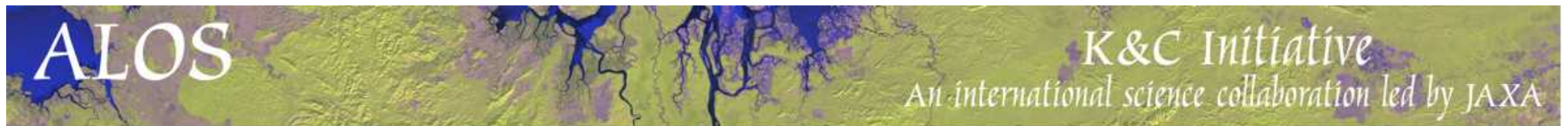


# ALOS-PALSAR data assimilation into INPE's Brazilian Amazon Environmental Monitoring Program (PRODES, DETER and DEGRAD)



Silvana Amaral  
Dalton de Morisson Valeriano

INPE - Brazilian National Institute for Space Research

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

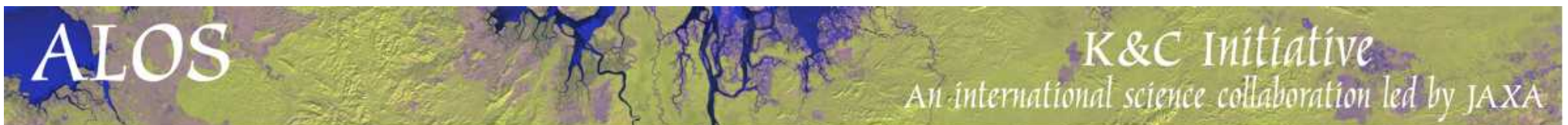


MINISTÉRIO DA CIÊNCIA E TECNOLOGIA  
**INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS**

## Assimilation of PALSAR data into INPE's Amazon Monitoring Program

### Project Update

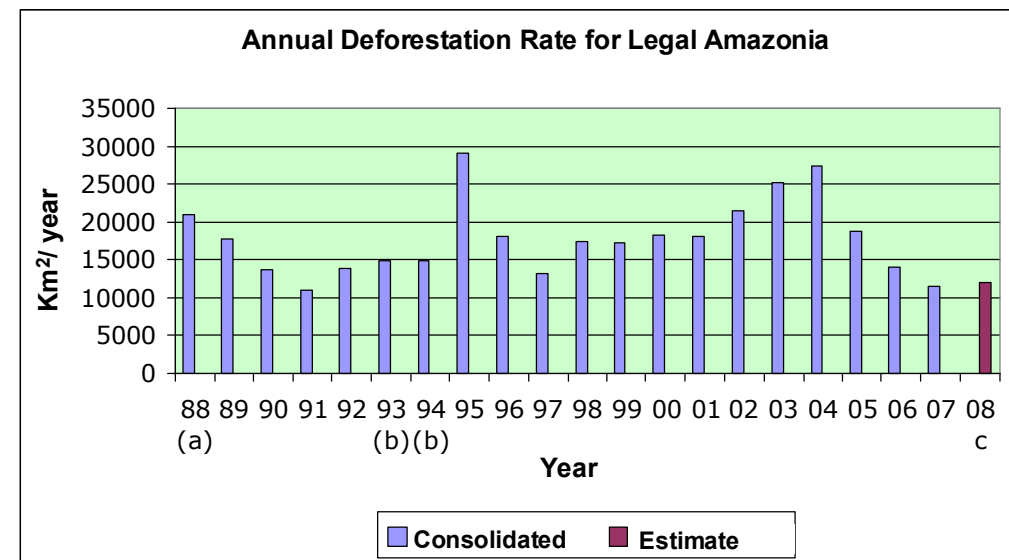
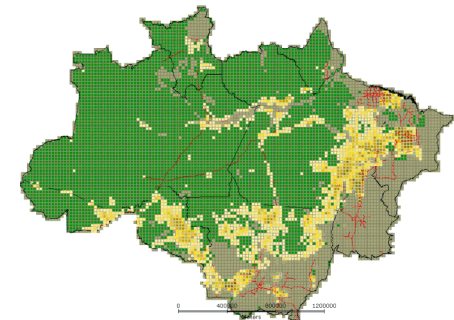
- “ Deter x Palsar
- “ Palsar x Deter Multi-temporal analysis
- “ Palsar Mosaic for Amazonia
- “ Next steps



# INPE's 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)

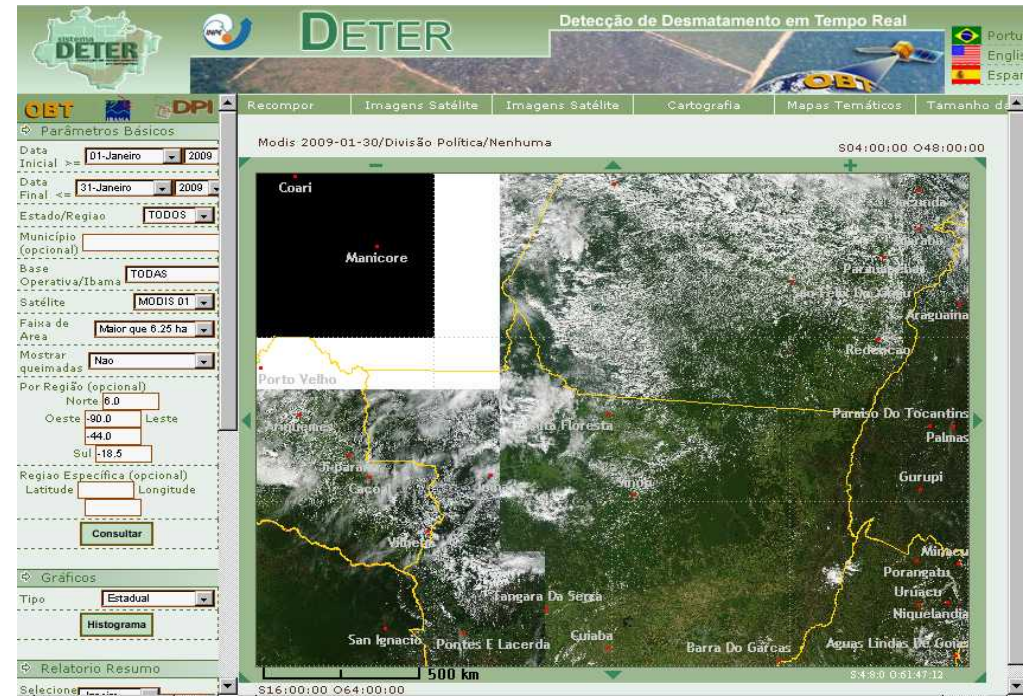




# INPE's Brazilian Amazon Environmental Monitoring Program

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

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



# INPE's Brazilian Amazon Environmental Monitoring Program

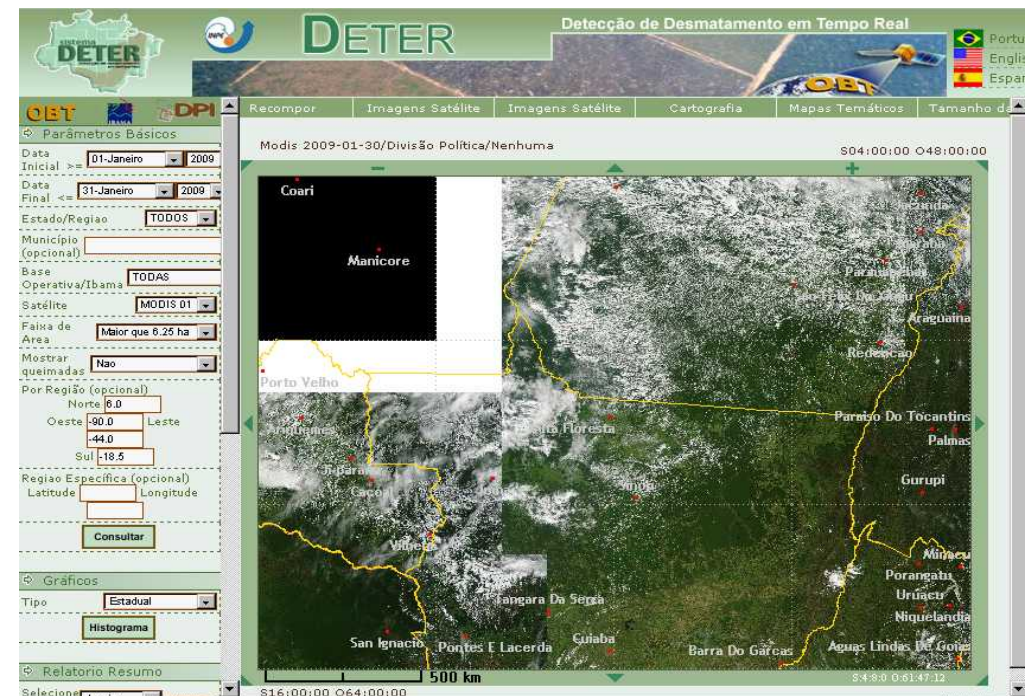
## DETER Impact

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

## DETER Limitation

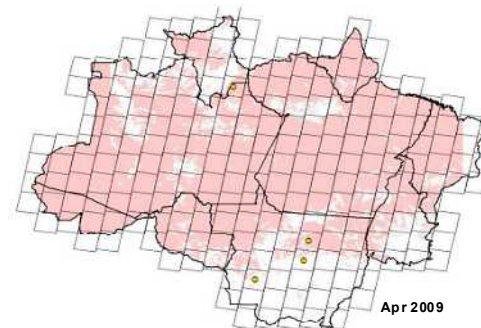
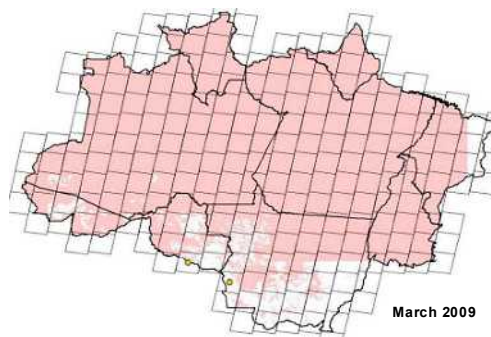
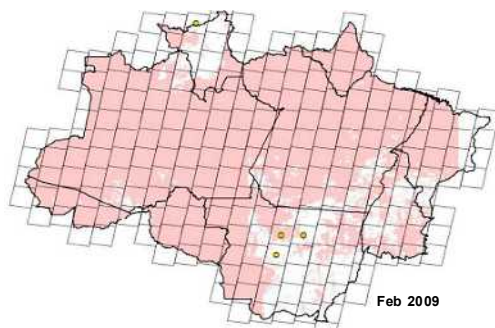
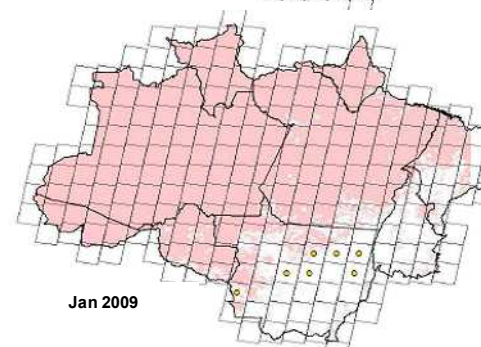
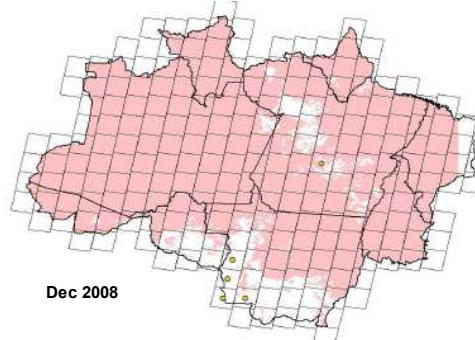
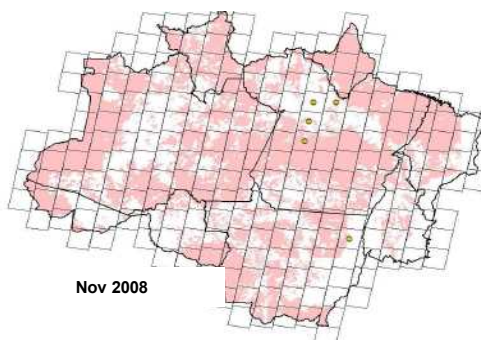
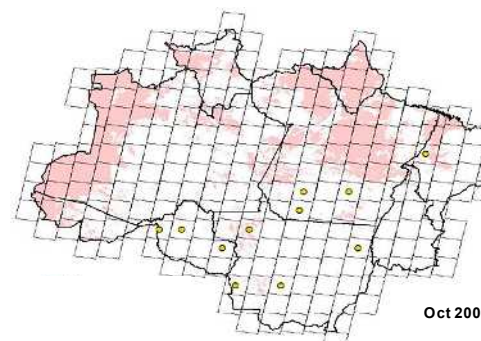
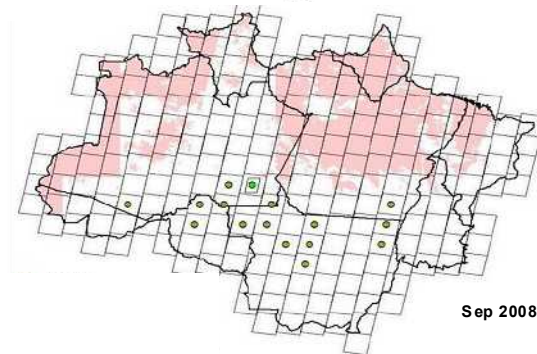
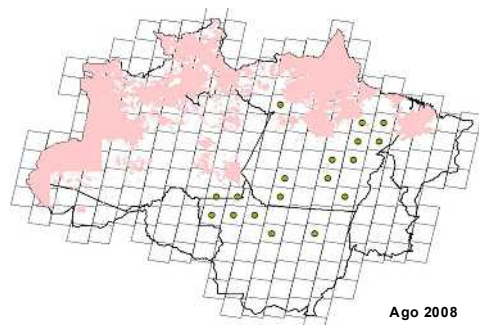
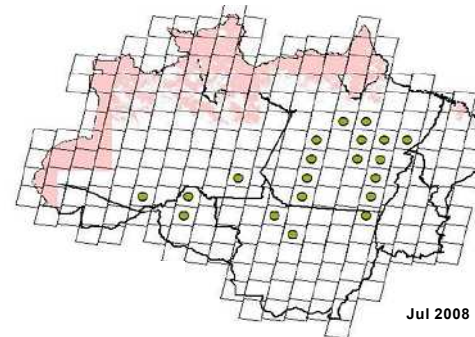
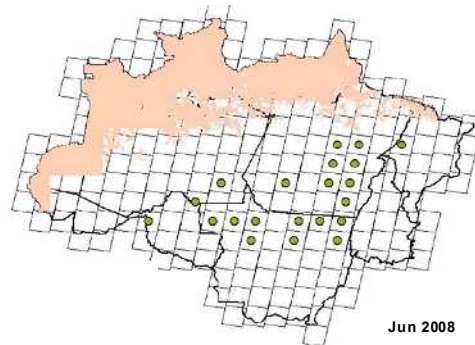
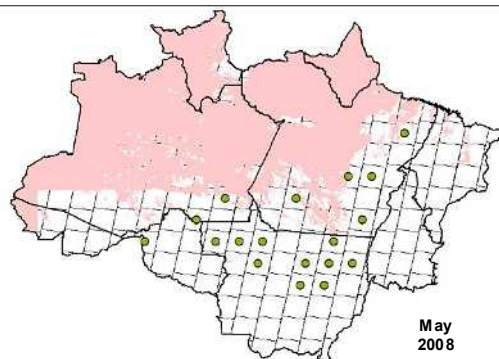


The screenshot shows the header of the DETER website, featuring the INPE logo and the text 'Coordenação-Geral de Observação da Terra - OBT'. Below the header is a navigation bar with links: Home OBT, Projetos, Pós-Graduação, Satélites, Imagens, Softwares, and Publicações. The main content area displays the 'sistema DETER' logo, which includes a map of Brazil with a green and brown color scheme. Below the logo, the text 'Sistema DETER' is followed by a paragraph explaining the system's purpose: 'O DETER é um levantamento rápido feito mensalmente pelo INPE desde maio de 2004, com dados do sensor MODIS do satélite Terra/Aqua e do Sensor WFI do satélite CBERS, de resolução espacial de 250 m. O DETER foi desenvolvido como um sistema de alerta para suporte à fiscalização e controle de desmatamento. Por esta razão o DETER mapeia tanto áreas de corte raso quanto áreas em processo de desmatamento por degradação florestal.' Another paragraph states: 'No caso de corte raso os órgãos de fiscalização podem fazer a responsabilização para ações ilegais e no caso das áreas de degradação progressiva, além da responsabilização, a federação e os estados podem atuar para reverter o processo, quando possível. Com este sistema, é possível detectar apenas desmatamentos com área maior que 25 ha. Devido à cobertura de nuvens nem todos os desmatamentos são identificados pelo DETER.' A third paragraph mentions: 'O DETER apresenta seus dados por extratificados por município, estado, base operativa do Ibama e unidades de conservação, buscando facilitar e agilizar as operações de fiscalização por quem de direito.' A fourth paragraph notes: 'O sistema DETER captura apenas parte dos desmatamentos ocorridos, devido à menor resolução das imagens/sensores utilizadas e as restrições de cobertura de nuvens.' The final paragraph explains: 'Desmatamento não é um evento, mas um processo. A conversão de floresta primária até o estágio de corte raso pode levar de alguns meses até vários anos para ser concluída. Os dados do DETER podem incluir áreas cortadas em períodos anteriores ao do mês de mapeamento ou em processo de desmatamento progressivo, mas cuja detecção não foi possível por limitações de cobertura de nuvens. É preciso distinguir entre o tempo de ocorrência e a oportunidade de detecção do desmatamento, que é quando a fração de exposição de solo permite a sua detecção.'



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

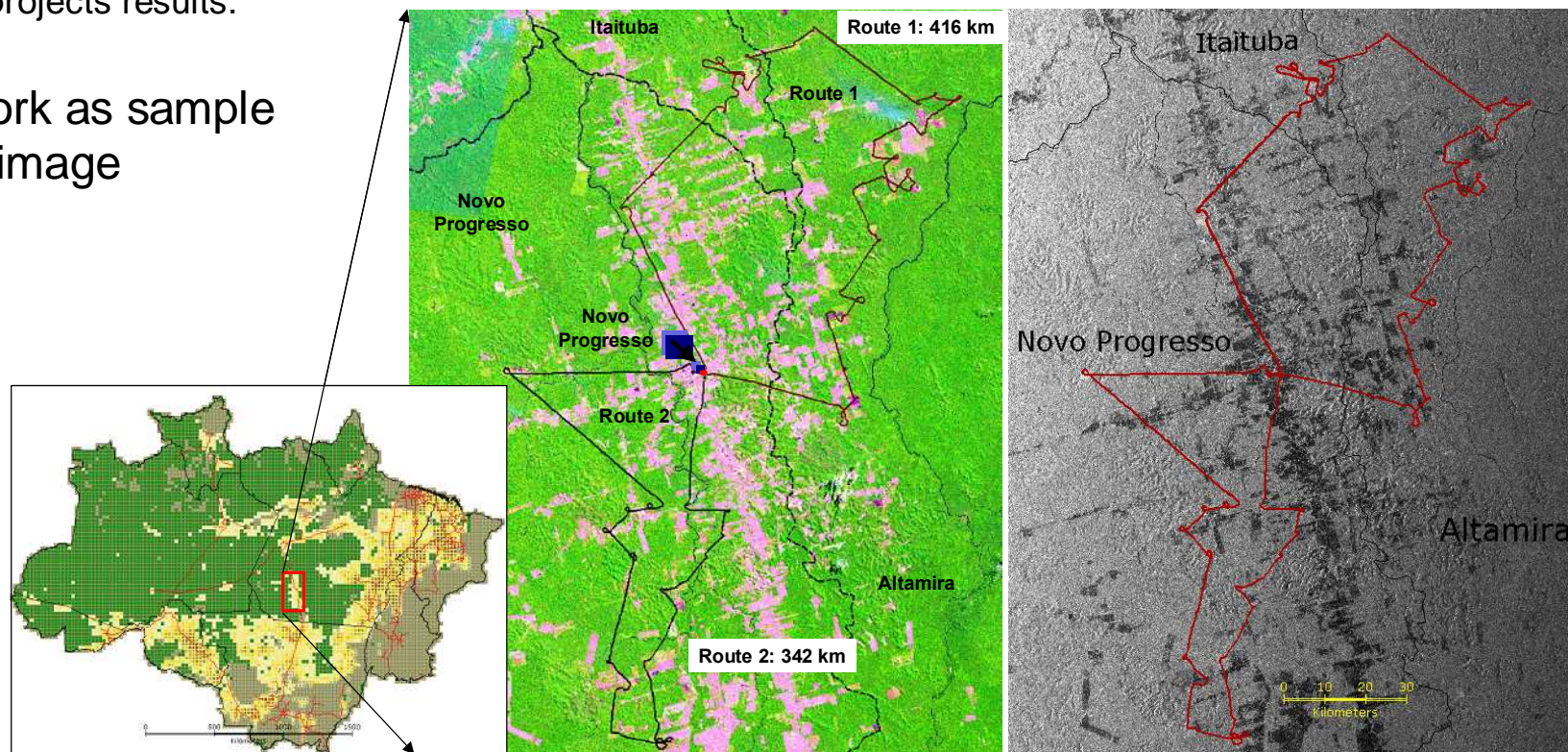
ALOS/PALSAR to detect deforestation in the Brazilian Amazônia

DETER\_R Radar based Near-Real Time Detection of Deforestation and Degradation

É K&C images to detect deforestation in Brazilian Amazônia to qualify deforestation results from DETER projects results.

É Fieldwork as sample

É Single image





September 2008  
INPE/IBAMA

Itaituba  
Novo Progresso  
Altamira



Coordenação-Geral de Observação da Terra - OBT

FotoTeca 2008

Recompor: Imagens Satélite Base Cartográfica Mapas Temáticos Tamanho da Tela

Consulta pelo mapa

Selecionar estado:

Selecionar Missão:

Opcional: Orbits  Ponto

Consultar

Consulta por foto

Norte:

Oeste:  Leste:

Sul:

Procurar

Consulta por município

Nome:

Estado:

Procurar

Mosaico LandSat 2007 (AMZ)/Divisão Política/Nenhuma

Novo Progresso

Qualquer problema, dúvida ou sugestão, por favor, entre em contato: [prodes@obt.inpe.br](mailto:prodes@obt.inpe.br)

Fotos de campo

Clique para ver a foto 9501 no mapa

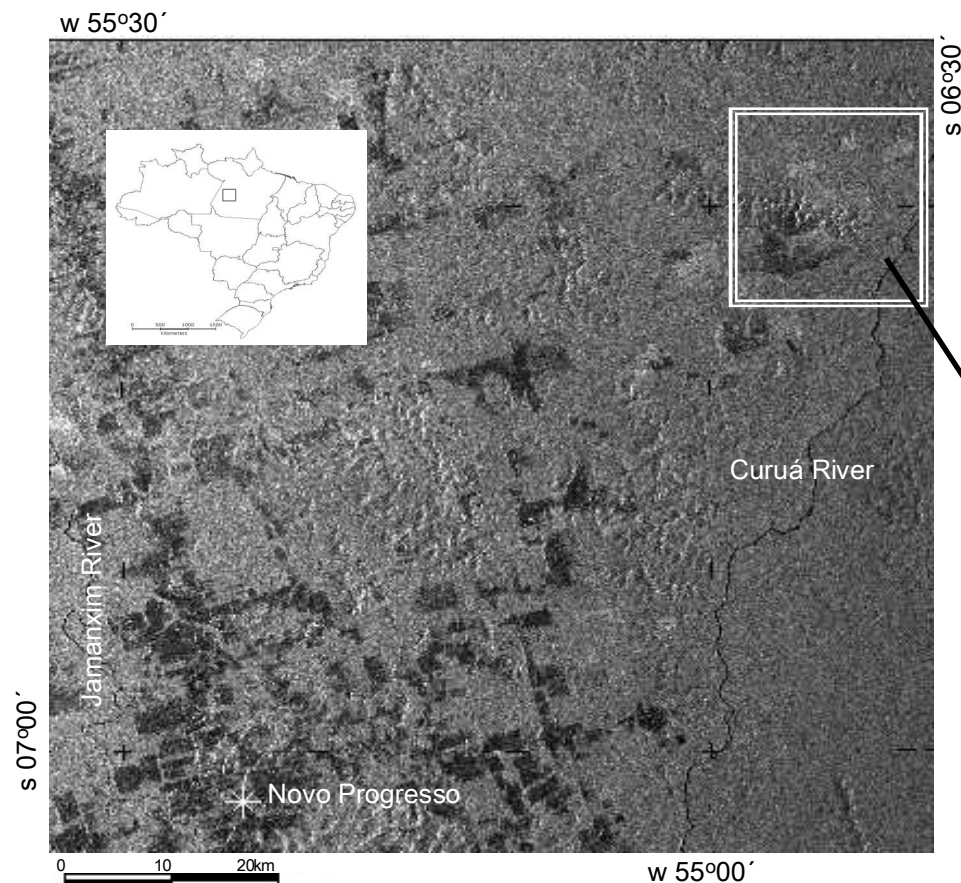
Orbits / Ponto Landsat	227 / 65
Orbits / Ponto CBERS	167 / 108
Lat	-7.258368
Long	-55.554752
Data da foto	2008-09-18
Município/UF	Novo Progresso/PA
Projeto	DETER

Concluído

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



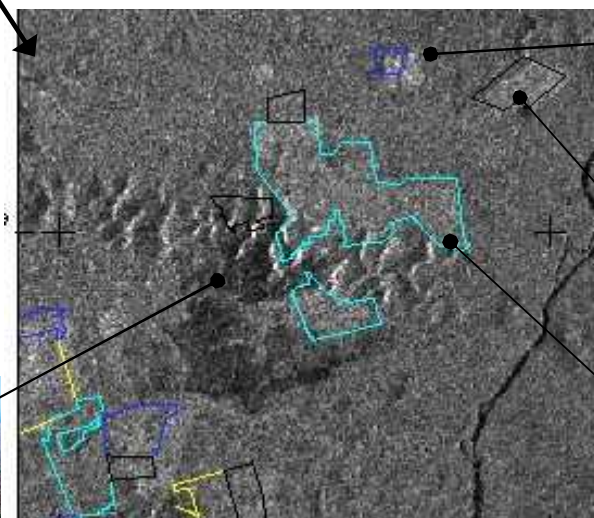
## Synergistic application of ALOS/PALSAR and DETER



### 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**

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

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

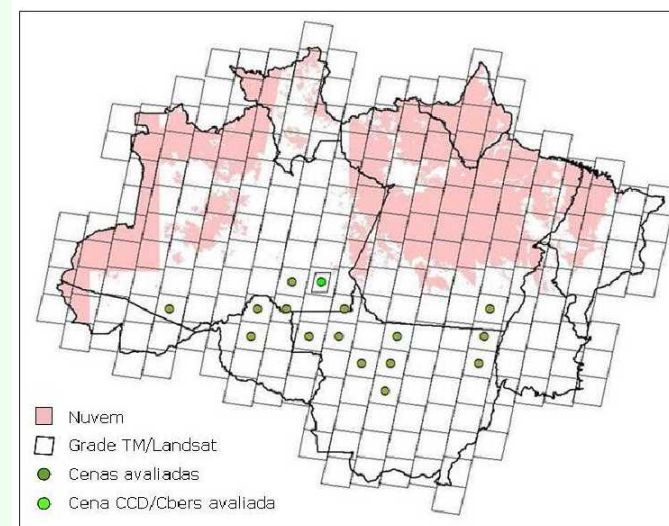
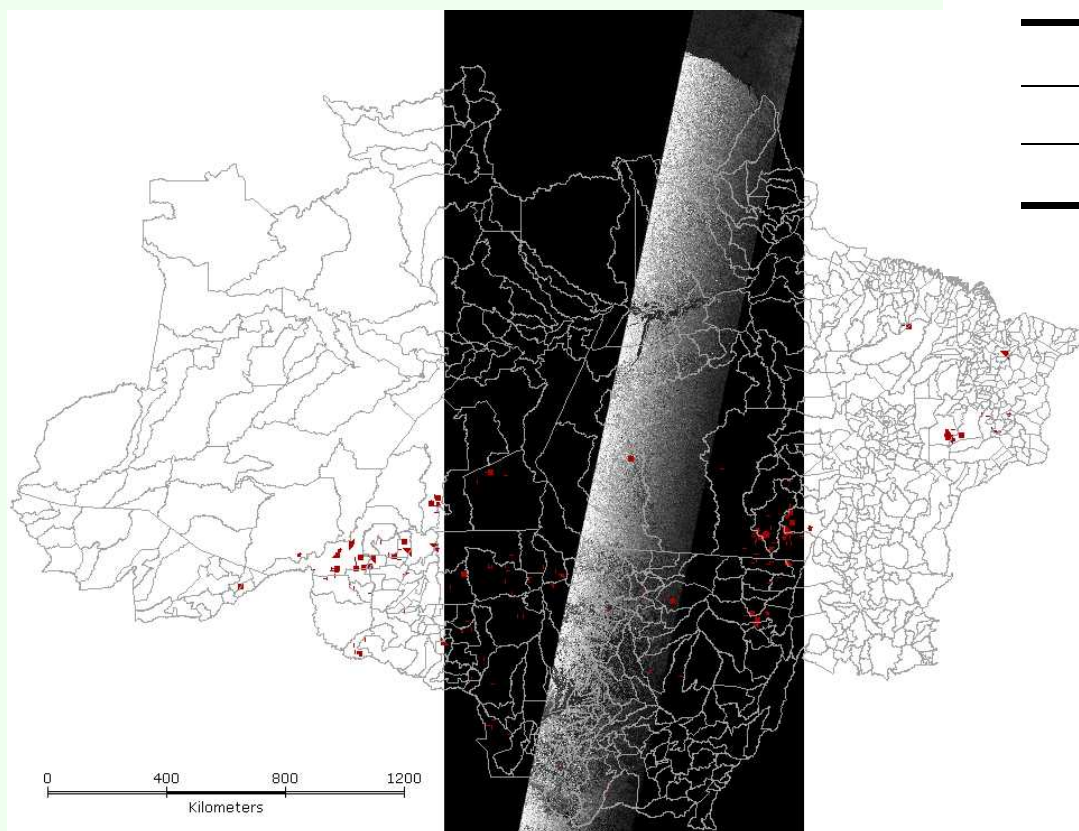
<b>Month</b>	<b>DETER polygons average area (km<sup>2</sup>)</b>	
	<b>Detected</b>	<b>Not detected</b>
<b>May</b>	7.00	3.86
<b>June</b>	5.51	3.21
<b>July</b>	2.46	1.68
<b>August</b>	2.35	1.83
<b>Average</b>	4.33	2.65



# 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 <sup>2</sup> )
Detected	34	44.74	0.92
Undetected	42	55.26	0.75
<b>Total</b>	<b>76</b>		



# 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 . wet / dry/ **spring**/ fall seasons

100 m

Change detection / Visual interpretation

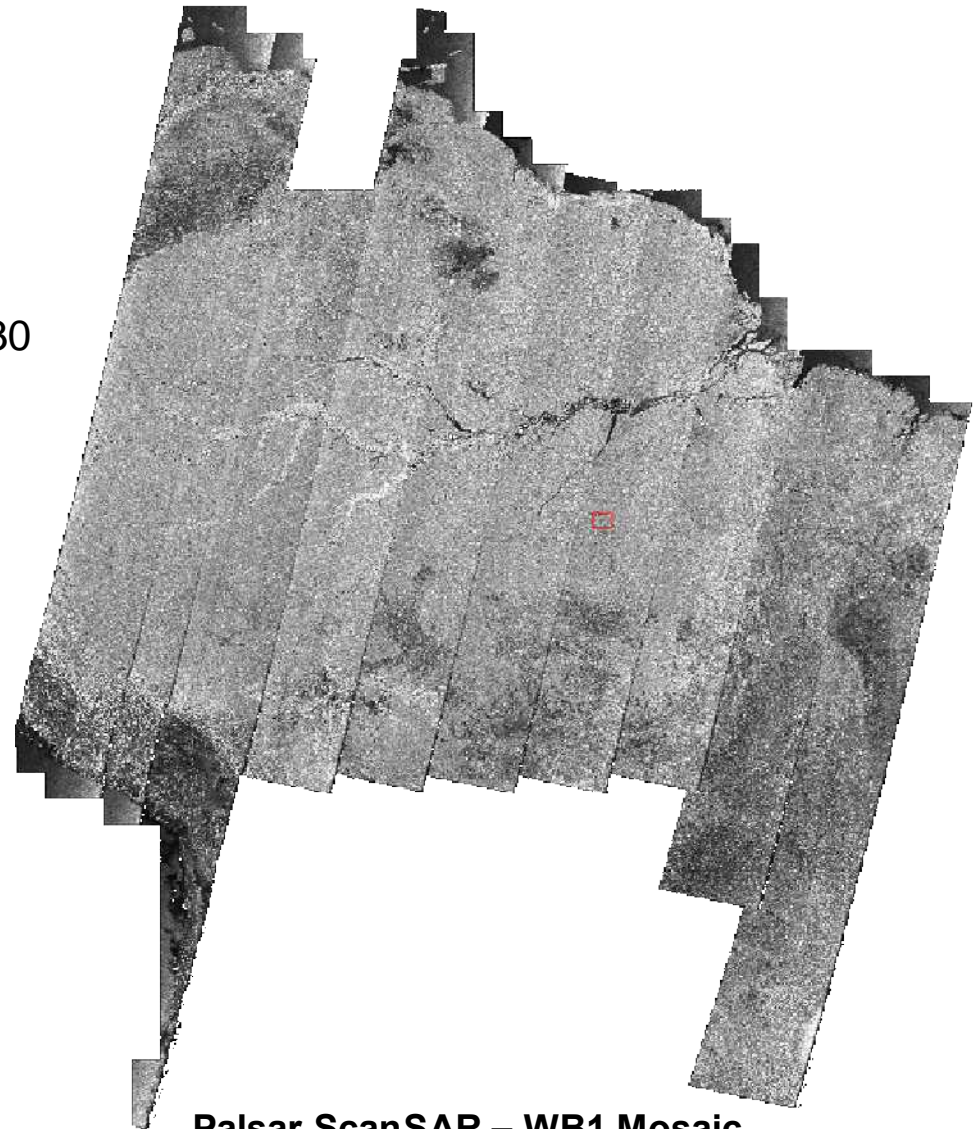
## Infrastructure

ENVI/ SarScape

SPRING

TerraAmazon (when operational)

Small team



**Palsar ScanSAR – WB1 Mosaic**

**April – May- June 2008 (100m)**



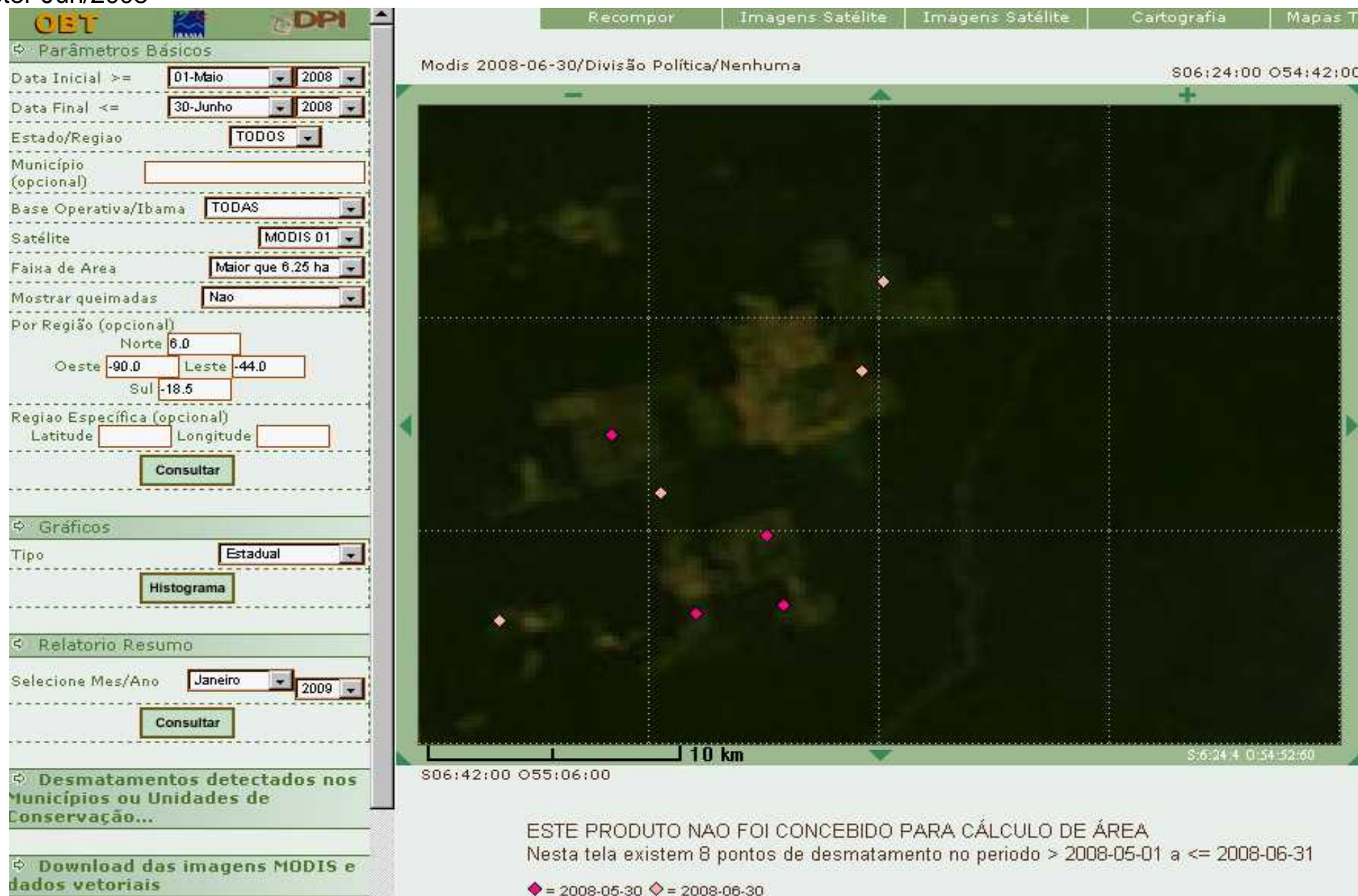
# ALOS/PALSAR to detect deforestation in the Brazilian Amazonia

Deter May/2008



# ALOS/PALSAR to detect deforestation in the Brazilian Amazonia

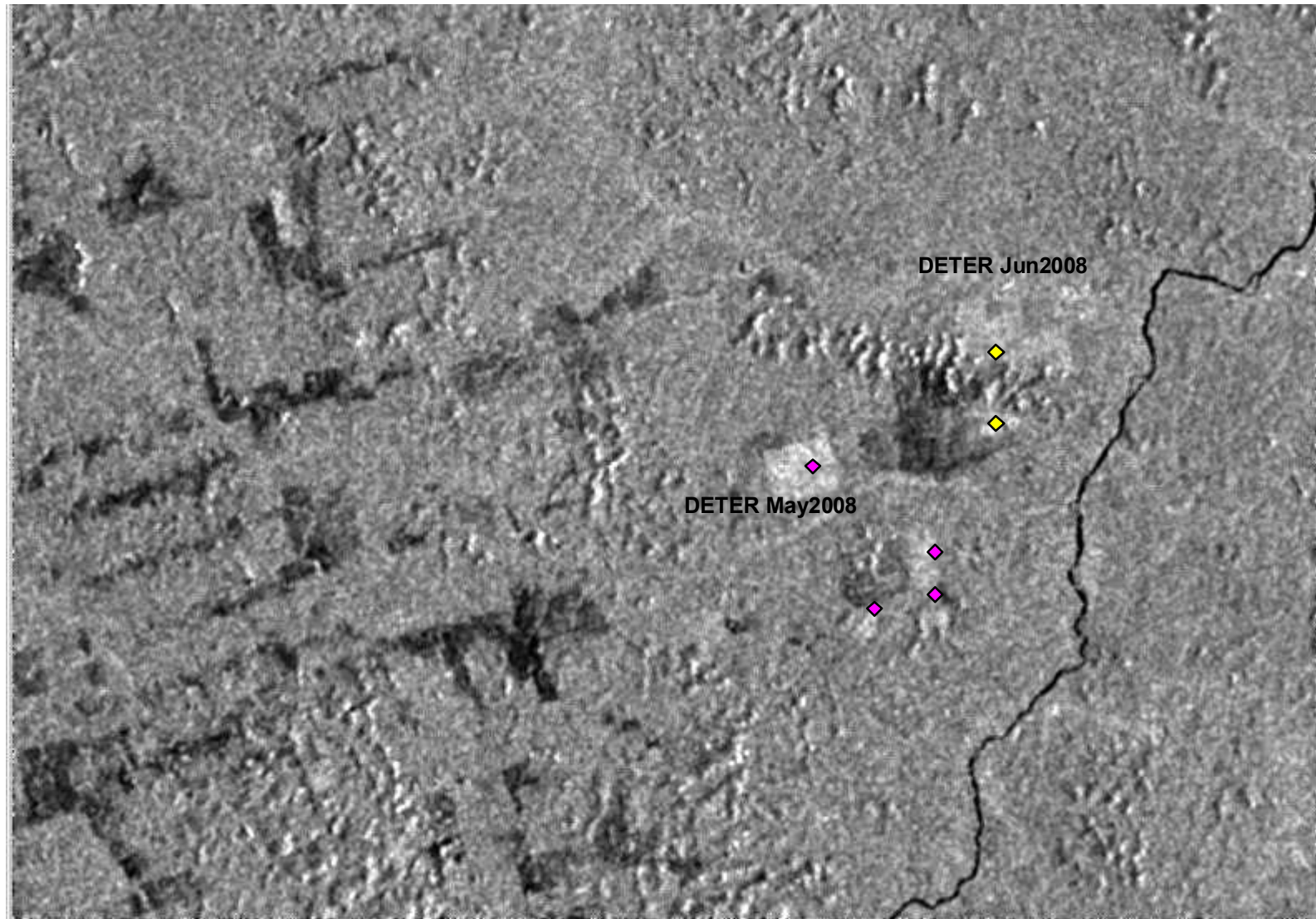
Deter Jun/2008





# ALOS/PALSAR to detect deforestation in the Brazilian Amazonia

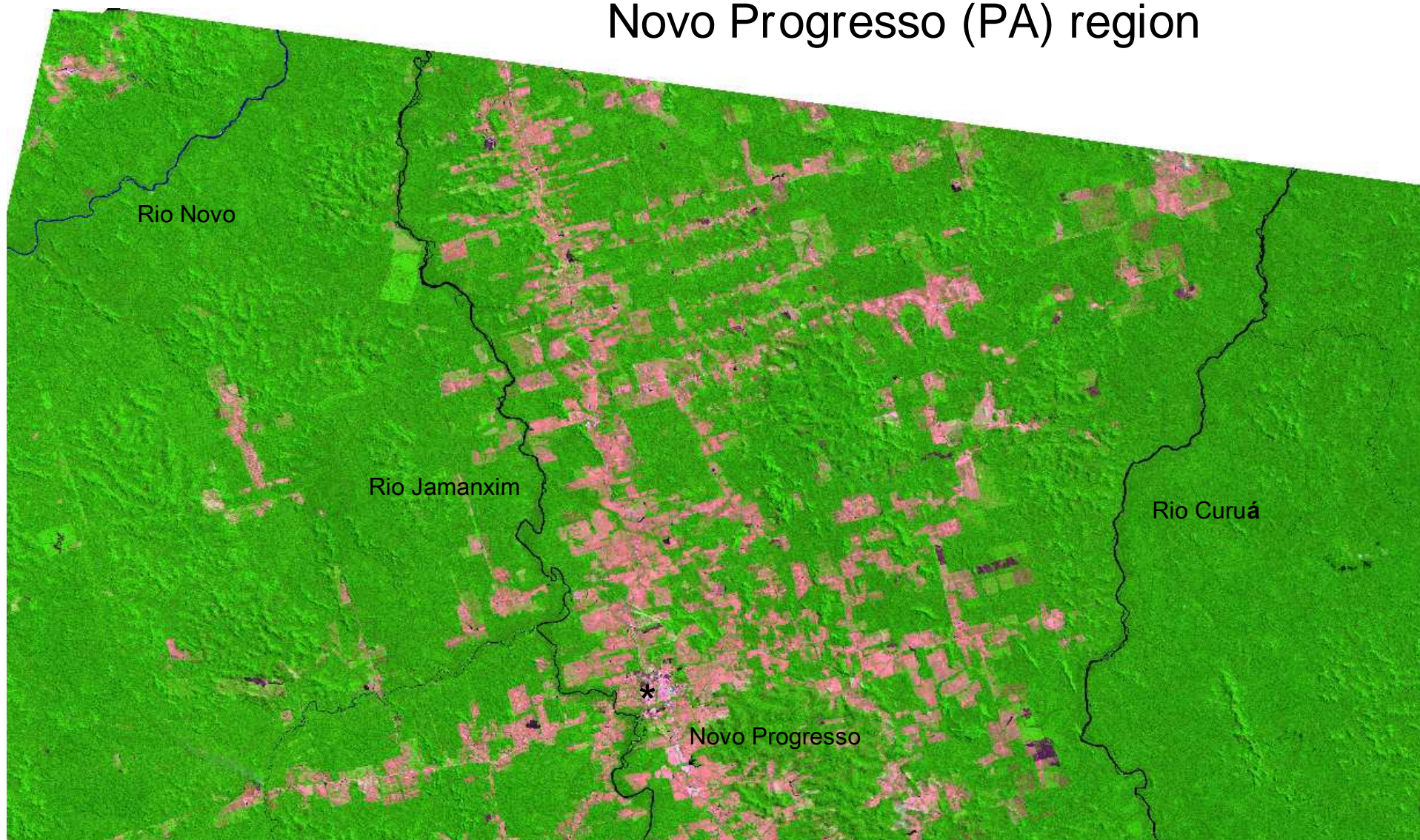
Palsar May /2008





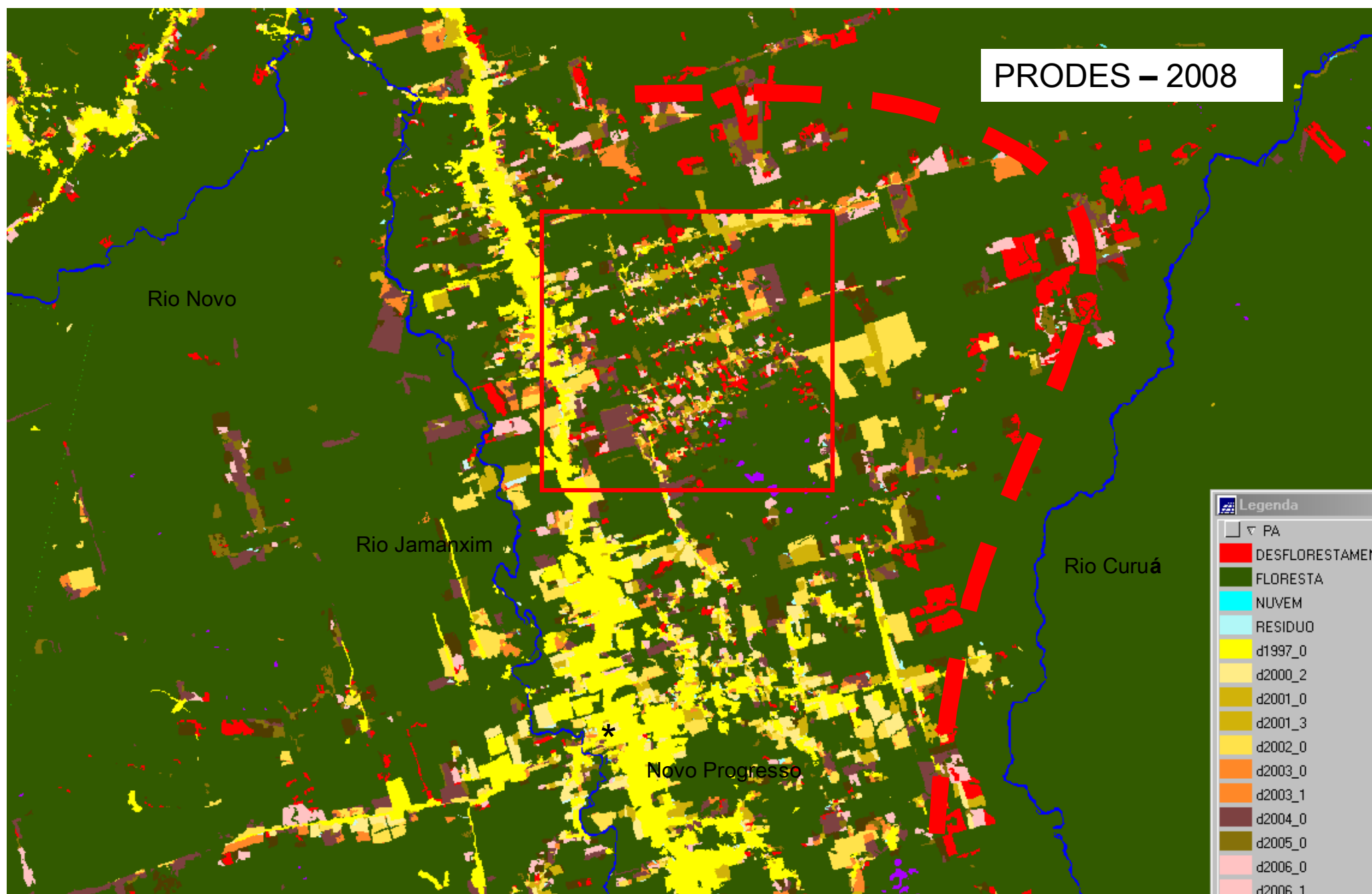
# ALOS/PALSAR to detect deforestation in the Brazilian Amazonia

## Novo Progresso (PA) region



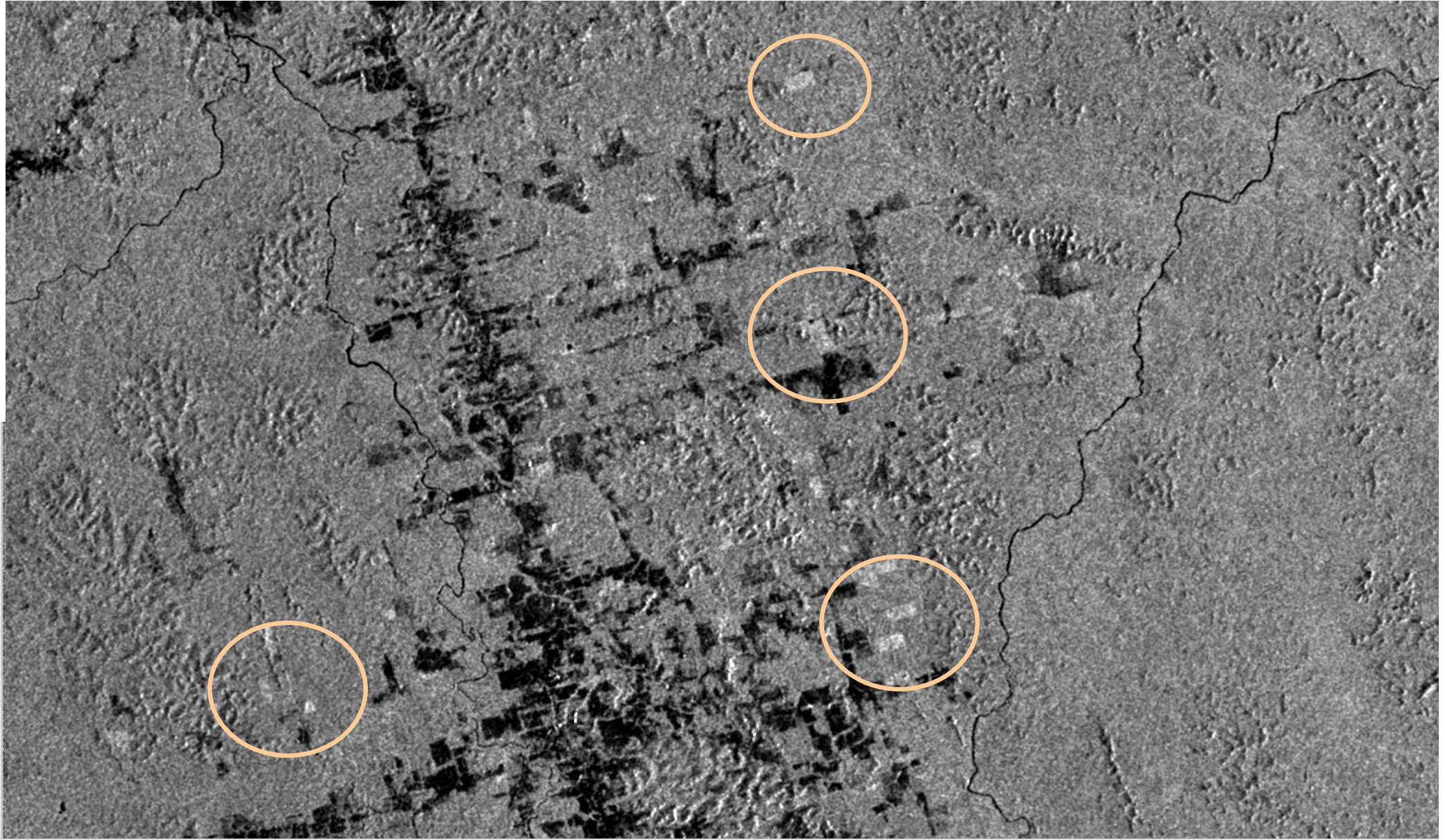
TM/Landsat – 2008/07/25





# Palsar Multitemporal for Deforestation Assessment

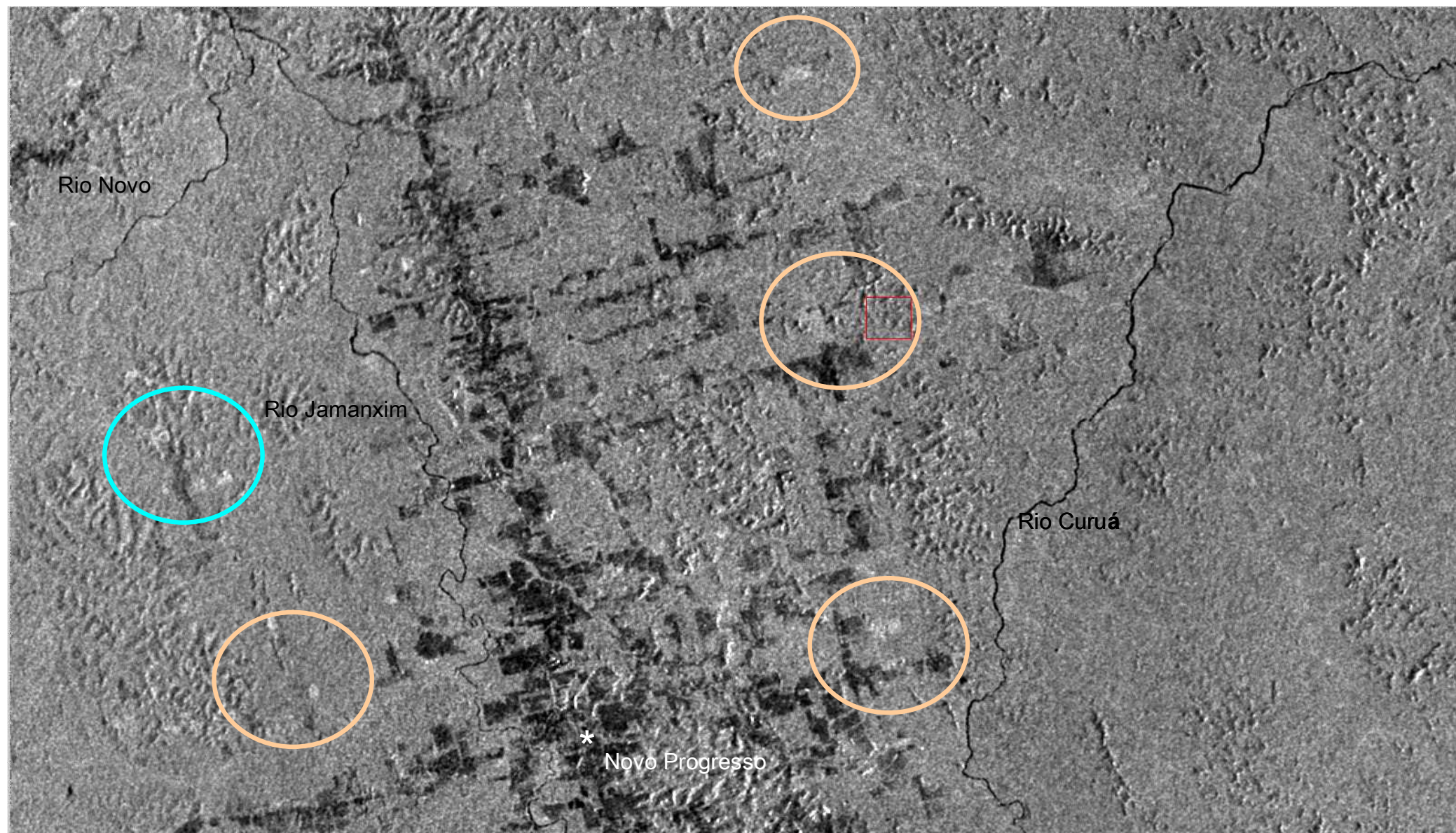
Out/2007





# Palsar Multitemporal for Deforestation Assessment

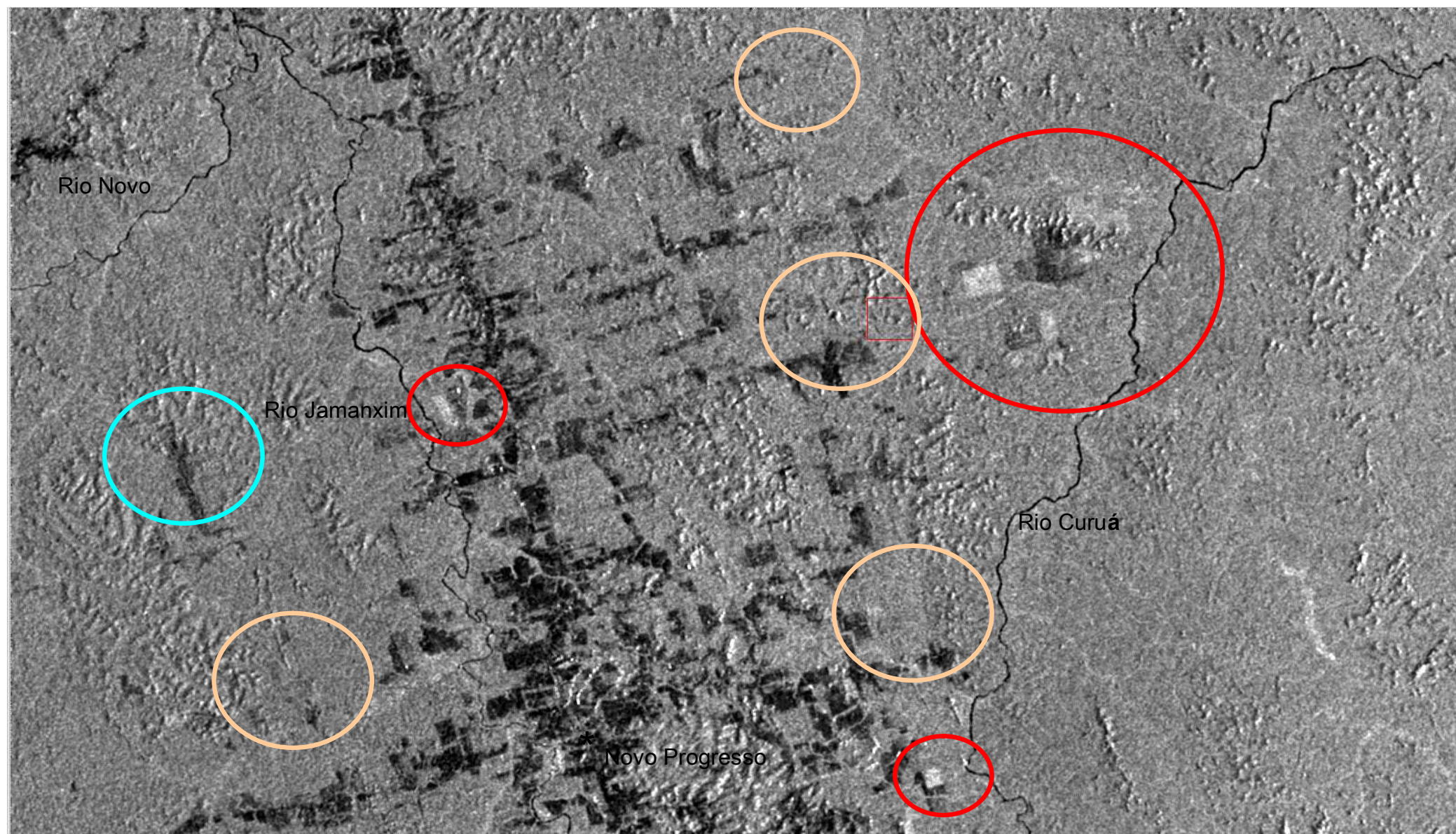
Jan/2008





# Palsar Multitemporal for Deforestation Assessment

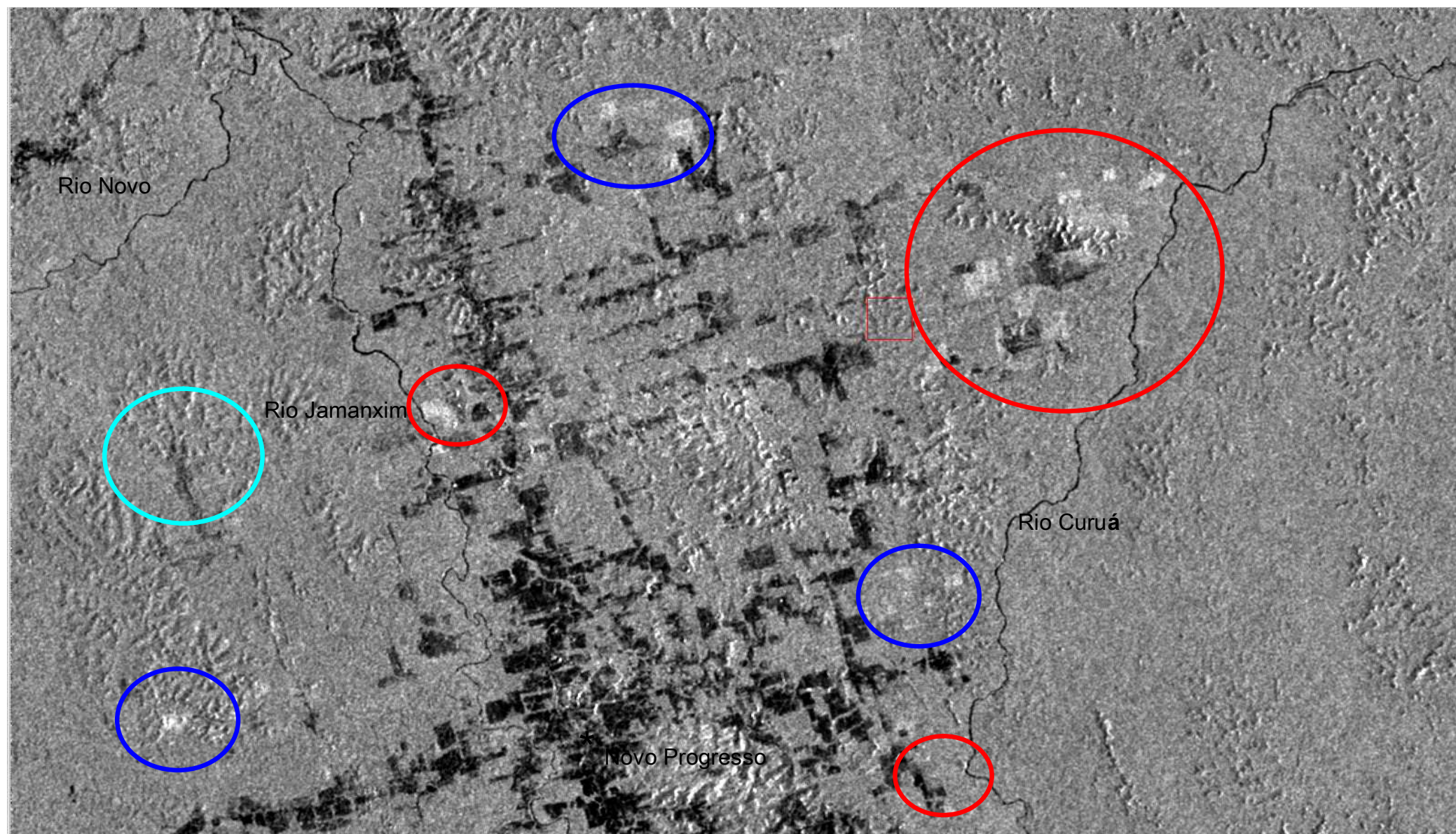
May/2008





# Palsar Multitemporal for Deforestation Assessment

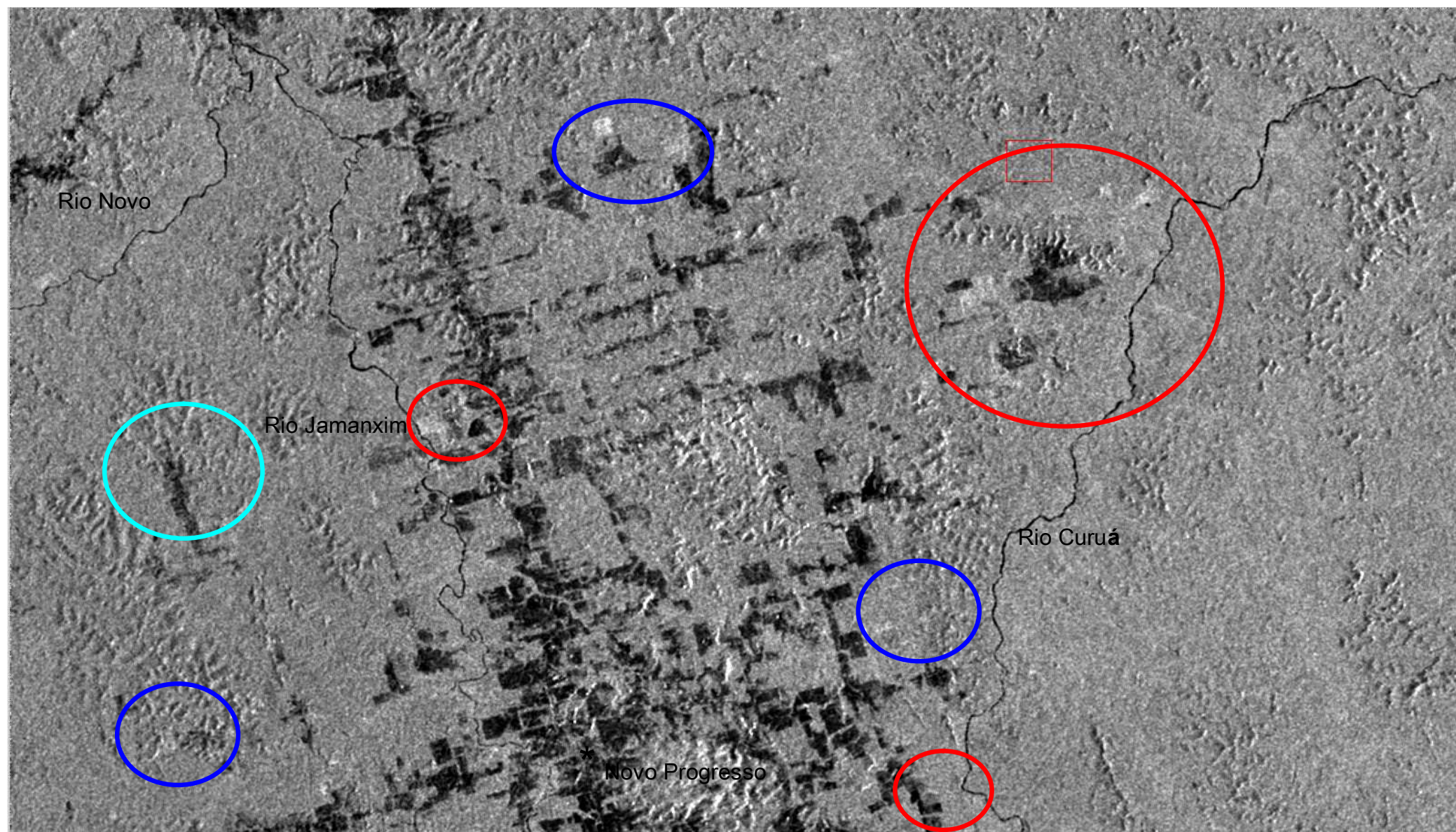
Aug/2008





# Palsar Multitemporal for Deforestation Assessment

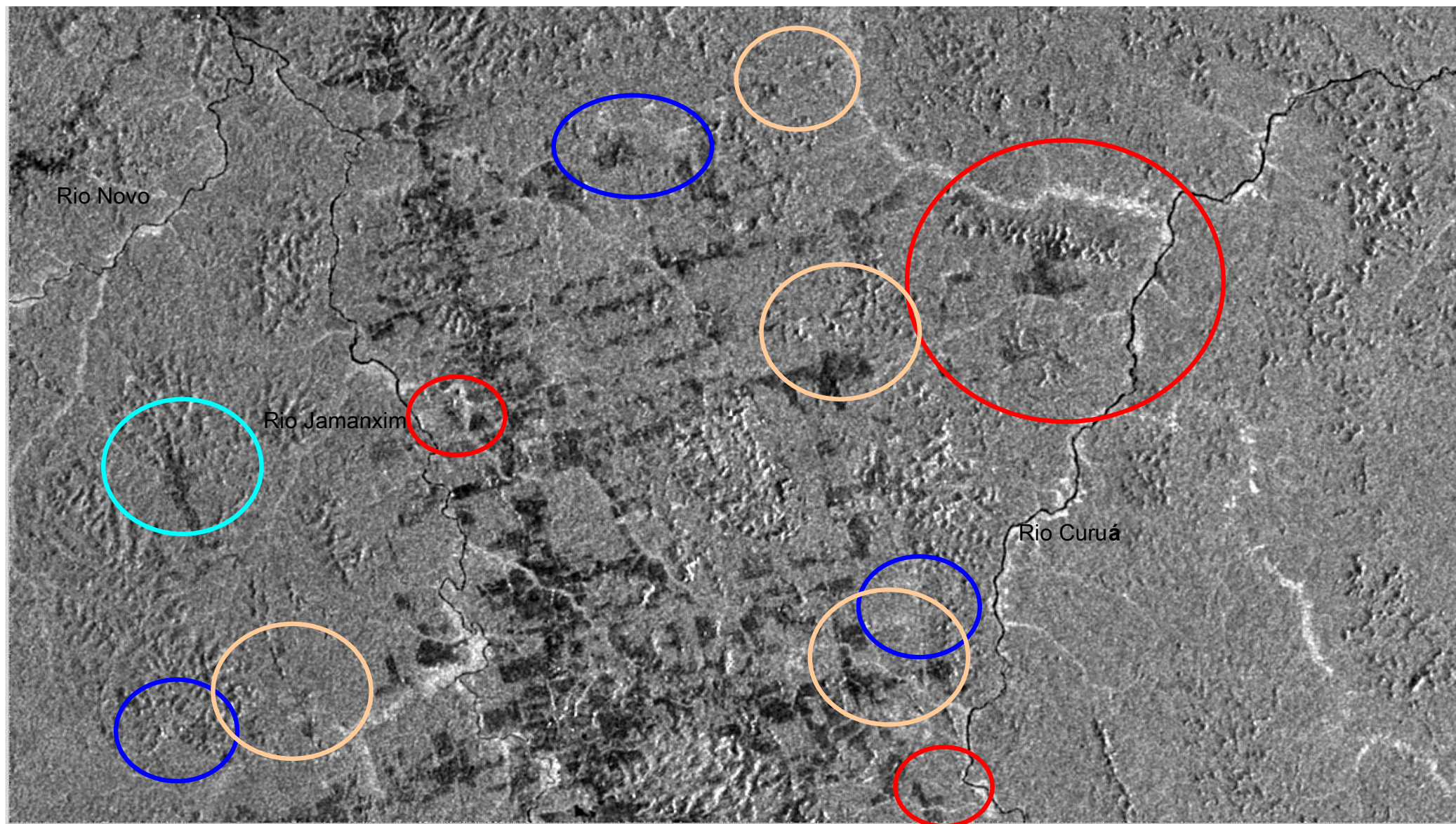
Oct/2008





# Palsar Multitemporal for Deforestation Assessment

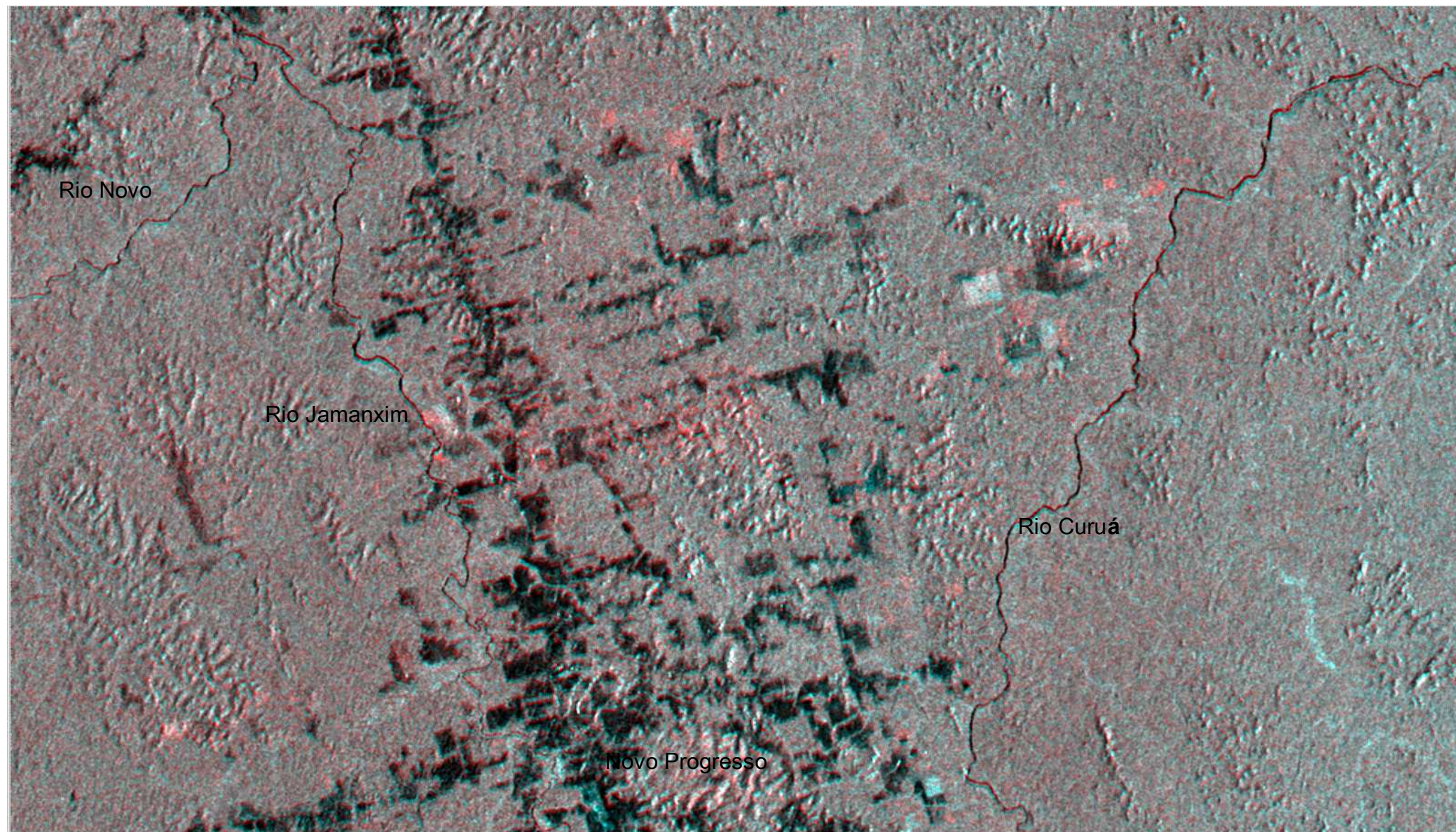
Apr/2009





# Palsar Multitemporal for Deforestation Assessment

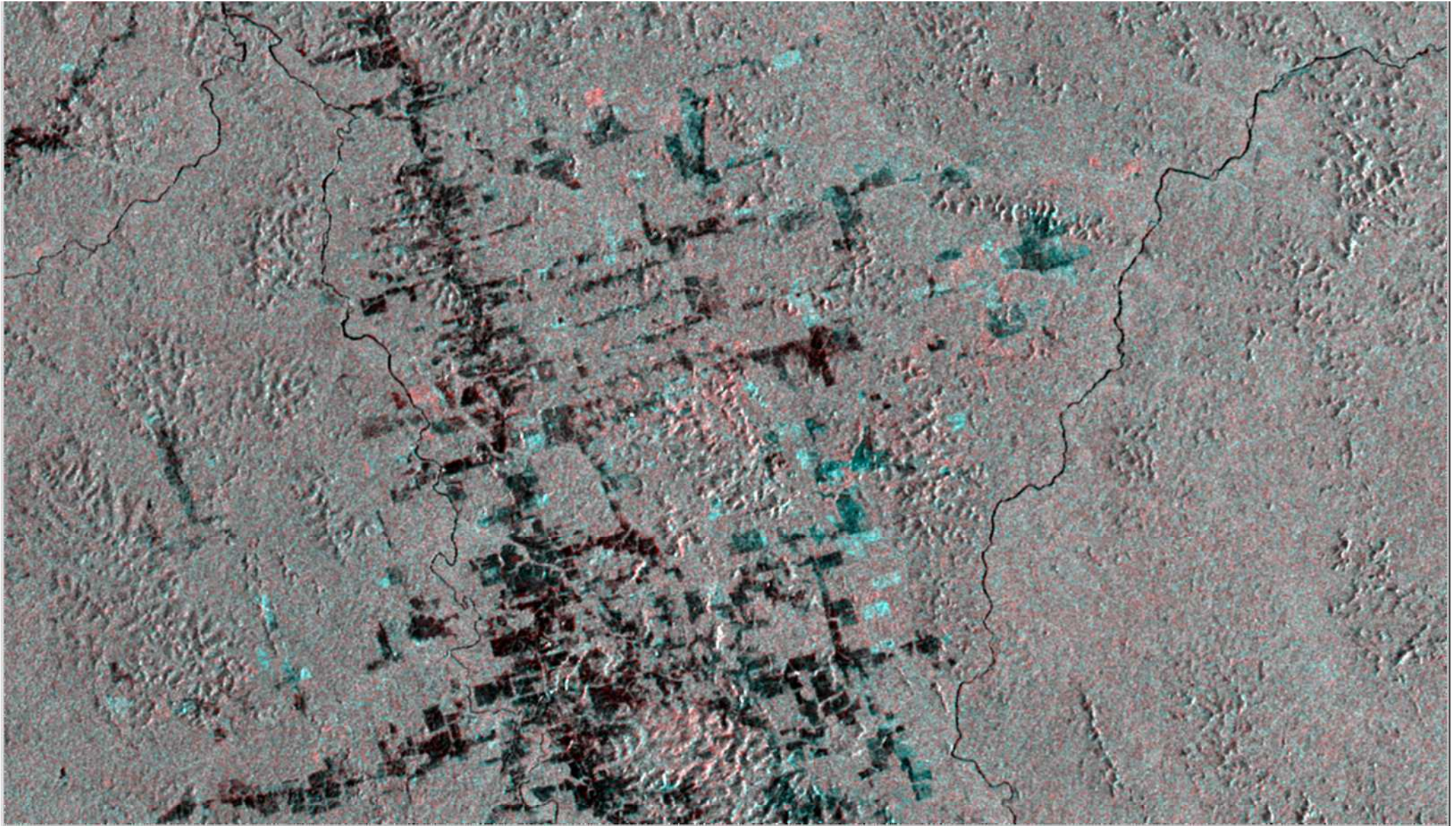
Aug /2008 (R)  
May/2008 (G & B)





## Palsar Multitemporal for Deforestation Assessment

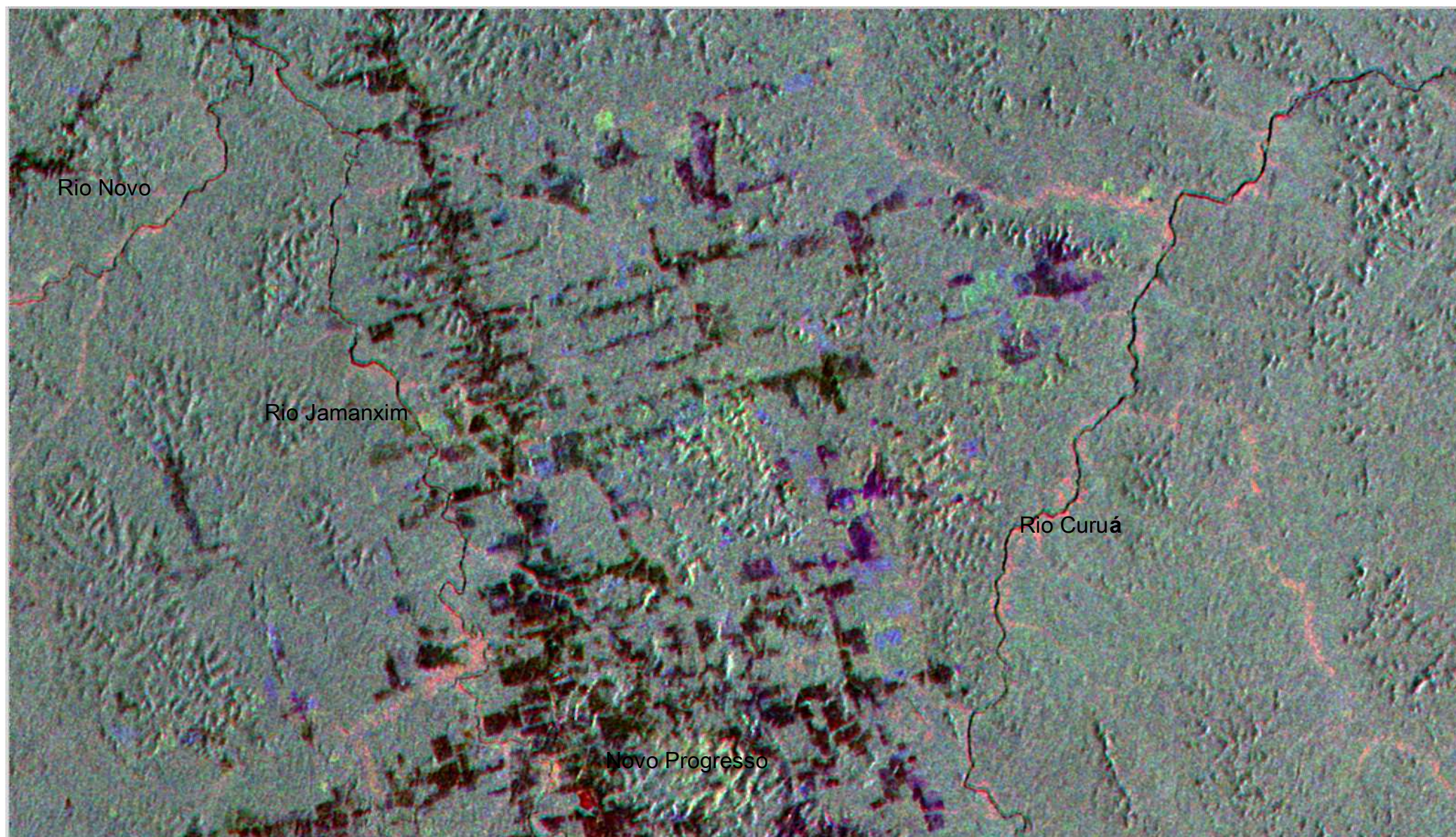
Out/2008 (R)  
Out/2007 (G & B)





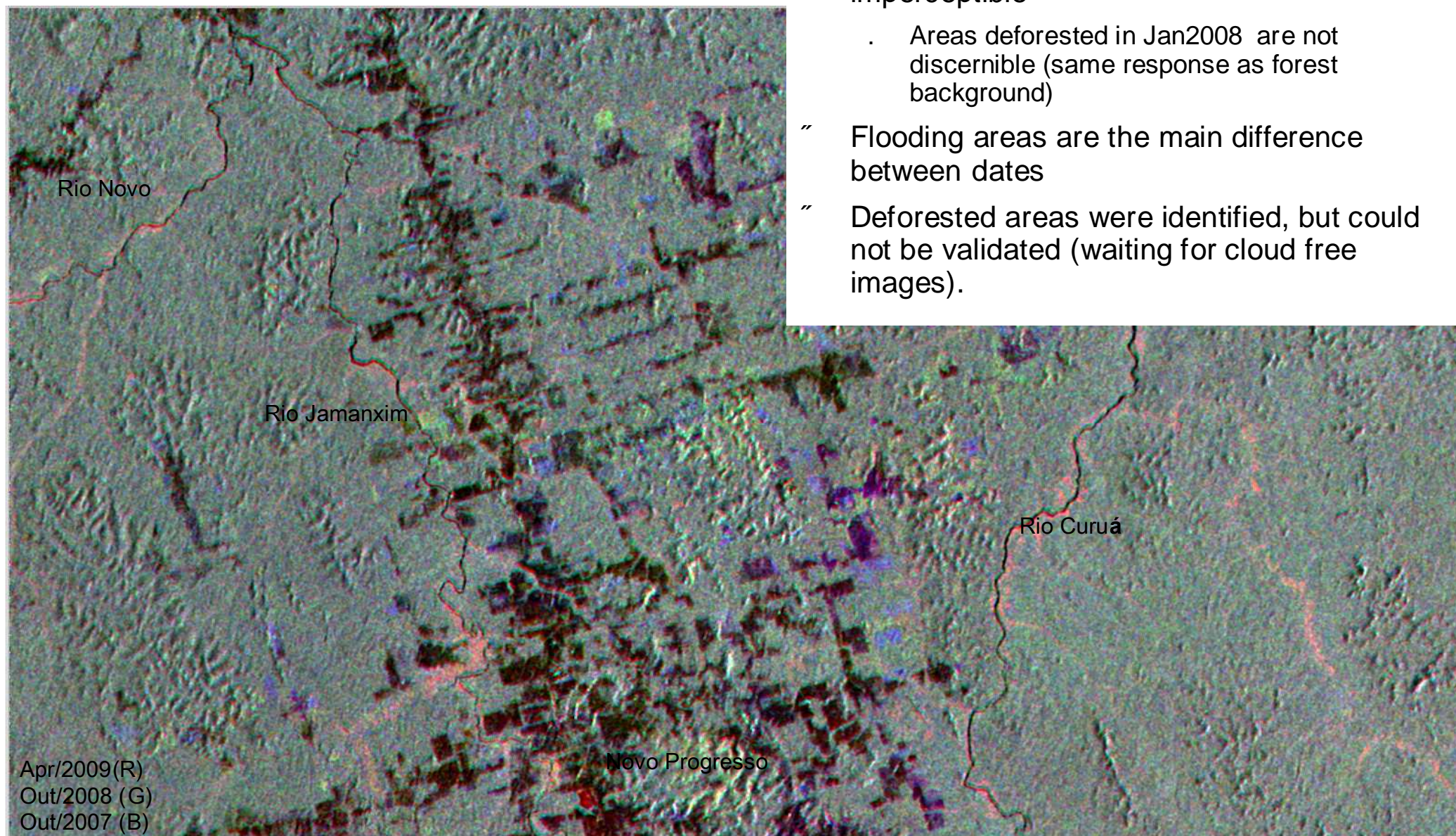
## Palsar Multitemporal for Deforestation Assessment

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





## PALSAR Apr2009 – end of wet season

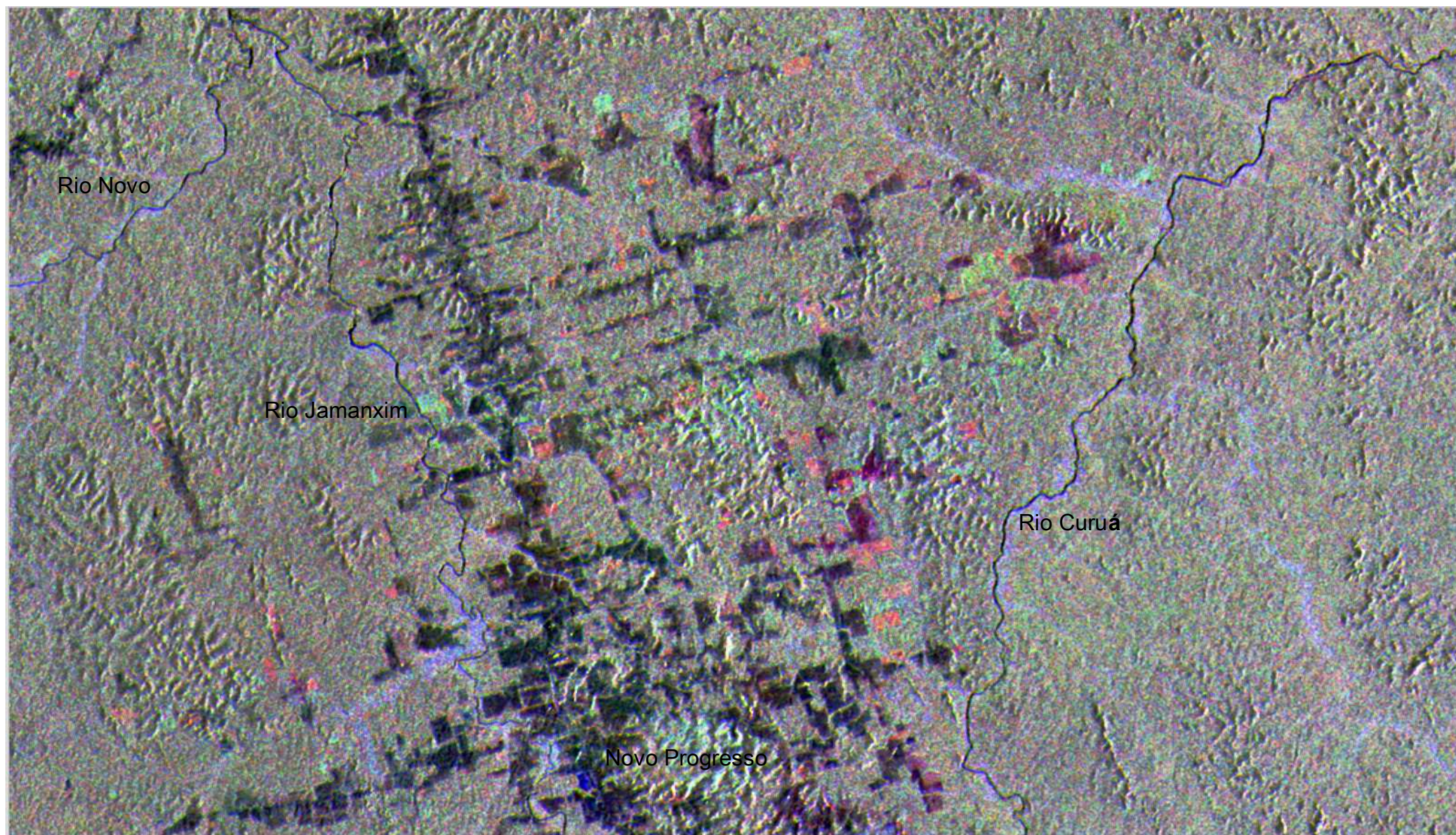


- “ Most of deforestation areas were imperceptible
  - . Areas deforested in Jan2008 are not discernible (same response as forest background)
- “ Flooding areas are the main difference between dates
- “ Deforested areas were identified, but could not be validated (waiting for cloud free images).

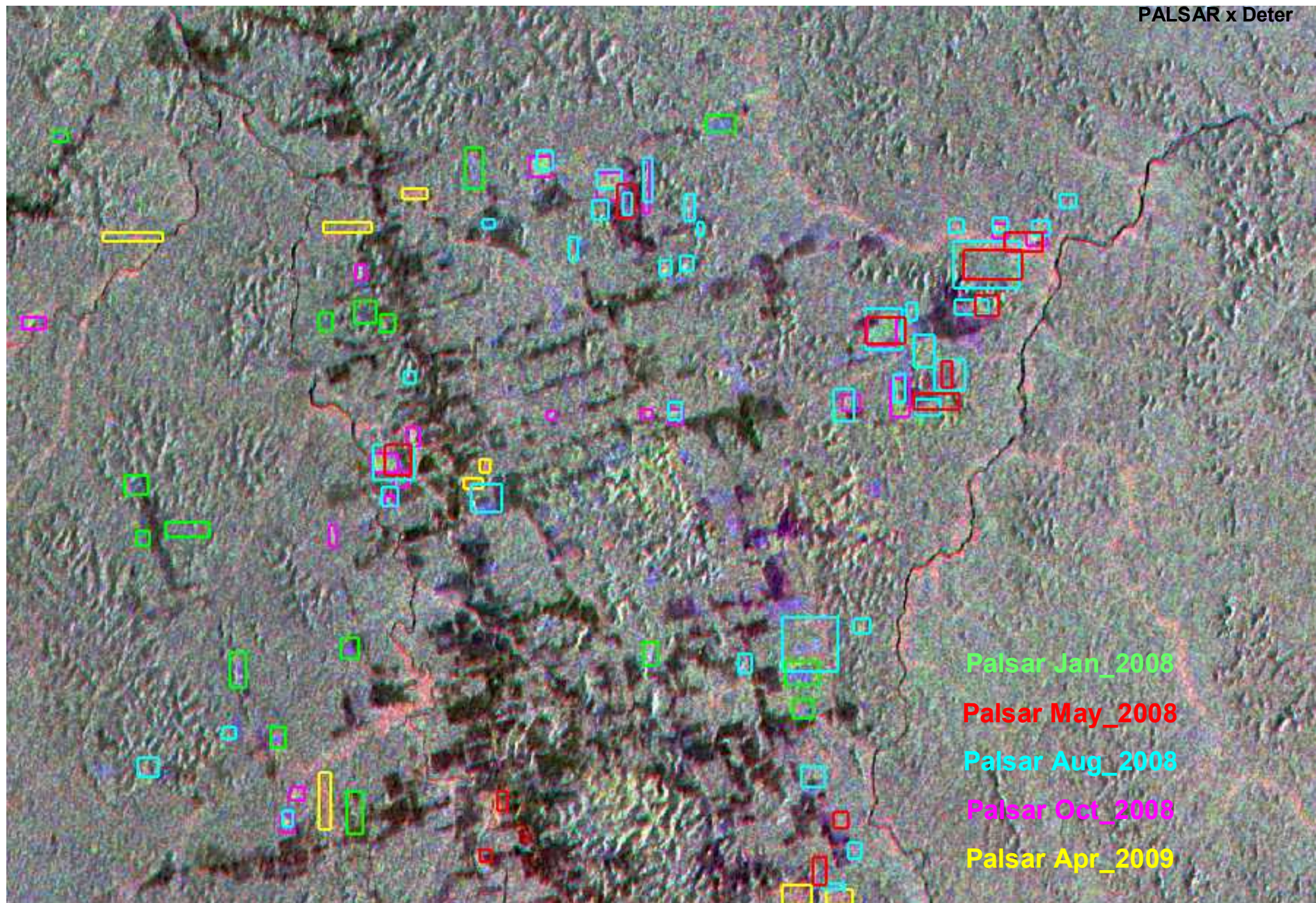


## Palsar Multitemporal for Deforestation Assessment

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





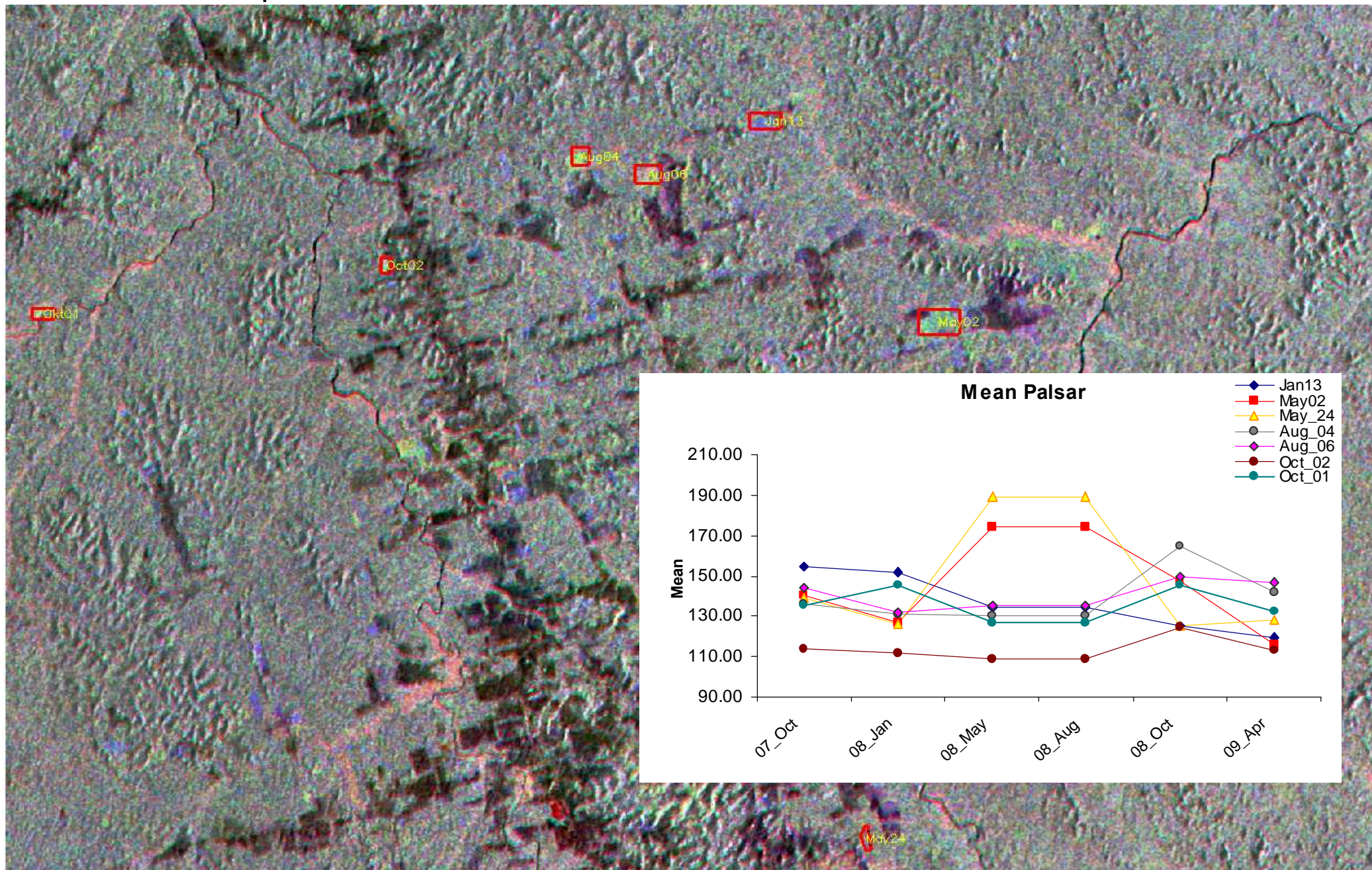




# Novo Progresso - Palsar ScanSAR

Jan 2007 . 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 . August values.
- “ Some Deforestation warnings (Alertas Deter) were early detected at PALSAR imagery.
- “ Radar data should be used as complementary information even for the %cloud free+period.
- “ Darker deforestation . areas older than 1 year.

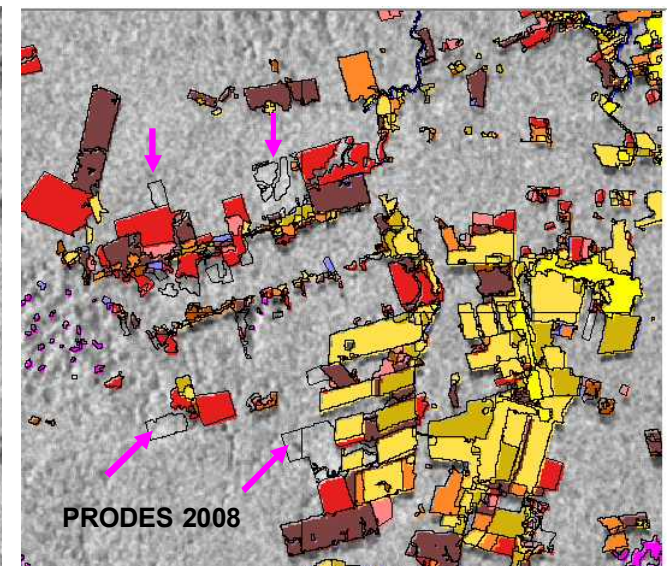
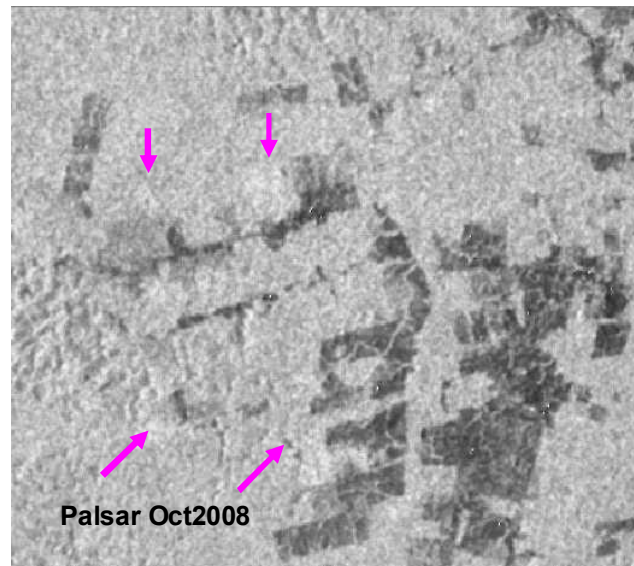
	Deter	Palsar Jan08	Palsar May08	Palsar Aug08	Palsar Oct08	Palsar Apr09
Def2007		11		3	1	
May	9		6	5	2	
Jun	22	1	3	7	1	
Jul	18	1		4	2	
Aug	29		1	9	5	
Sep	1				1	
Oct	68	2		8	6	1
Nov	6					
NA		1 (small)	2 (flood)	1 (relieve)	1 (small)	
Total	153	16	12	38	20	9

- “ 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

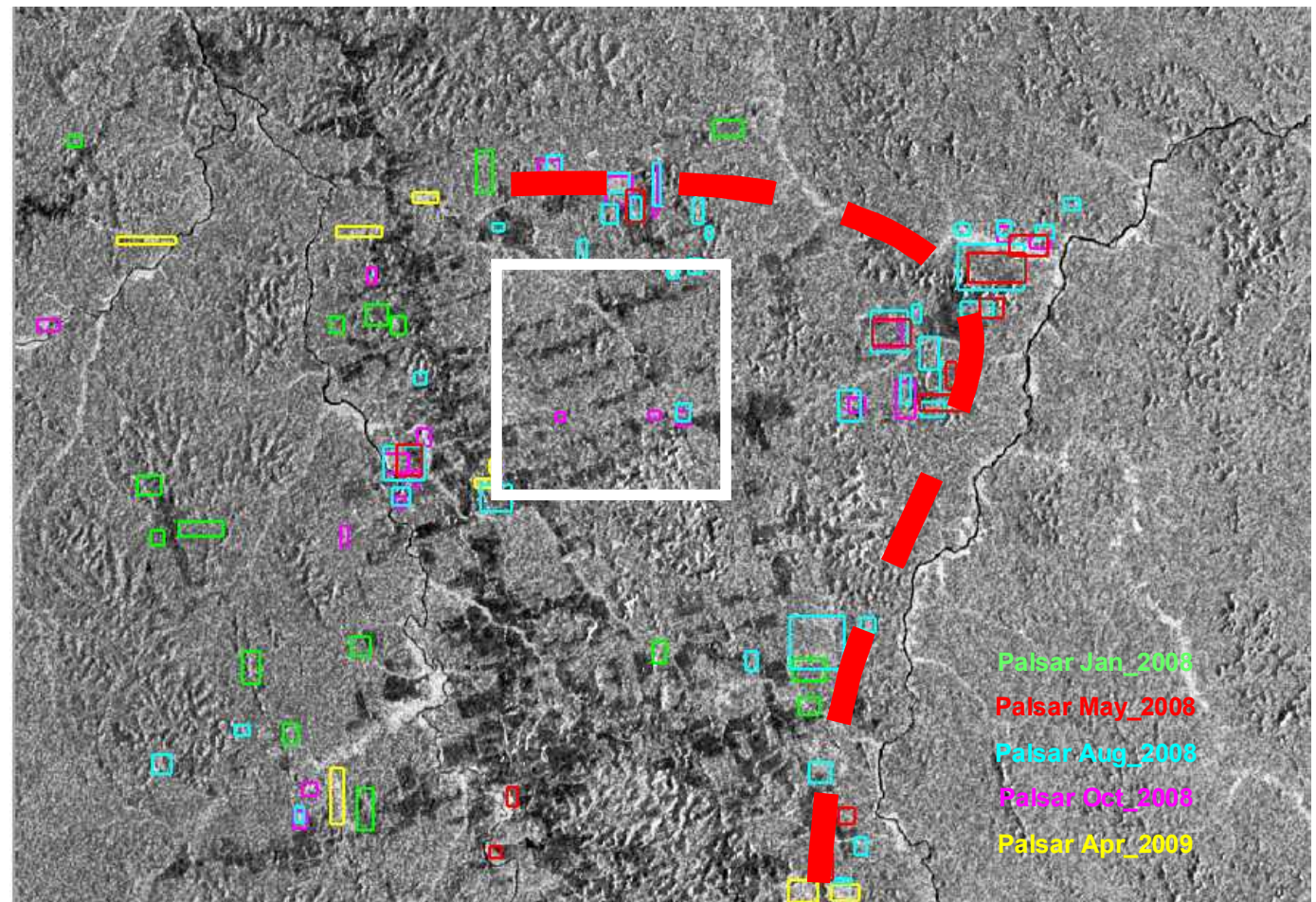
- “ Image interpretation improvement with simple procedures: Speckle filter (Lee enhanced or kernel), and (linear 2%) contrast.
- “ Georeferencing procedure is not completed dominated . still have problems considering the needs for multi-temporal analysis
- “ Visual interpretation of deforestation warnings (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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