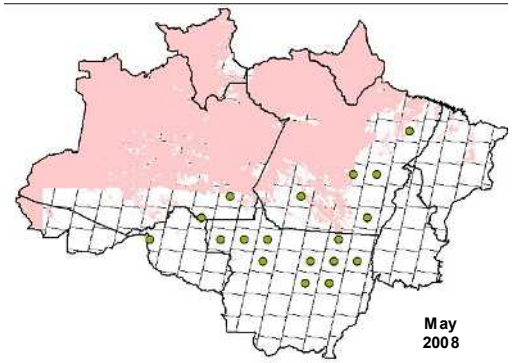
DETER Impact

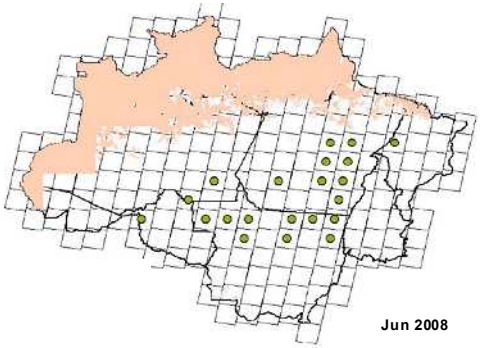
- Information for strategic decisions by deforestation control agencies ï Federal, State and Municipal levels
- Better efficiency in law enforcement
- Immediate public awareness by monthly information dissemination (www.obt.inpe.br/deter)

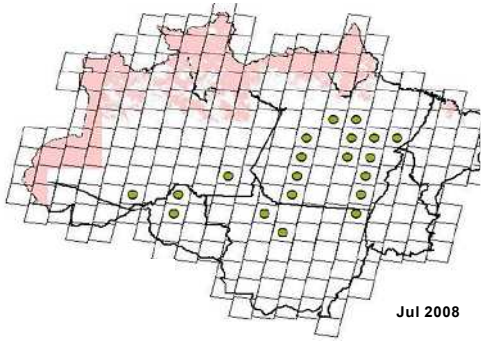
DETER Limitation

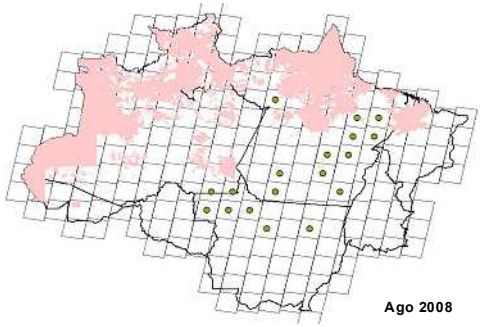


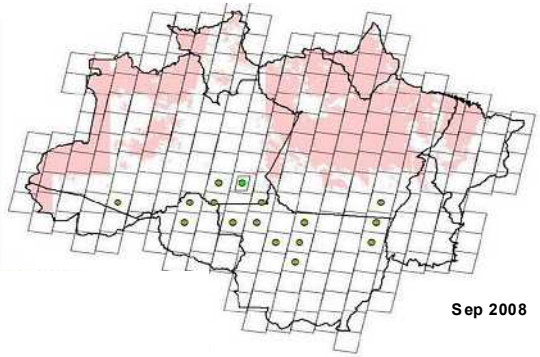
MODIS imagery - 250m resolution

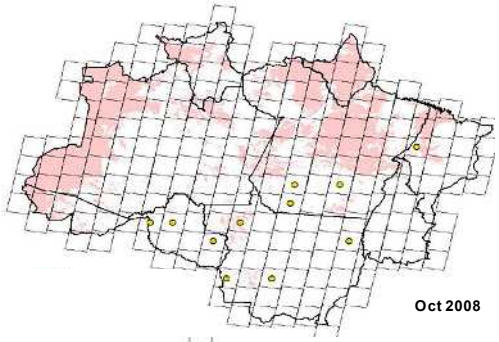


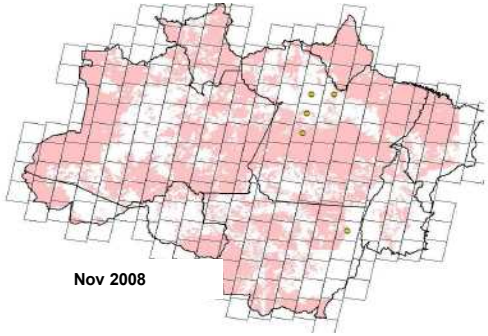


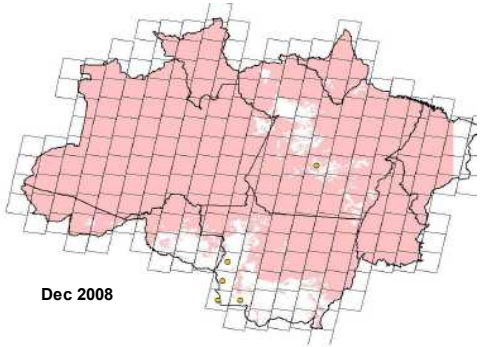


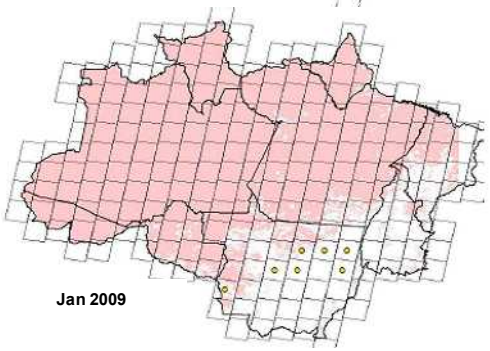


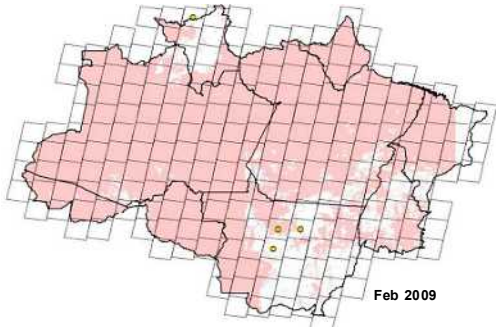


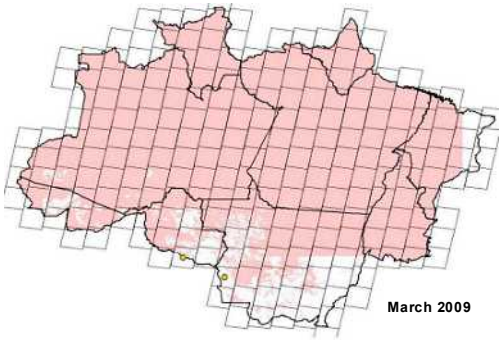


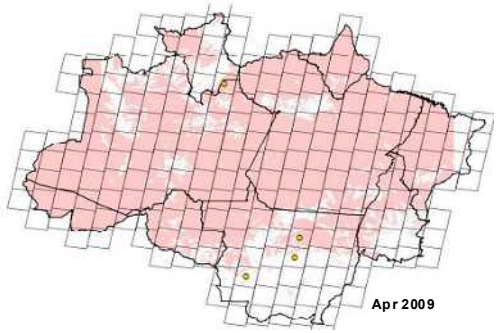












Amazonia Deter Cloud Cover

(2008-2009)

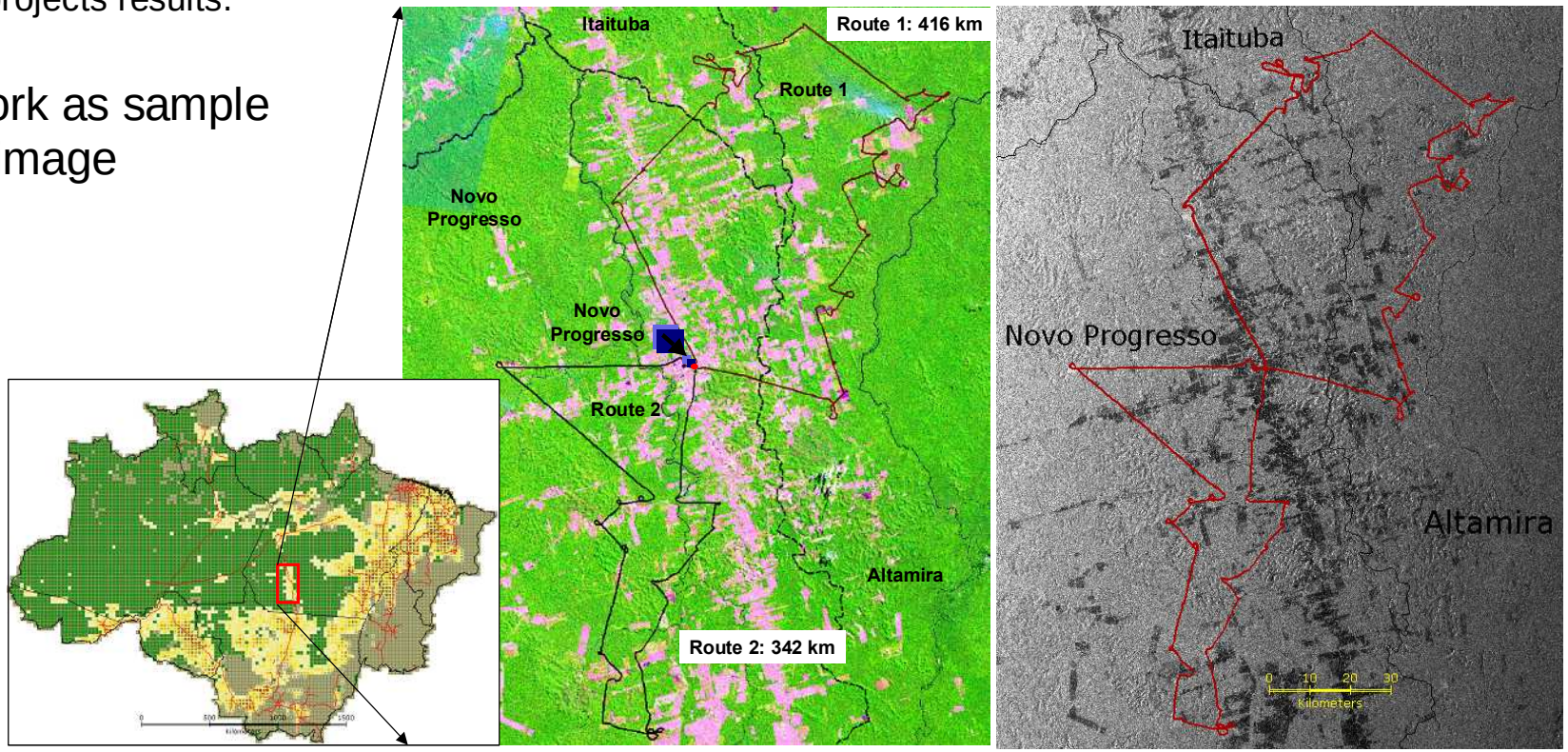
ALOS/PALSAR to detect deforestation in the Brazilian Amazônia

Synergistic application of ALOS/PALSAR and DETER

ALOS/PALSAR to detect deforestation in the Brazilian Amazônia

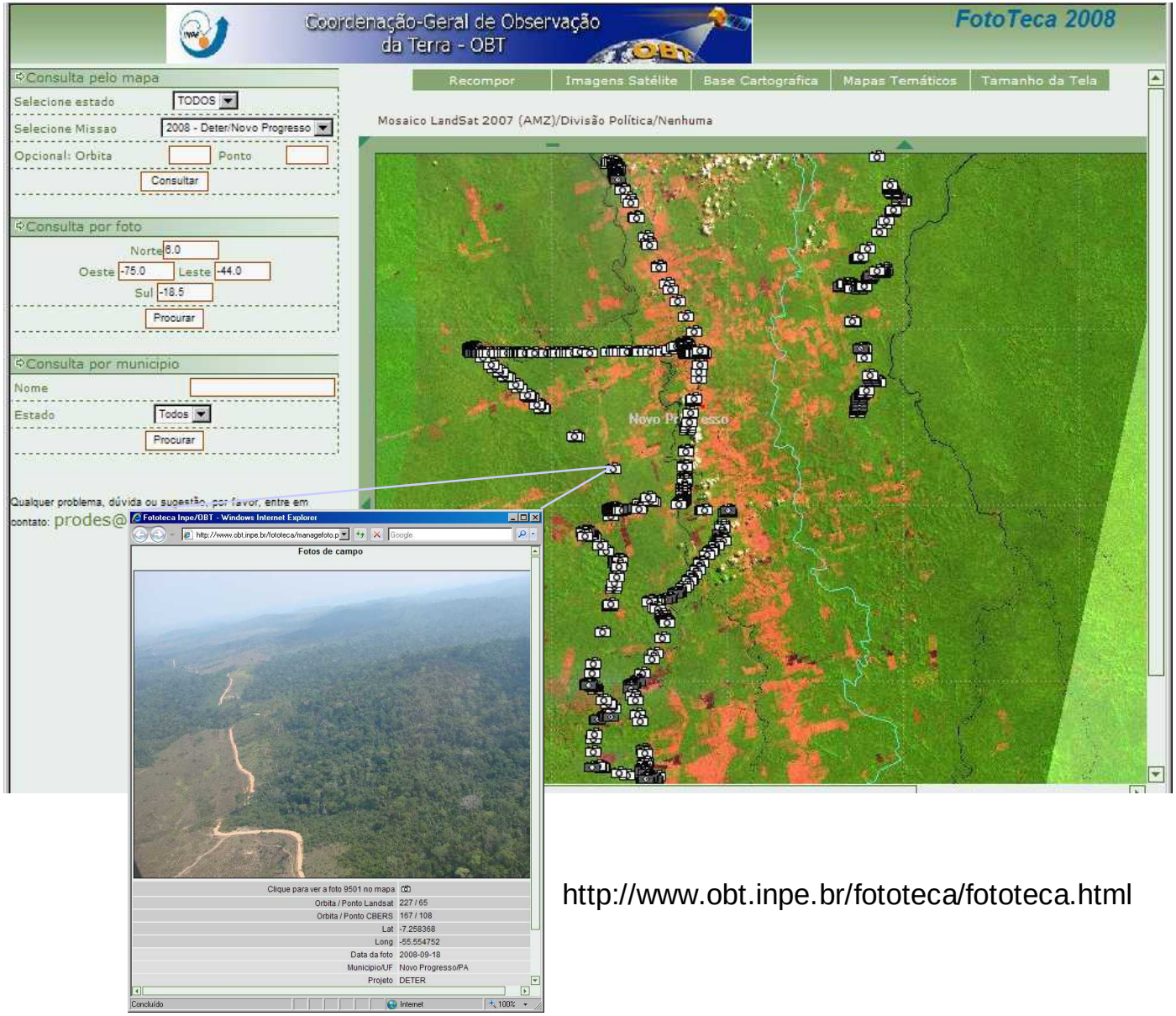
DETER_R Radar based Near-Real Time Detection of Deforestation and Degradation

- K&C images to detect deforestation in Brazilian Amazônia to qualify deforestation results from DETER projects results.
- Fieldwork as sample
- Single image



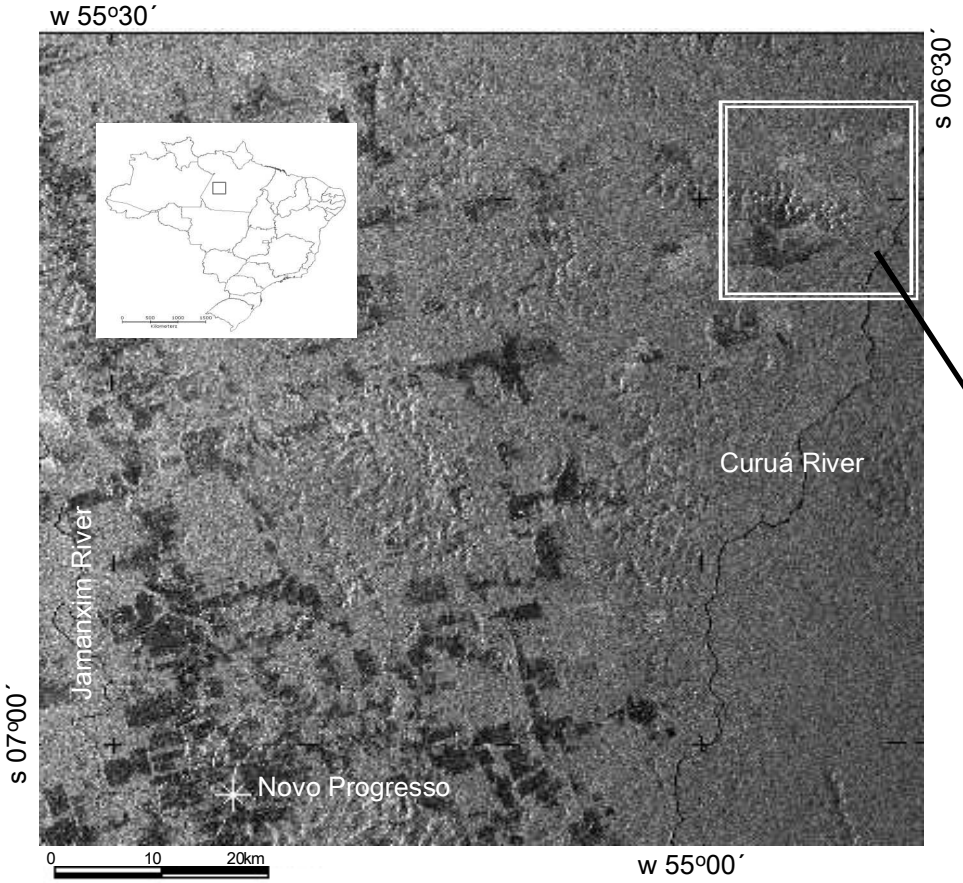
September 2008
INPE/IBAMA

Itaituba
Novo Progresso
Altamira

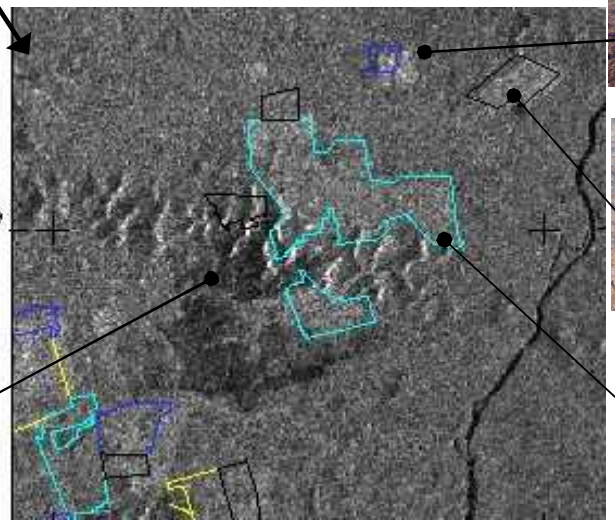


http://www.obt.inpe.br/fototeca/fototeca.html

Synergistic application of ALOS/PALSAR and DETER



ALOS PALSAR K&C image, WB1 – August,2008 and Deforestation Polygons Deter (May-Aug/2008)



ALOS/PALSAR ScanSAR (HH-WB1) K&C Image from 08/08/30, (Novo Progresso, State of Pará, Brazilian Amazon Region)

Deforestation polygons mapped by DETER in May (yellow), June (cyan), July (blue), and August (black), 2008 and verified by field work in September, 2008.

ALOS/PALSAR to detect deforestation in the Brazilian Amazônia

ALOS PALSAR K&C images, WB1 – August,2008 and Deforestation Polygons Deter (May-Aug/2008)

ALOS-PALSAR image assessment for DETER clear-cut polygons verified during the fieldwork

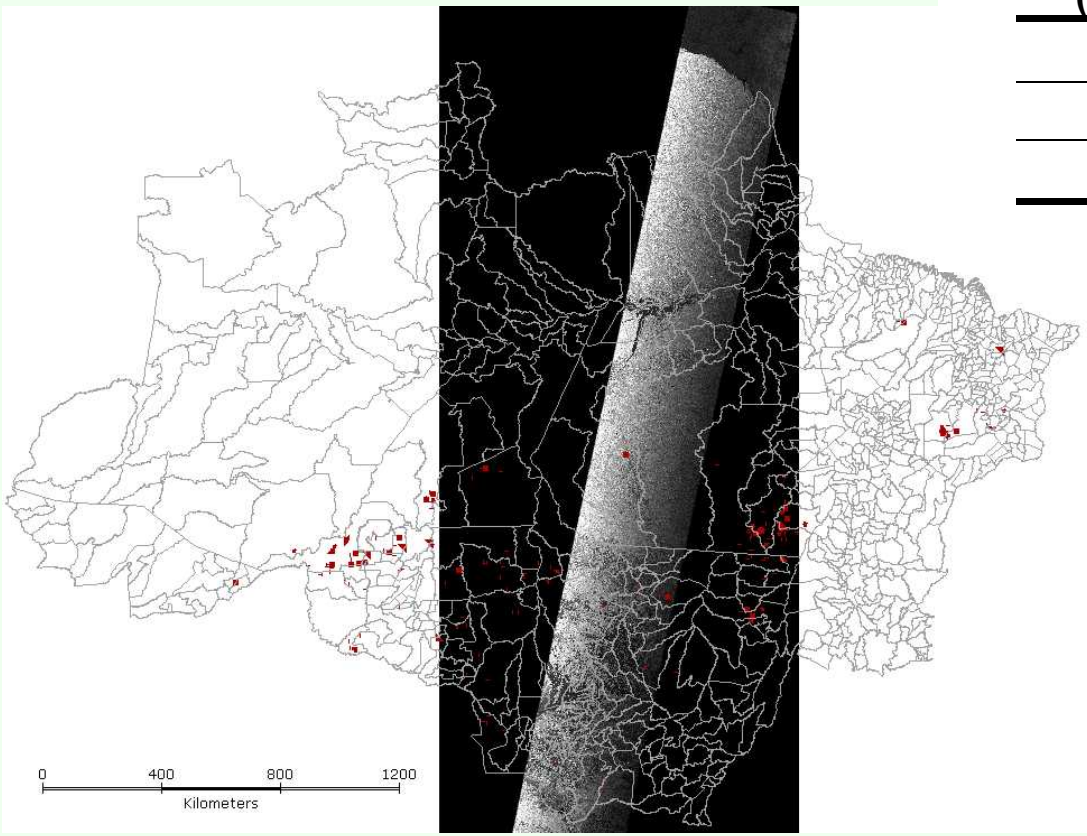
	Deter Clear-cut	ALOS detection	%
May	12	6	50.00
June	17	7	41.18
July	14	10	71.43
August	24	14	58.33
Total	67	37	55.22

Average Area of DETER clear-cut polygons verified during the fieldwork

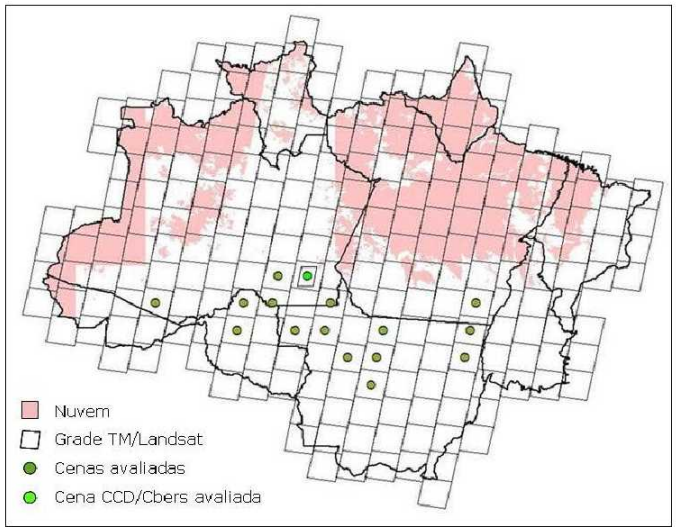
	DETER polygons average area (km^2)	
Month	Detected	Not detected
May	7.00	3.86
June	5.51	3.21
July	2.46	1.68
August	2.35	1.83
Average	4.33	2.65

ALOS/PALSAR to detect deforestation in the Brazilian Amazônia

Deter - September/2008 and ALOS PALSAR K&C WB1 – October, 2008



ALOS (10-15-2008)	DETER Polygons (Sept-2008)	%	Area (km^2)
Detected	34	44.74	0.92
Undetected	42	55.26	0.75
Total	76		



ALOS/PALSAR to detect deforestation in the Brazilian Amazônia

Methodology:

Multi-temporal approach
K&C images
Highest temporal frequency - Cycles 25 to 30

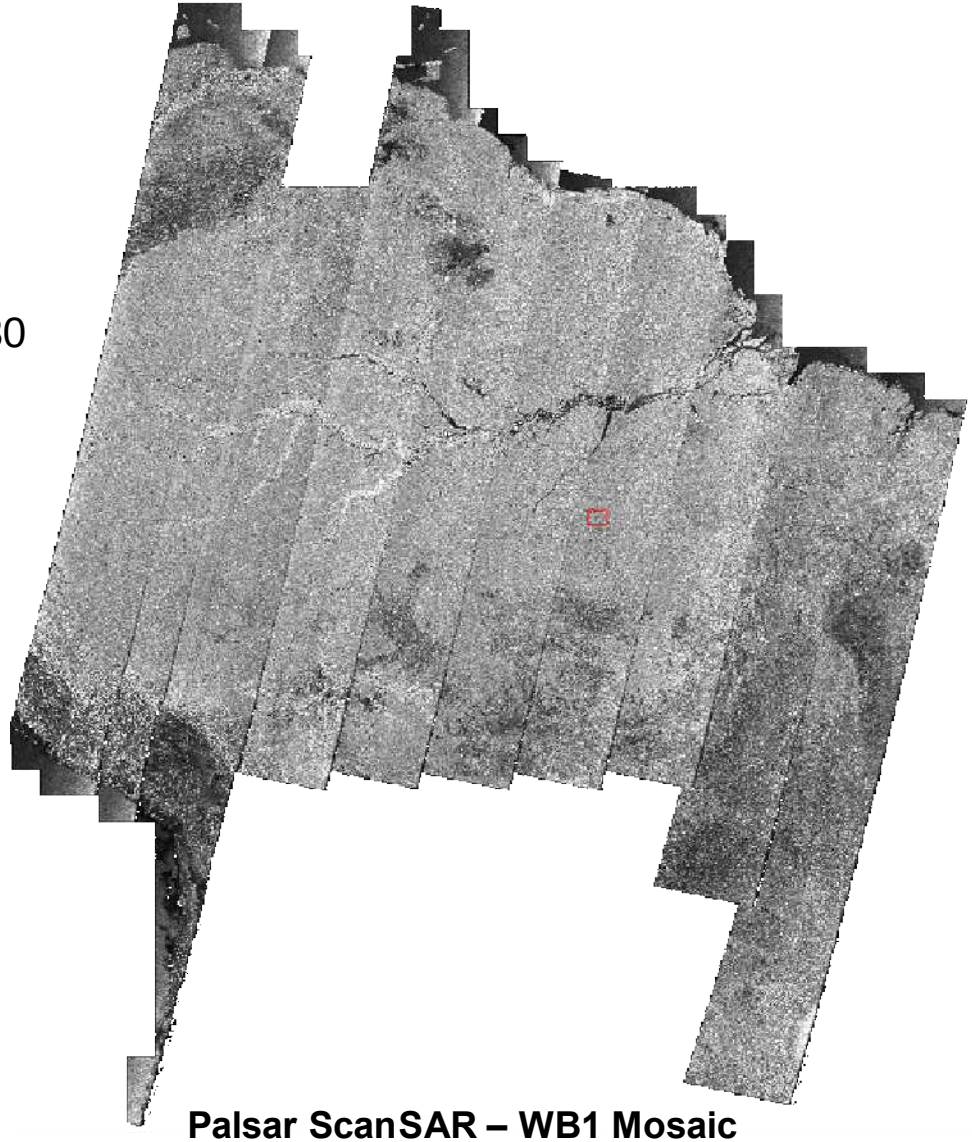
Mosaics for Brazilian Amazon

Seasonal ï wet / dry/ **spring**/ fall seasons
100 m
Change detection / Visual interpretation

Infraestructure

ENVI/ SarScape
SPRING
TerraAmazon (when operational)

Small team



Palsar ScanSAR – WB1 Mosaic

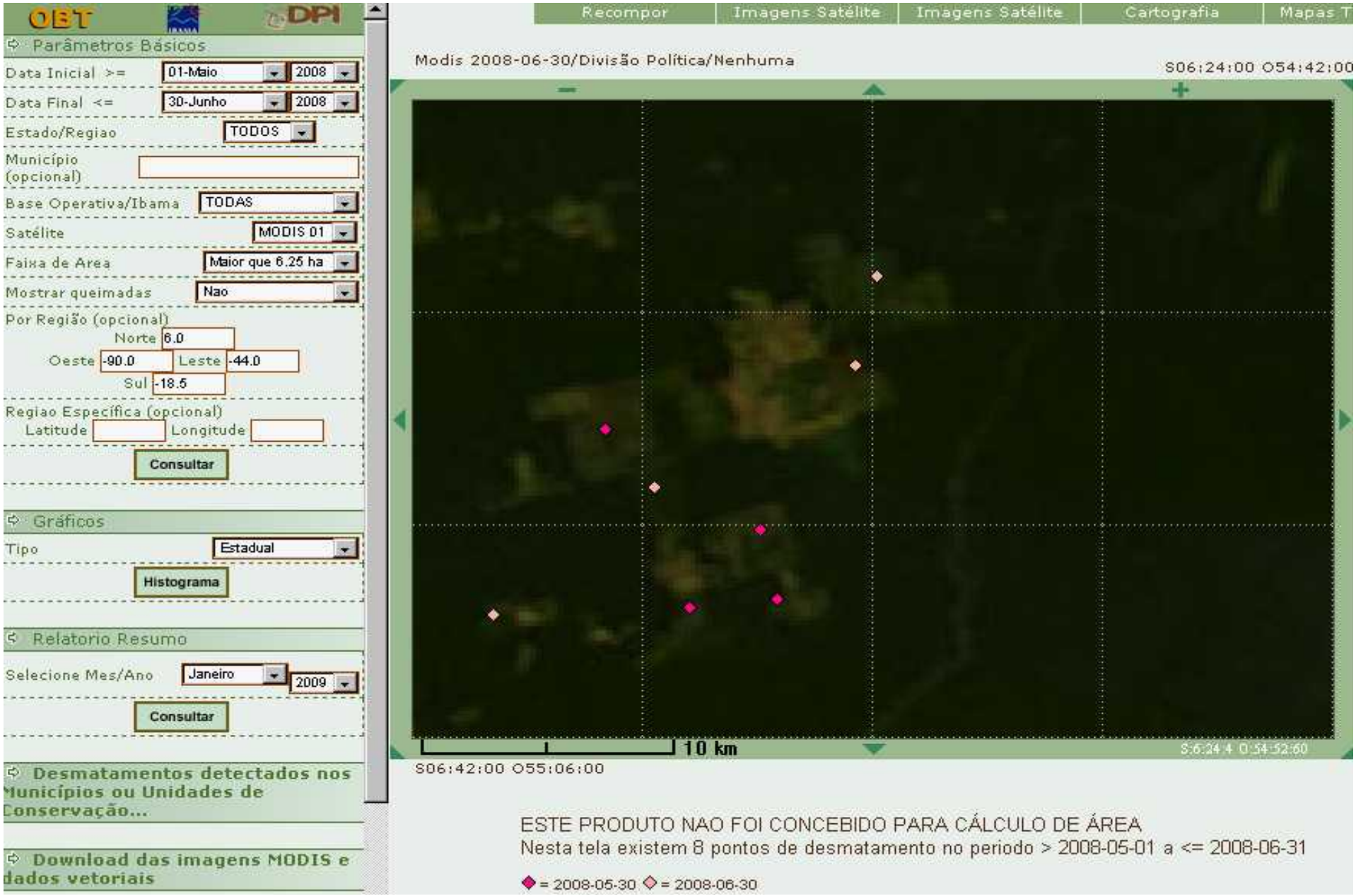
April – May- June 2008 (100m)

ALOS/PALSAR to detect deforestation in the Brazilian Amazonia

Deter May/2008

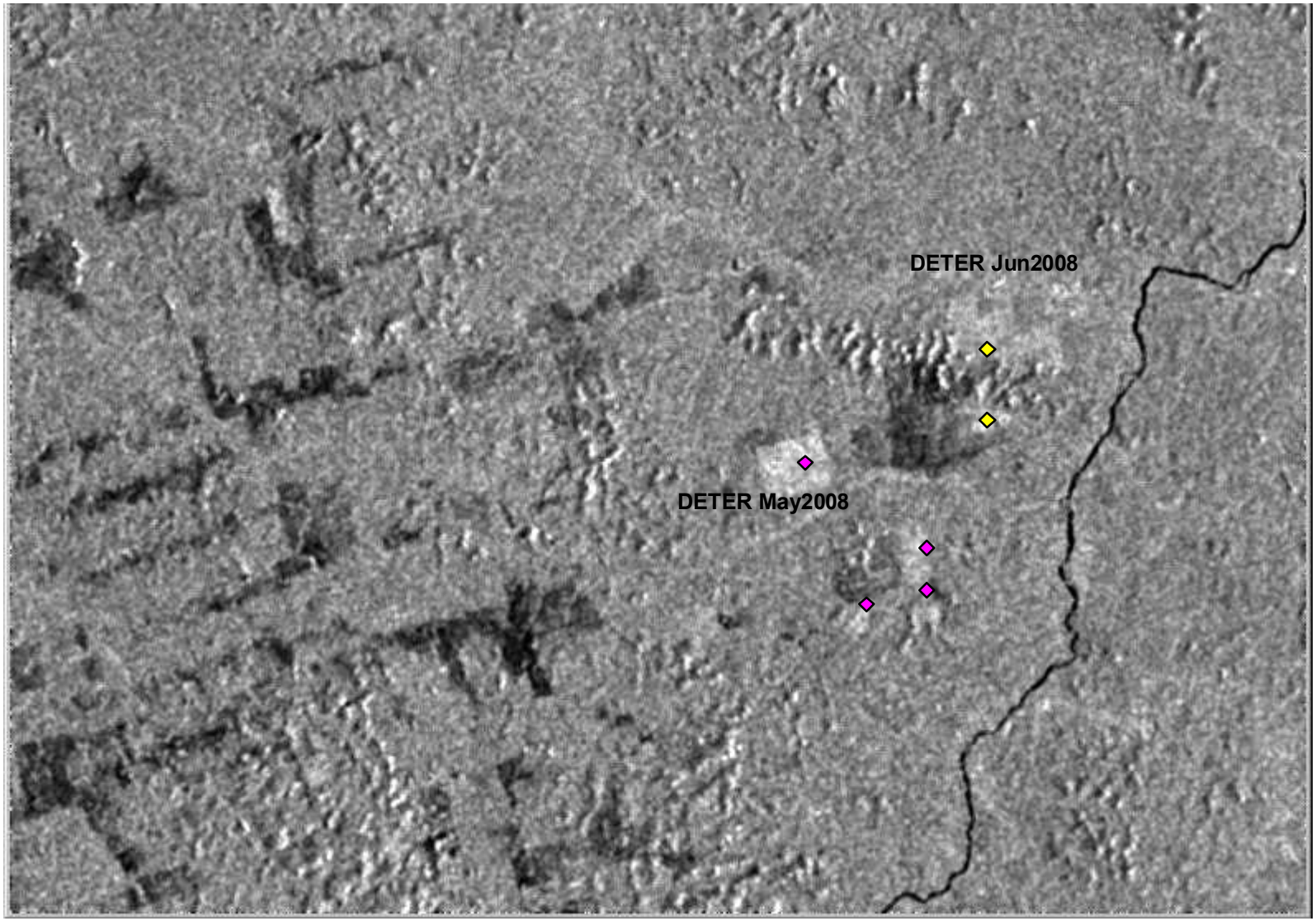
ALOS/PALSAR to detect deforestation in the Brazilian Amazonia

Deter Jun/2008



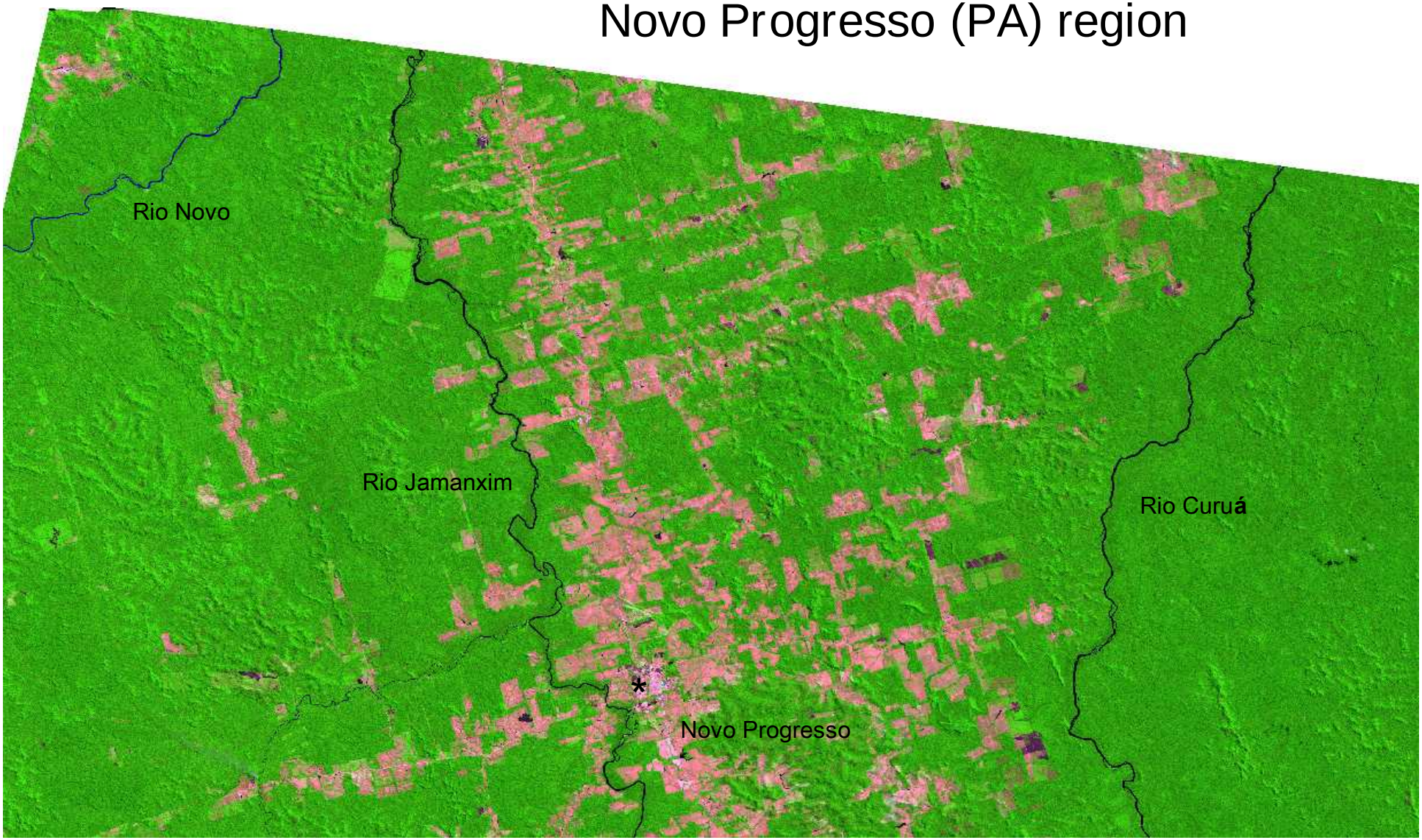
ALOS/PALSAR to detect deforestation in the Brazilian Amazonia

Palsar May /2008

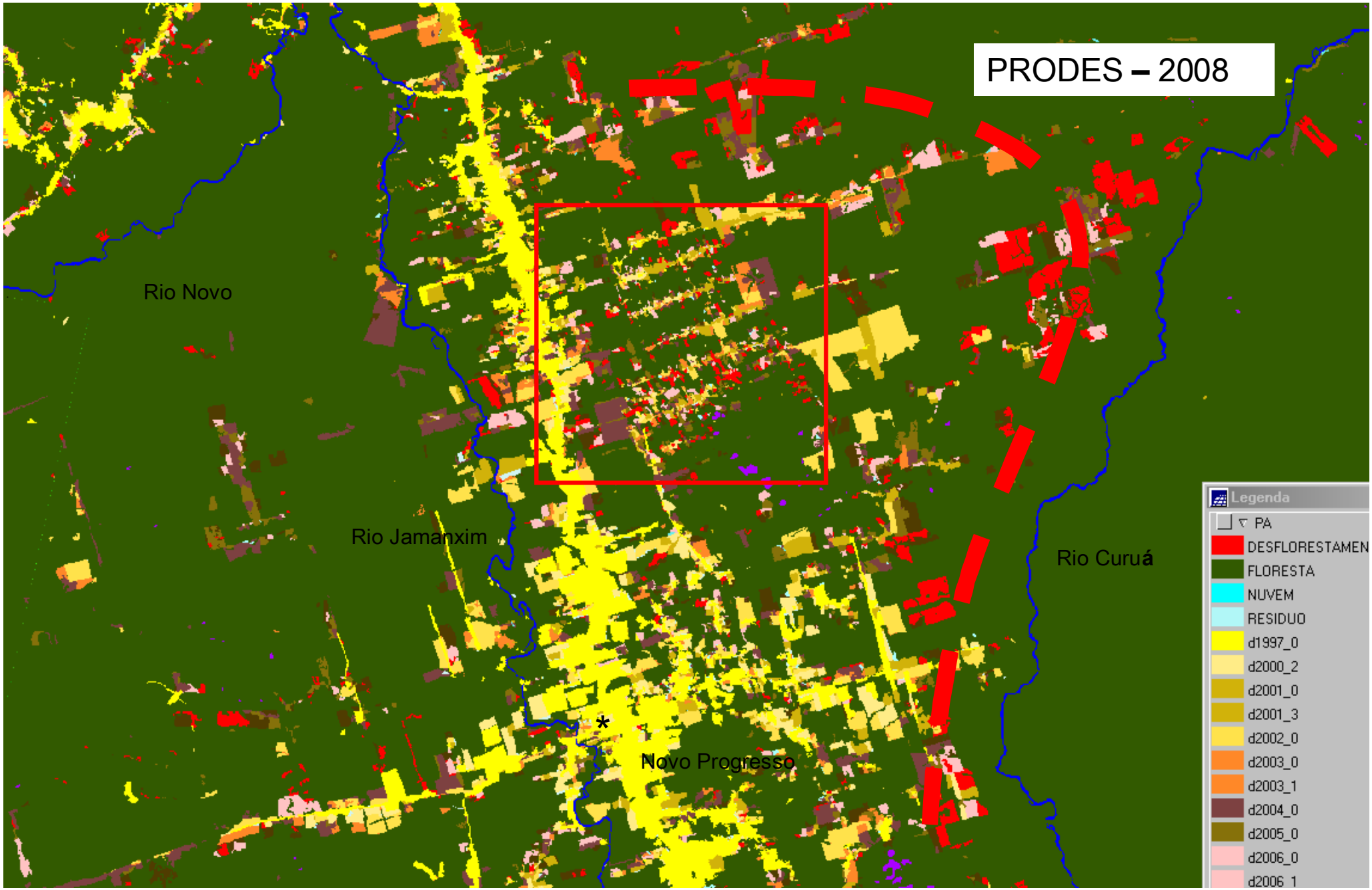


ALOS/PALSAR to detect deforestation in the Brazilian Amazonia

Novo Progresso (PA) region

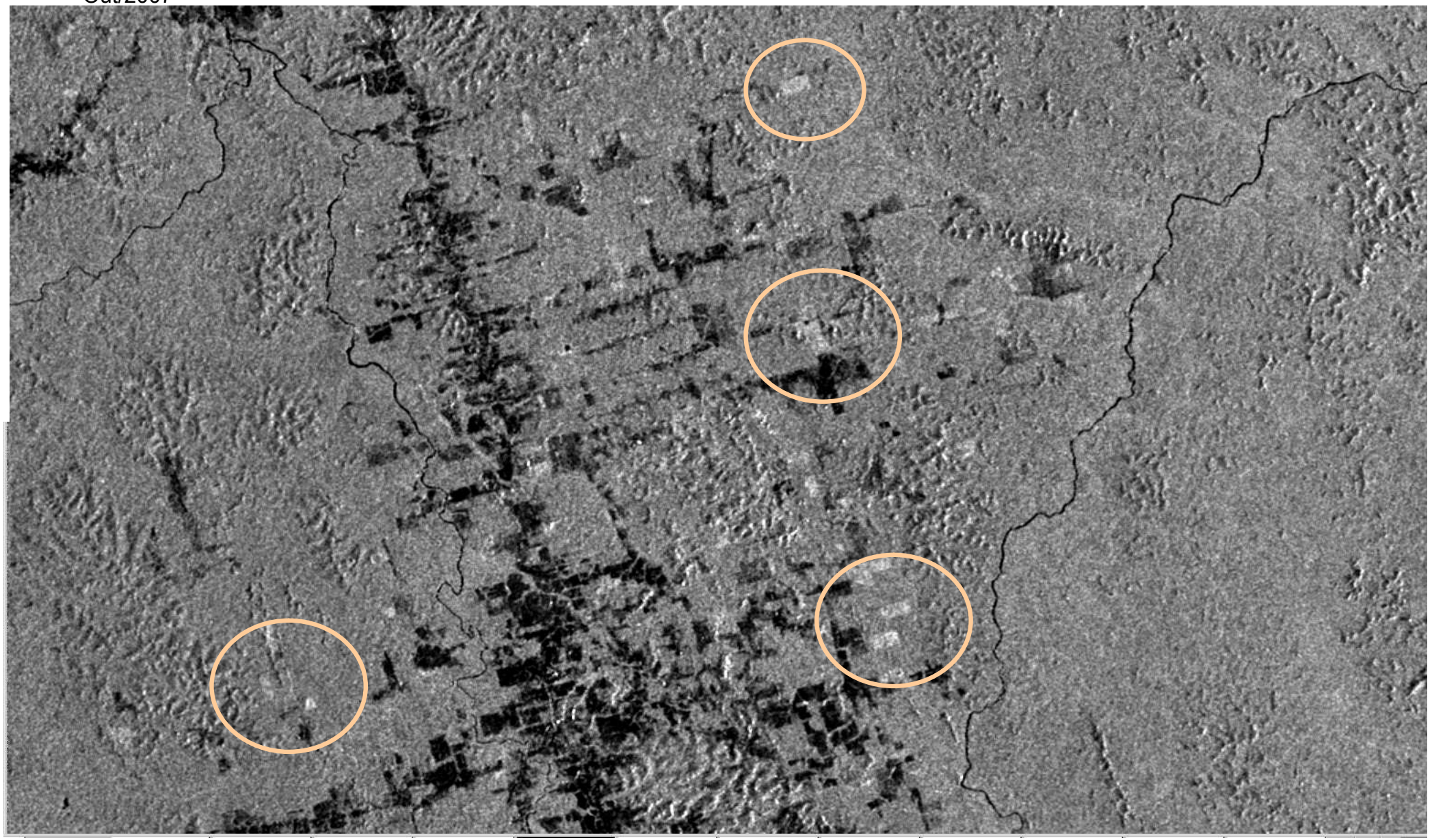


TM/Landsat – 2008/07/25


PRODES – 2008
Rio Novo
Rio Jamanxim
Rio Curuá
Novo Progresso
Legenda
PA
DESFLORESTAMEN
FLORESTA
NUVEM
RESIDUO
d1997_0
d2000_2
d2001_0
d2001_3
d2002_0
d2003_0
d2003_1
d2004_0
d2005_0
d2006_0
d2006_1

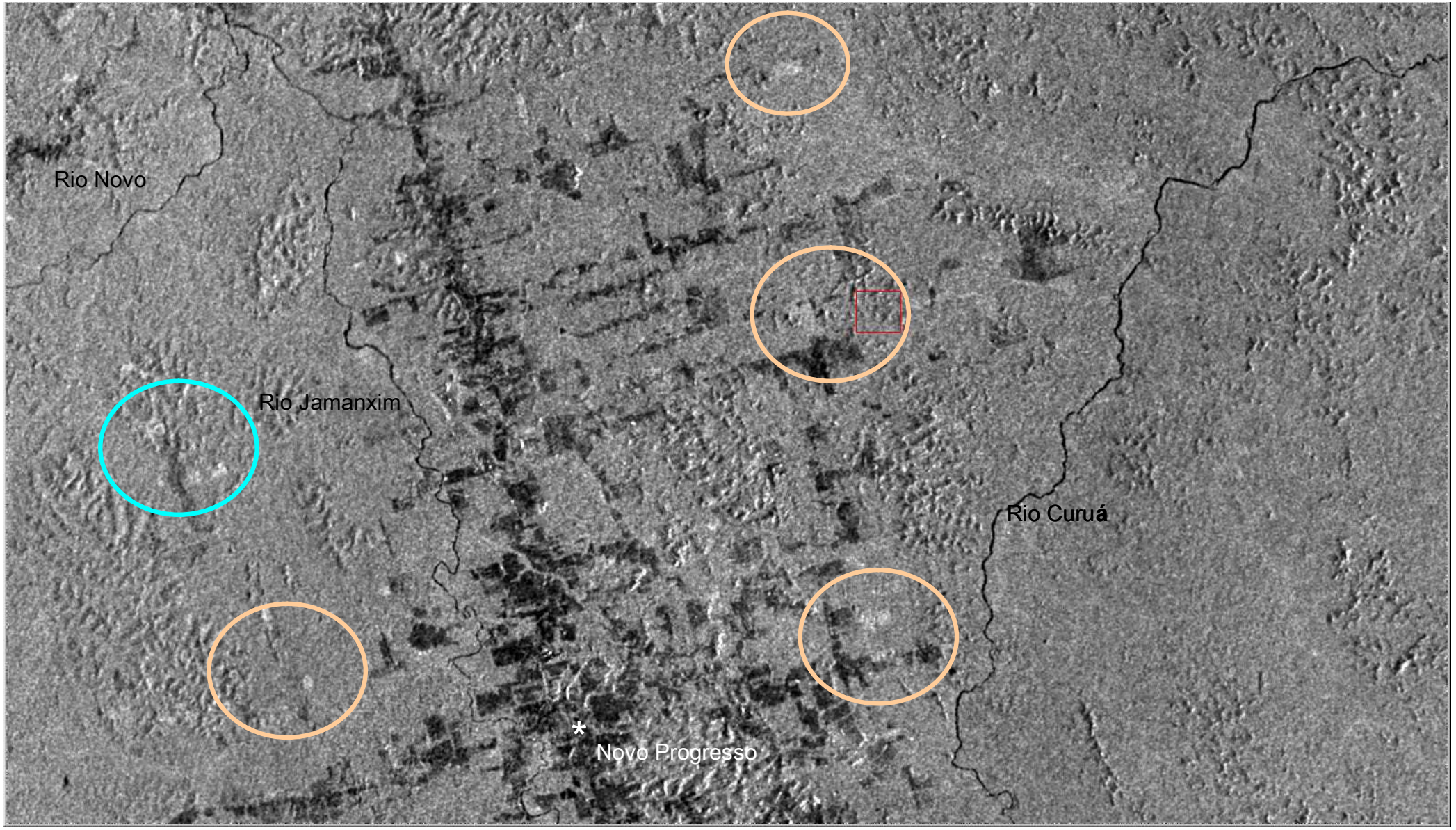
Palsar Multitemporal for Deforestation Assessment

Out/2007



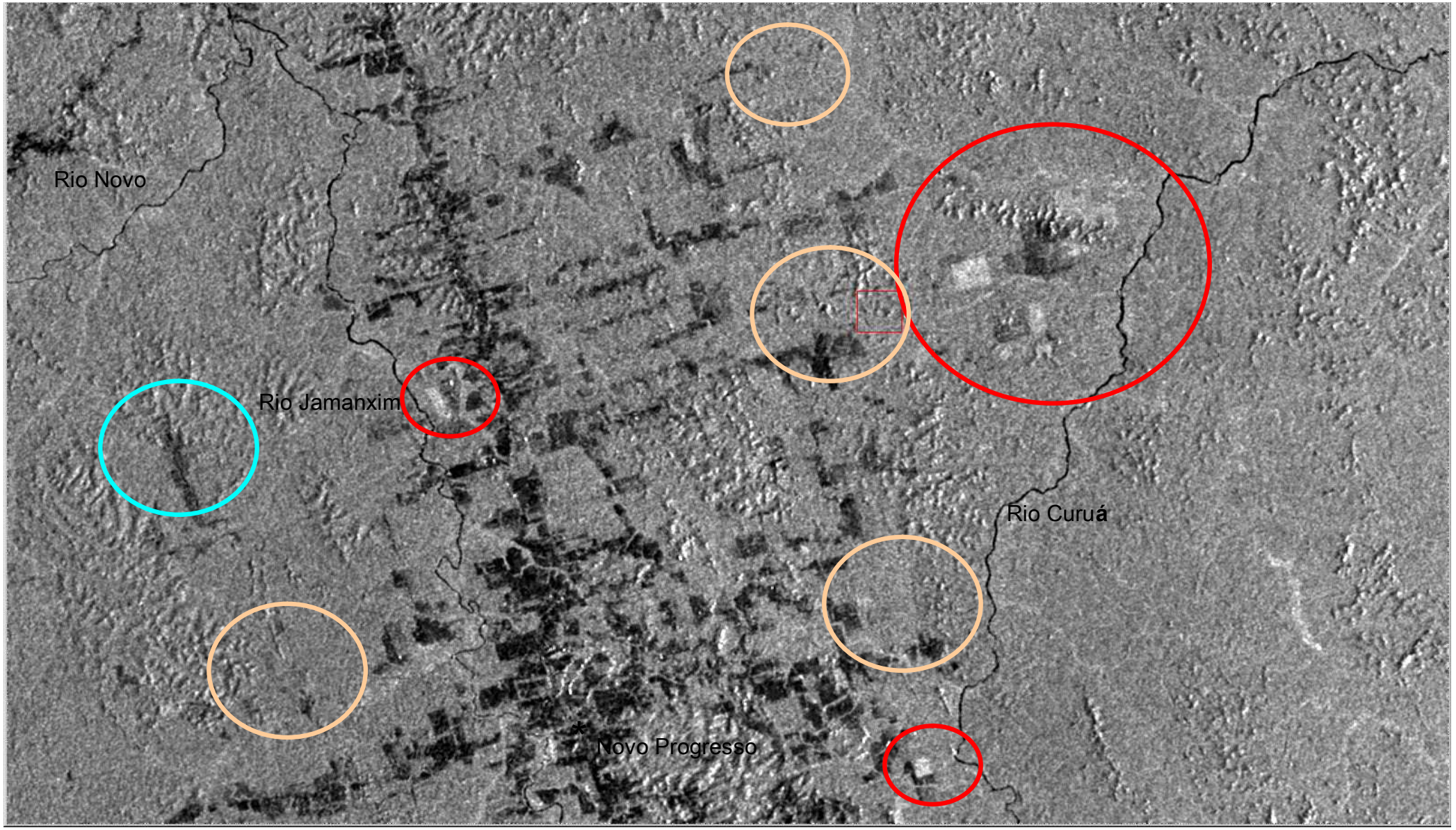
Palsar Multitemporal for Deforestation Assessment

Jan/2008



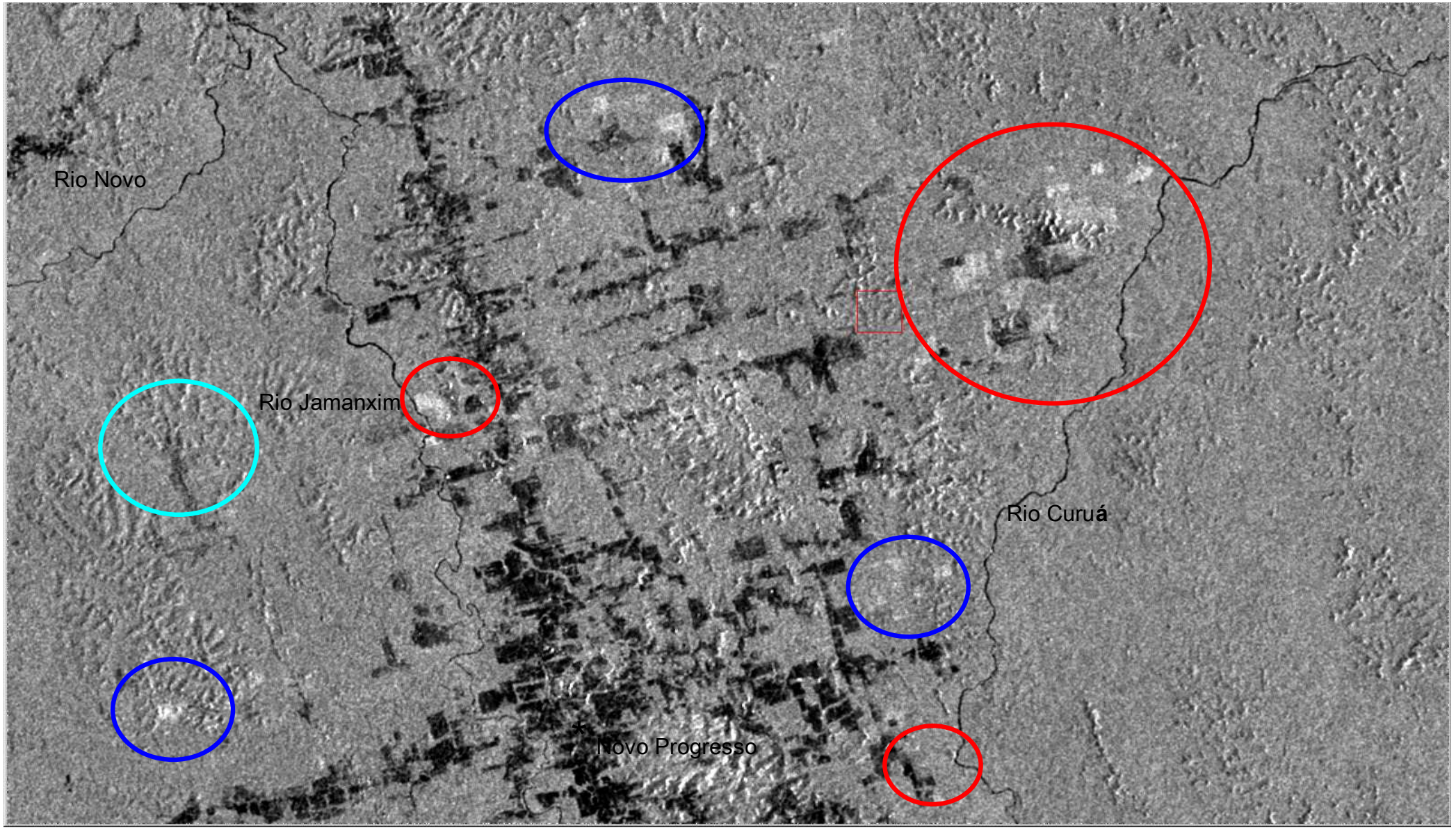
Palsar Multitemporal for Deforestation Assessment

May/2008



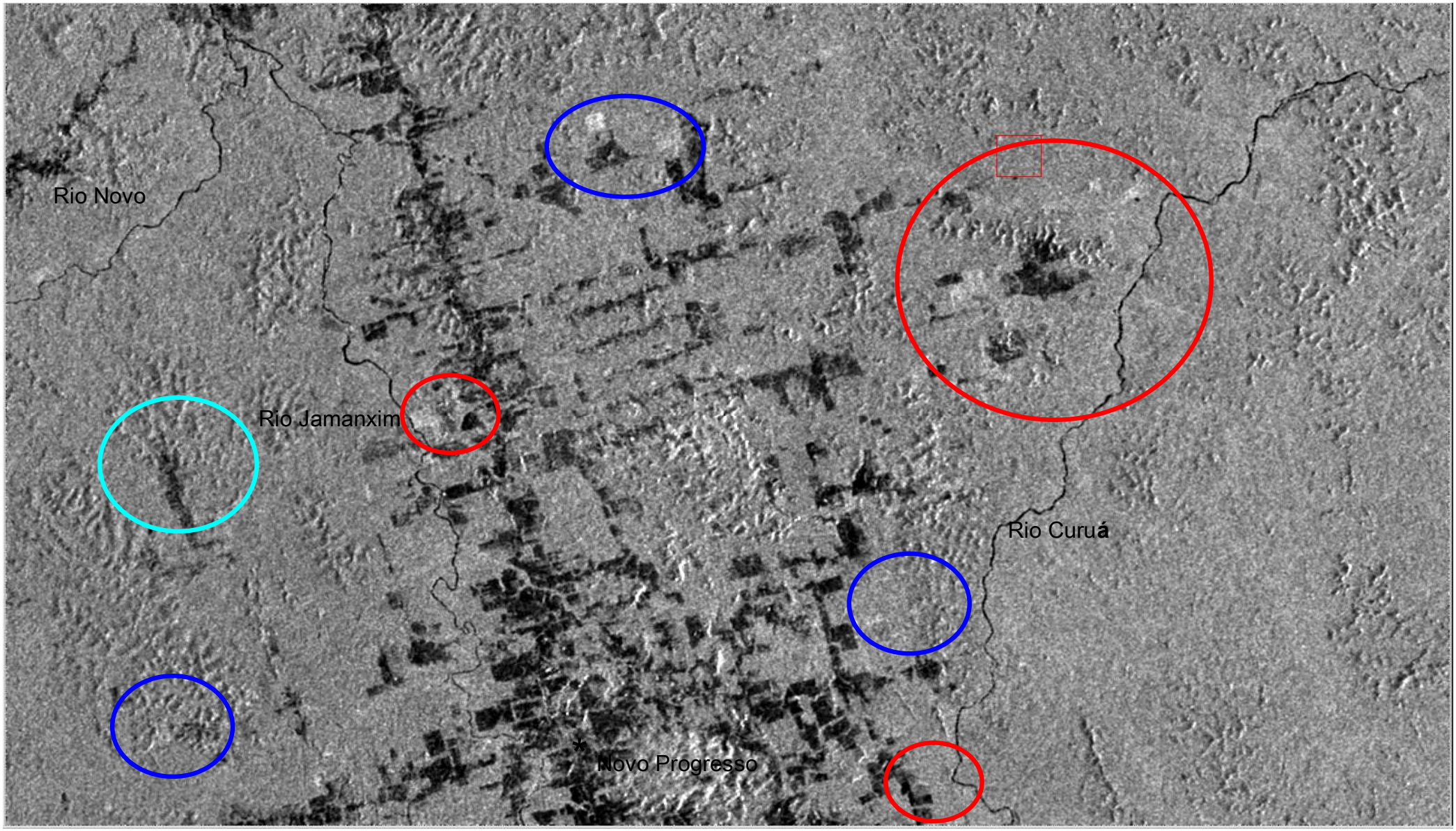
Palsar Multitemporal for Deforestation Assessment

Aug/2008



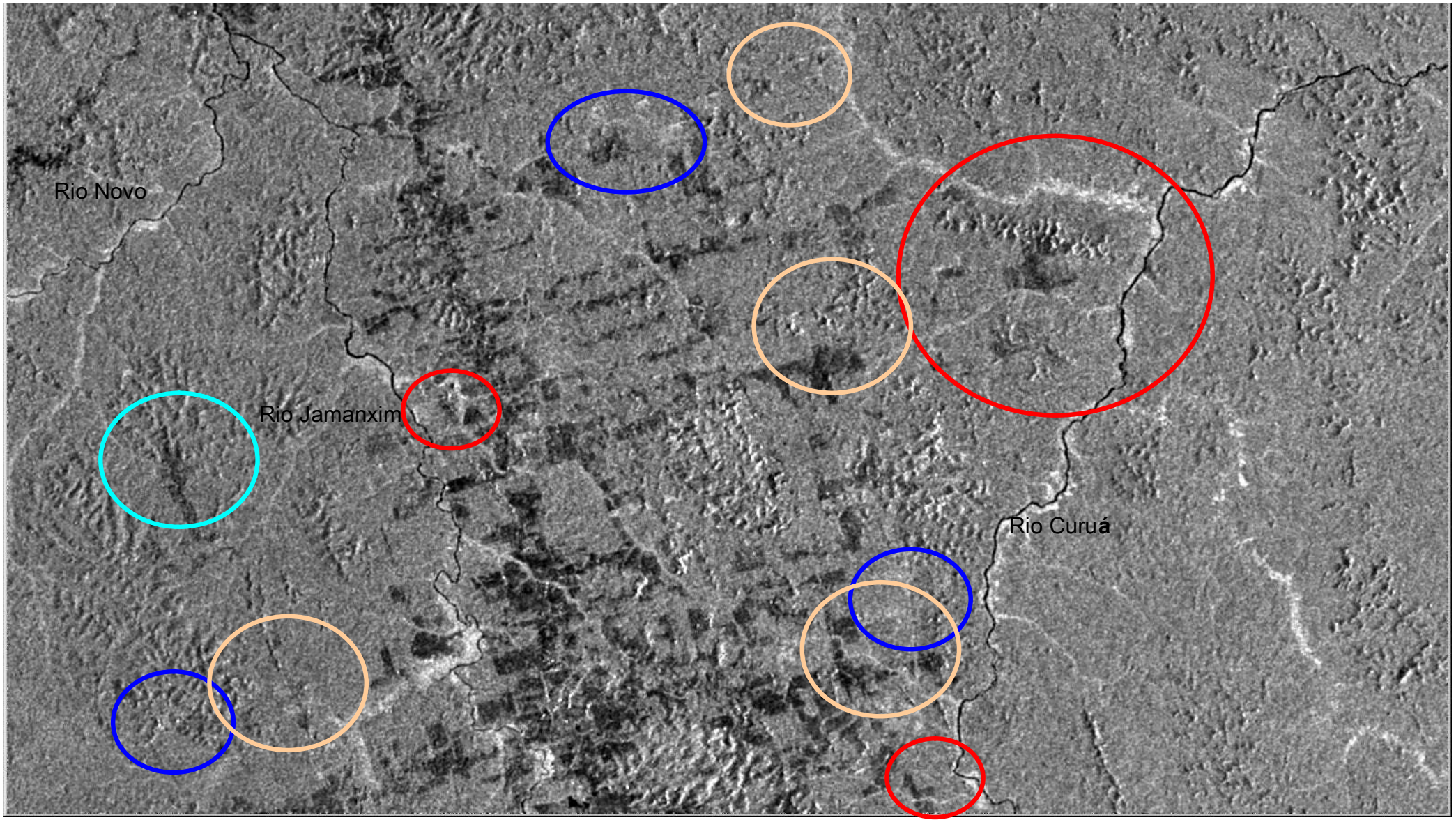
Palsar Multitemporal for Deforestation Assessment

Oct/2008



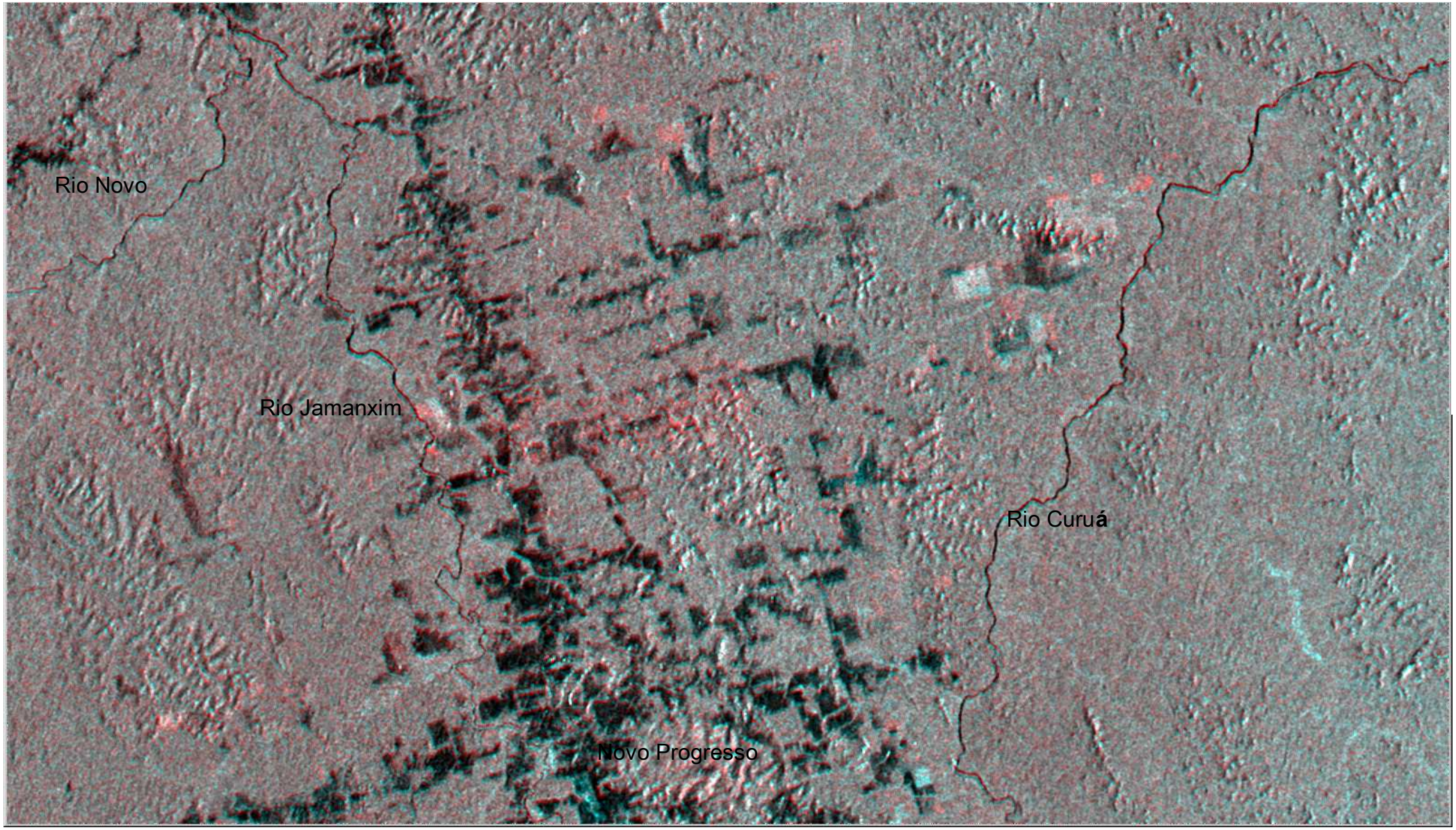
Palsar Multitemporal for Deforestation Assessment

Apr/2009



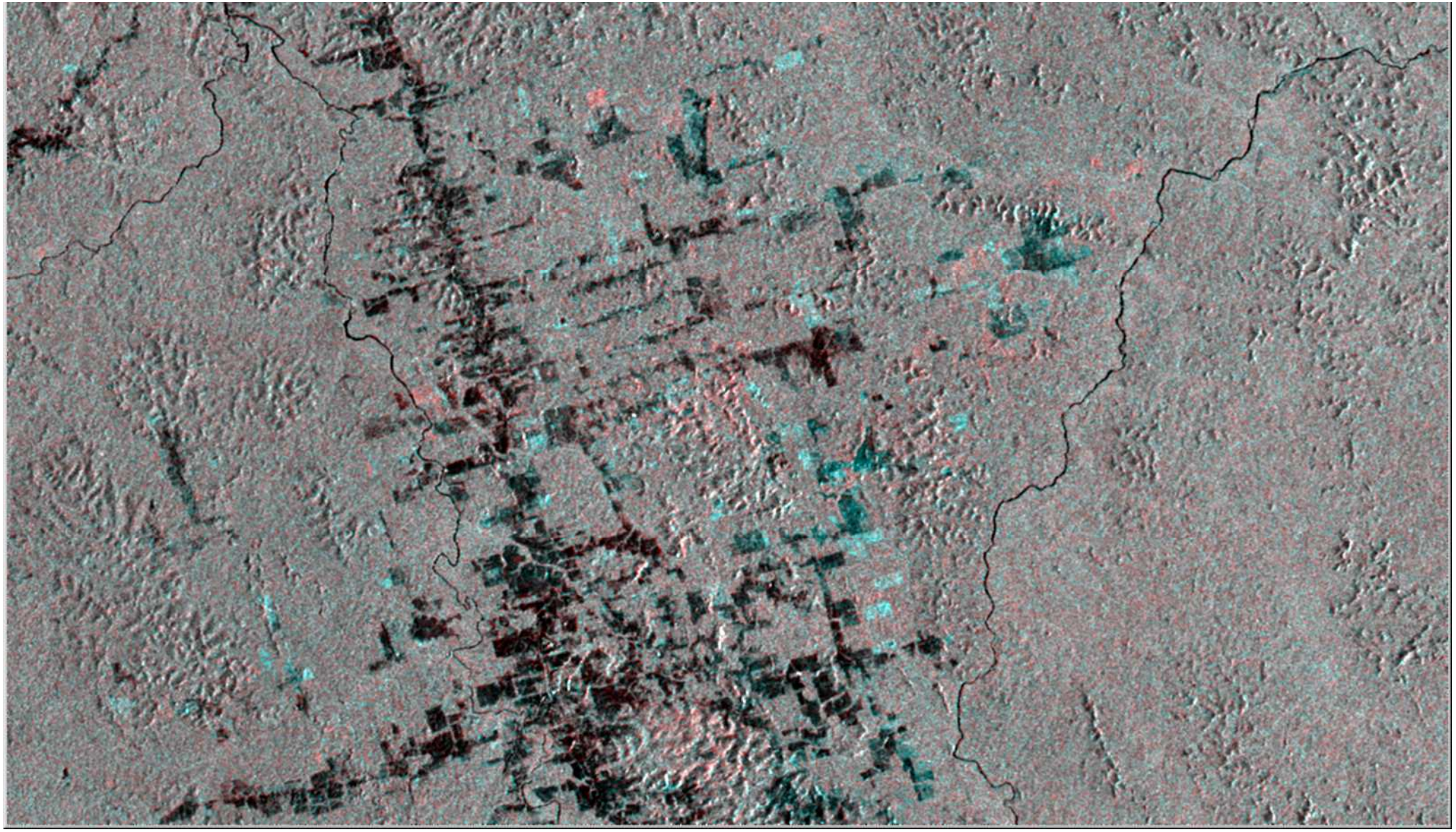
Palsar Multitemporal for Deforestation Assessment

Aug /2008 (R)
May/2008 (G & B)



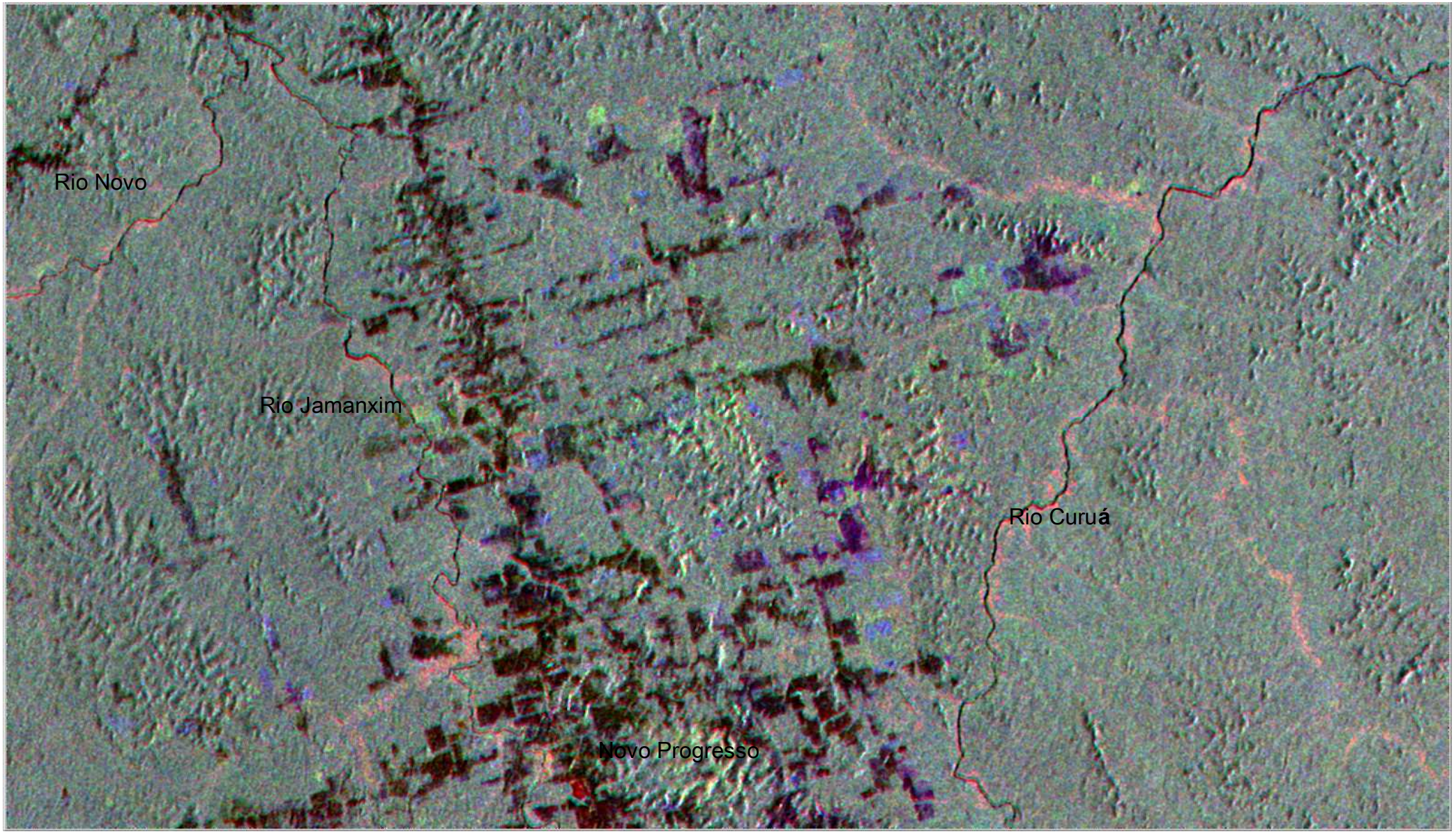
Palsar Multitemporal for Deforestation Assessment

Out/2008 (R)
Out/2007 (G & B)



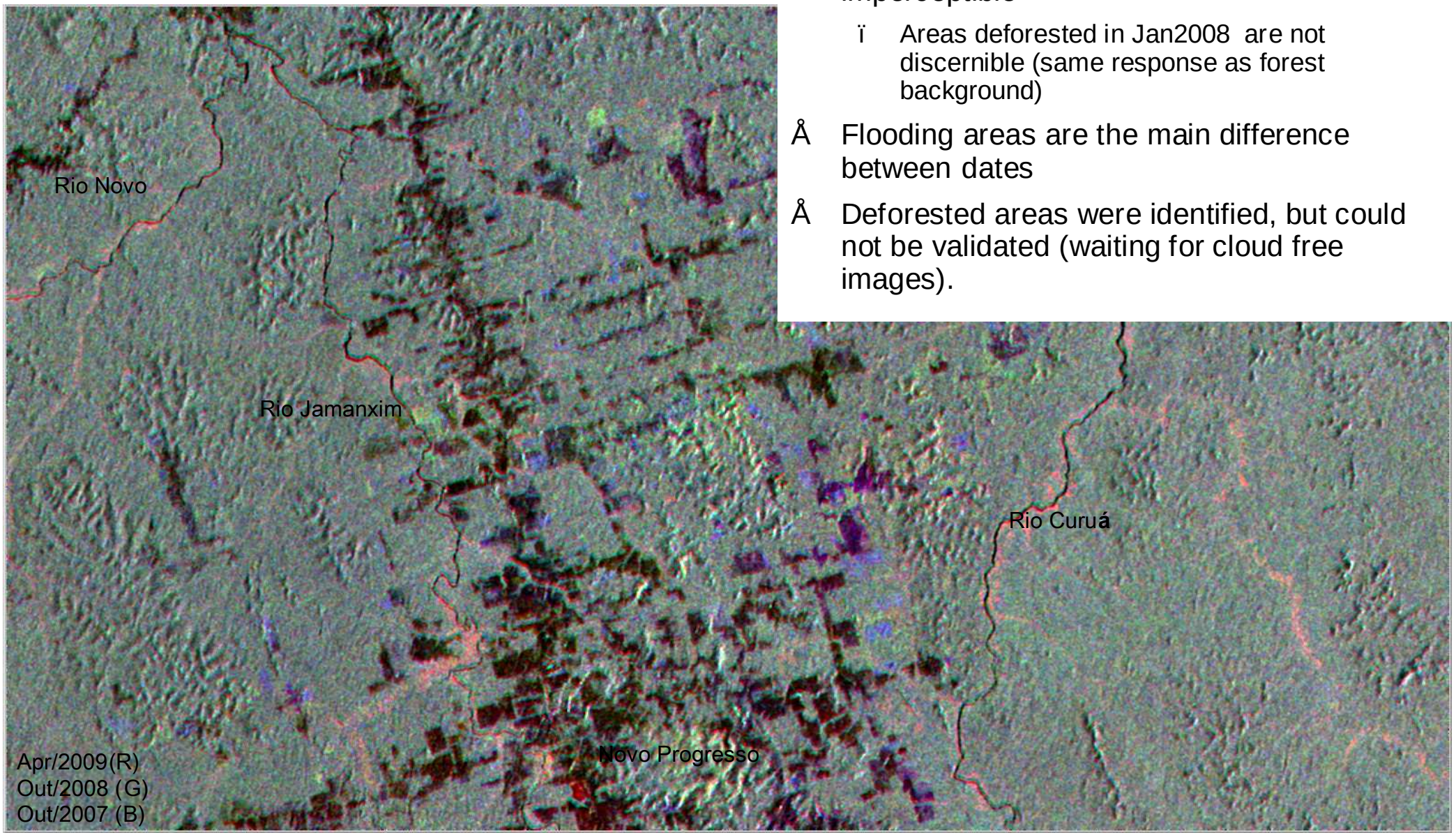
Palsar Multitemporal for Deforestation Assessment

Apr/2009(R)
Out/2008 (G)
Out/2007 (B)



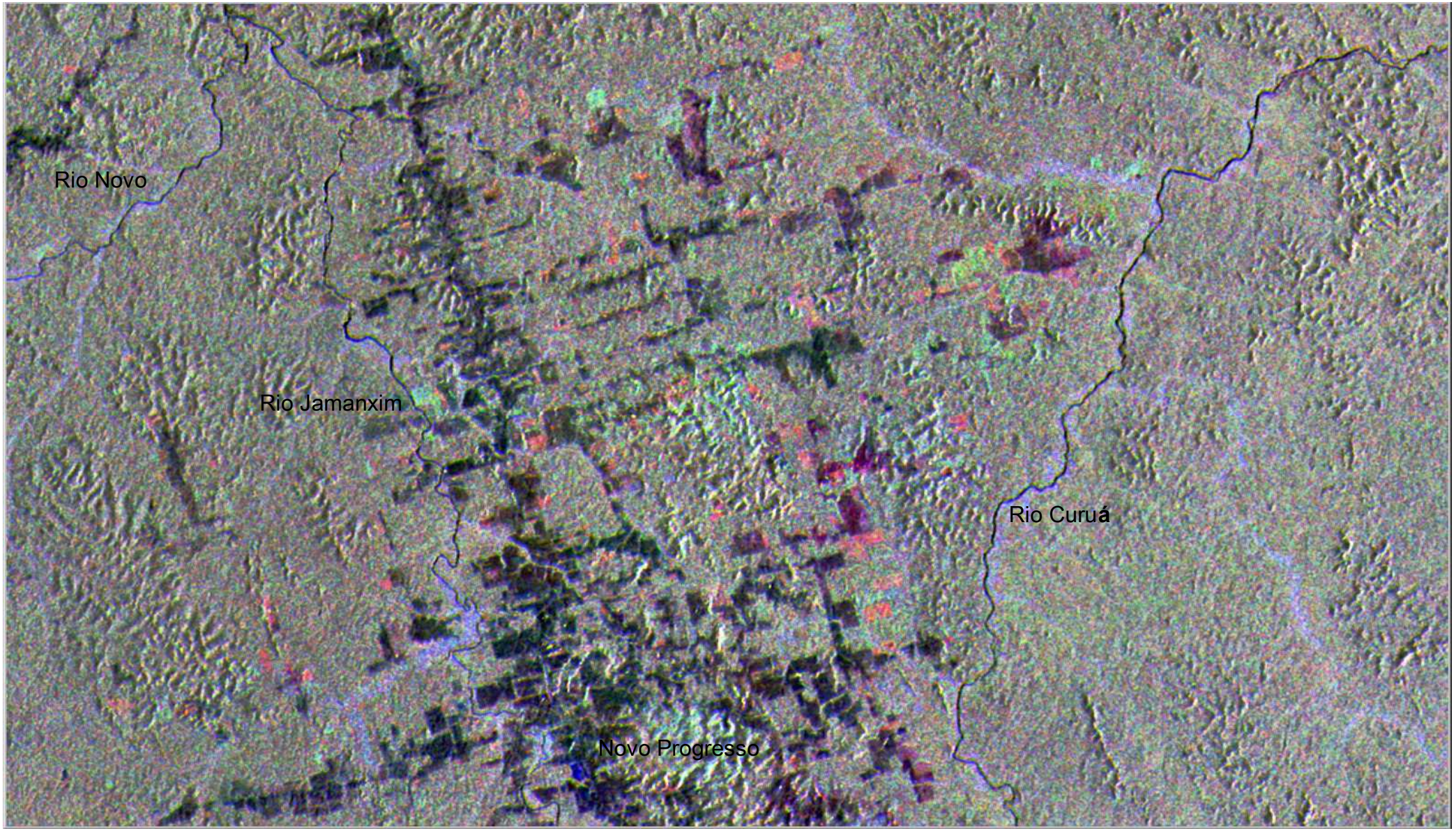
PALSAR Apr2009 – end of wet season

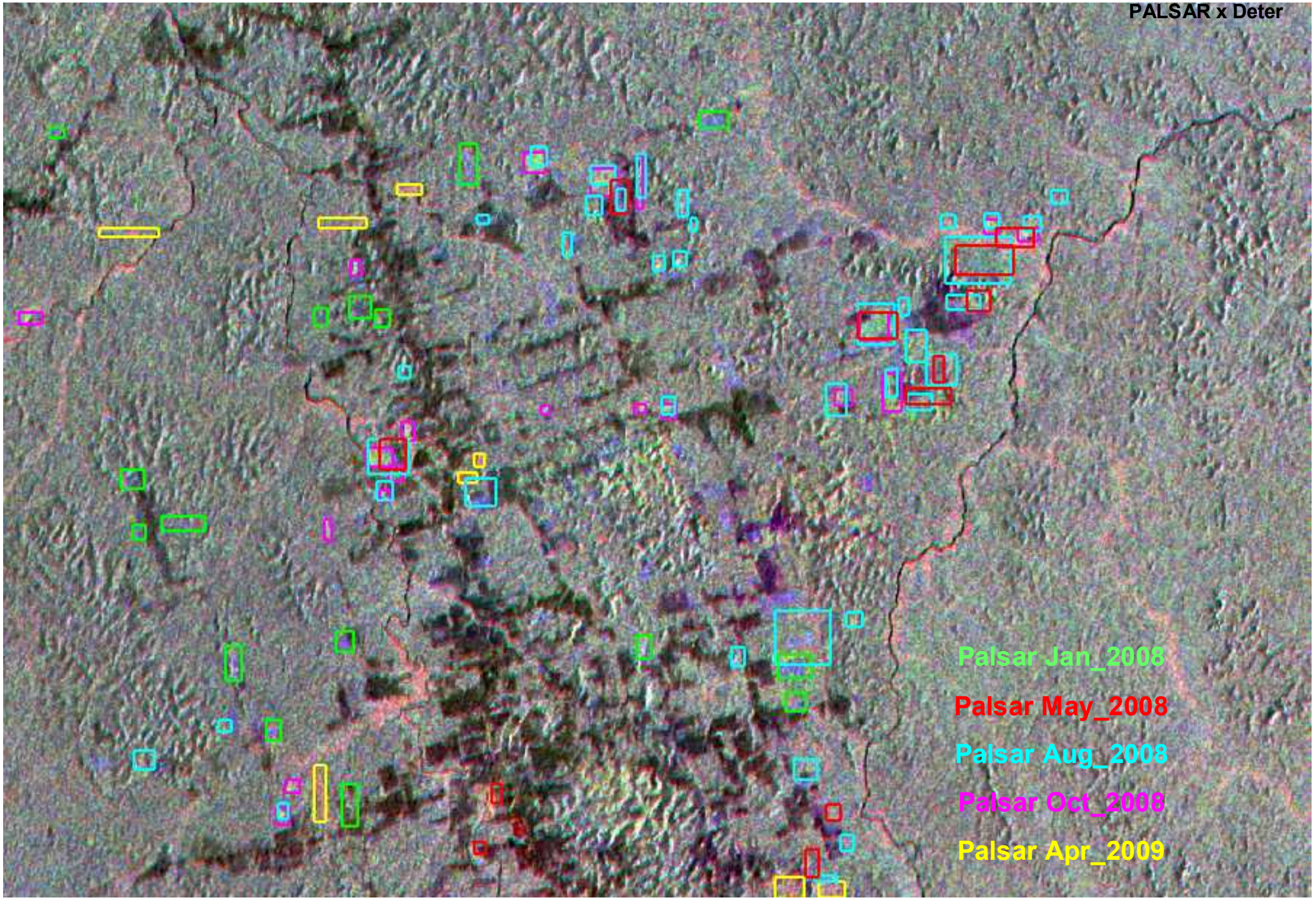
- Most of deforestation areas were imperceptible
  - Areas deforested in Jan2008 are not discernible (same response as forest background)
- Flooding areas are the main difference between dates
- Deforested areas were identified, but could not be validated (waiting for cloud free images).



Palsar Multitemporal for Deforestation Assessment

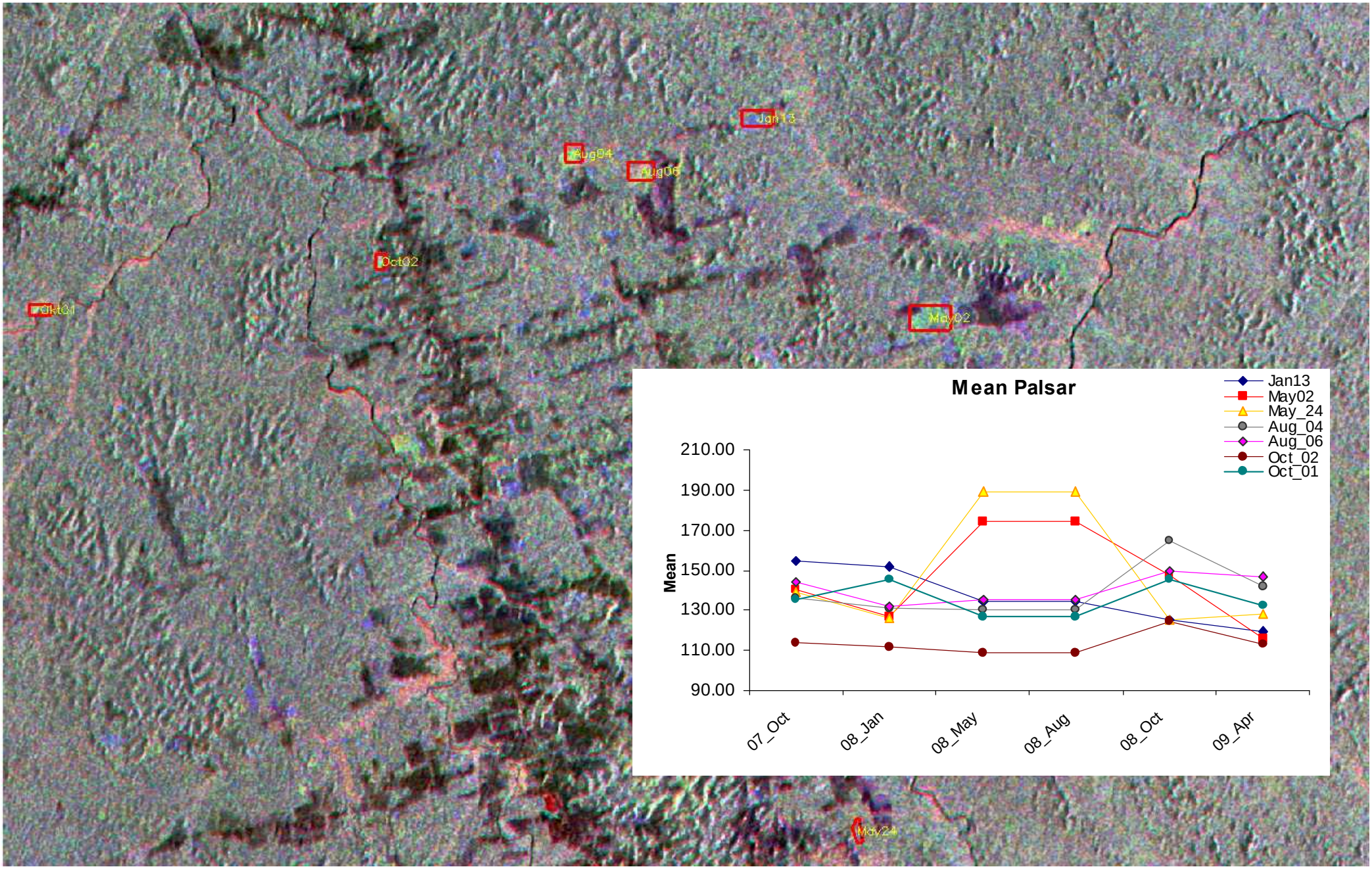
Out/2007 (R)
Out/2008 (G)
Apr/2009 (B)




PALSAR x Deter
Palsar Jan_2008
Palsar May_2008
Palsar Aug_2008
Palsar Oct_2008
Palsar Apr_2009

Novo Progresso - Palsar ScanSAR
Jan 2007 ï Apr 2009

PALSAR x Deter



Remarks – Multi-temporal analysis

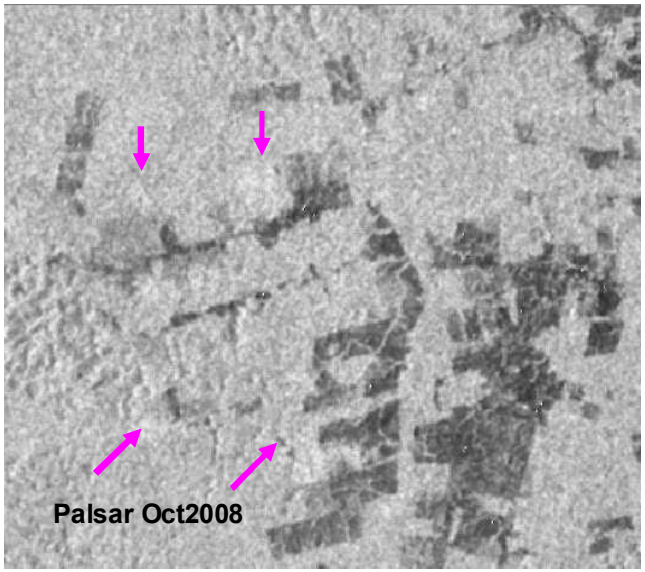
- Deforestation - considered clear-cutting and progressive deforestation
- Visual interpretation of Palsar ScanSAR WB1 images, multitemporal composition
- Eventually, Deter identifies the same area in different months ï August values.
- Some Deforestation warnings (Alertas Deter) were early detected at PALSAR imagery.
- Radar data should be used as complementary information even for the ñcloud freeò period.
- Darker deforestation ï areas older than 1 year.

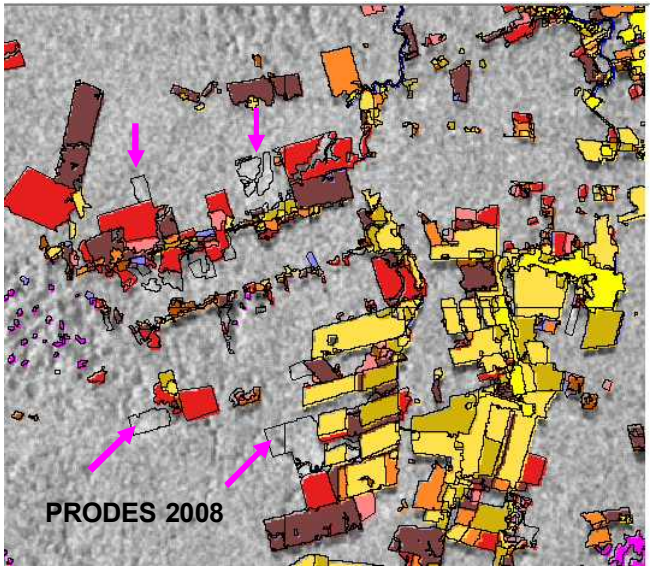
	Deter	Palsar Jan08	Palsar May08	Palsar Aug08	Palsar Oct08	Palsar Apr09
Def2007		11		3	1	
May	9		6	5	2	
Jun	22	1	3	7	1	
Jul	18	1		4	2	
Aug	29		1	9	5	
Sep	1				1	
Oct	68	2		8	6	1
Nov	6					
NA		1(small)	2(flood)	1 (relieve)	1 (small)	
Total	153	16	12	38	20	9

- Relieve, flooding areas and deforestation of small areas and/or adjacent to previous deforested area has to be considered as source of misinterpretation.

Remarks – Image processing

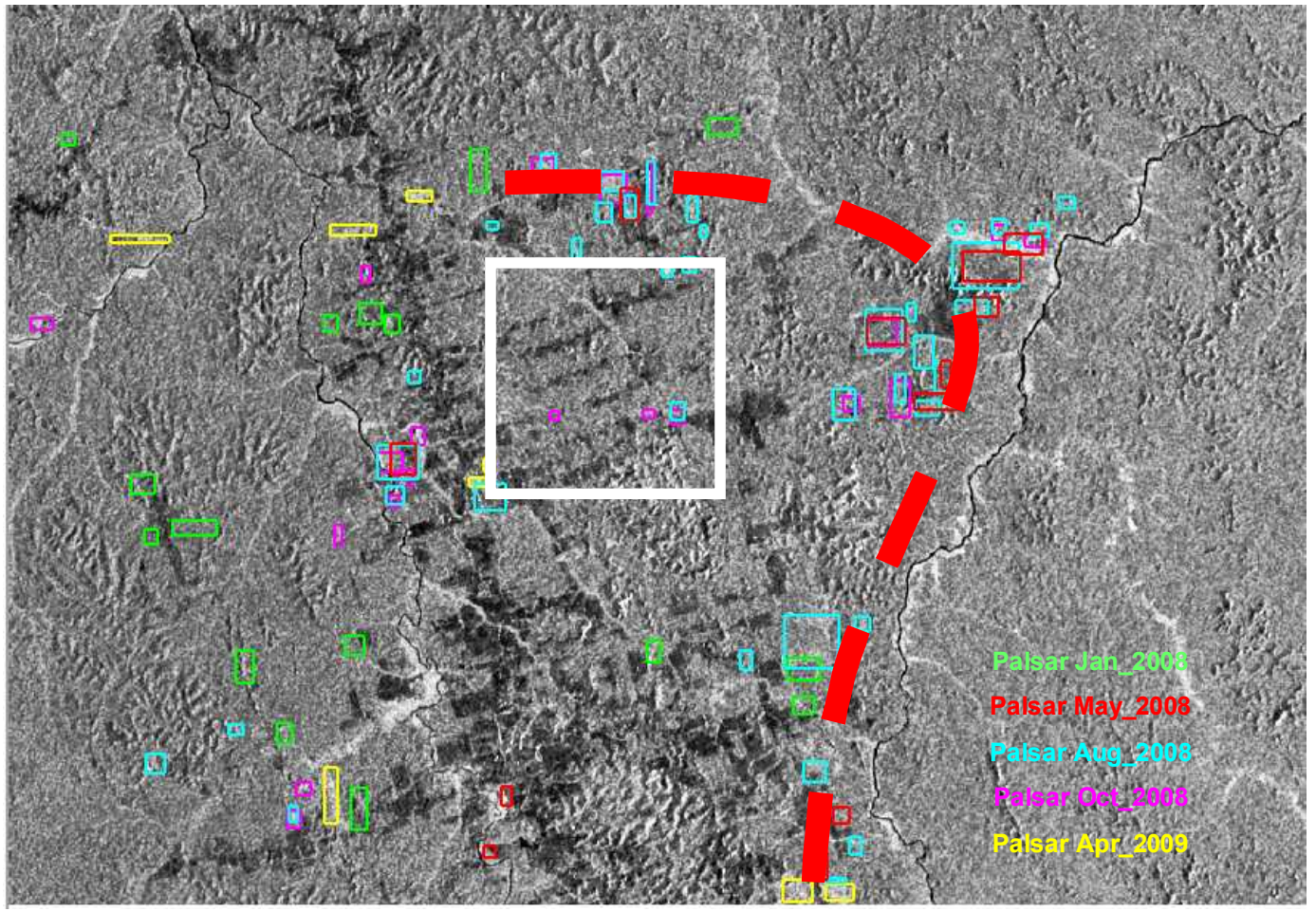
- Image interpretation improvement with simple procedures: Speckle filter (Lee enhanced or kernel), and (linear 2%) contrast.
- Georeferecing procedure is not completed dominated ï still have problems considering the needs for multi-temporal analysis
- Visual interpretation of deforestation warnings (alertas Deter) is feasible considering the constraints already reported.
- Masking previous deforestation is basic to avoid duplication of warnings





Next Steps

- Refine Apr-May-Jun/2008 Mosaic for Legal Amazon
- Prepare other 3 mosaics 2008 (Jul-Aug-Sept, Oct-Nov-Dec, and Jan-Feb-March)
- Improve the geometry of final image for multi-temporal analysis
- IBAMA partnership
- Identify deforestation based on PALSAR multi-temporal imagery for a recent date and validate with field work.



Thank you !

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